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# Lead Paint and Lead Bullets: Perception and Risk

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Abstract

Worries and claims of injury and illness due to exposure to environmental and industrial health hazards and war-related materials were frequent in operations in the 1990's. These issues and concerns continue today. Most follow-up studies do not support a cause and effect link. This paper, written as an academic assignment and as an academic exercise, argues that inappropriate assumptions concerning risks are responsible for most of the concerns expressed. The paper does not dispute the genuine illnesses which resulted and does not discuss their alternative etiology. Examples are provided where health hazard concerns affected operations. Some background literature is reviewed concerning how personal decisions are made and how this might contribute to the formation of inappropriate assumptions concerning risk. Suggestions for how military organizations can address these issues and concerns, and preserve the health and operational capability of their personnel are provided.

THESIS STATEMENT

Assumptions of injury due to exposure to environmental and industrial health hazards impact operations and are founded largely in inappropriate personal decisions and processes concerning risk.

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Each of us makes assumptions and decisions about risks every day. It is a testament to our survival as a species that over millennia, we have occupied most parts of this planet and have developed strategies to live in each environment. Our capacity to survive gained in the very long term through the harshness of evolution, and now more quickly both complicated and assisted by social and societal structures, suggests that we have been effective at dealing with environmental adversity and the attendant risks. It does not mean that we are necessarily good at always prioritizing risk and in taking appropriate individual decisions and actions. This latter issue is at the heart of this paper.

This paper will focus on the bases and impacts of assumptions concerning the risk of injury and illness posed by low levels of Environmental and Industrial Health Hazards (LL-EIHH). As will be elaborated later, normally these hazards are considered to present potential long term effects. Therefore, except for infectious diseases, acute (early) effects would not normally be expected to occur in time to affect the current operation or even be

that evident in the immediate post-operation period. However, as will be shown, where inappropriate assumptions are made about these risks, immediate and near term operational impact and illness can result.

Since a key tenet of this paper is the importance of proper assignment of priorities and cause-and-effect assumptions concerning the risks surrounding any operation, it is essential to make clear now and to repeat later, that the probability that improper assumptions that low level EIHH risks will have a profound impact on operations is normally low. In the context of the typical Probability of Occurrence vs. Consequence matrix, the issues discussed here would be in the low probability, but potentially high consequence quadrant. The higher risks in operations such as those pursued today by Canadians in Afghanistan include; accident, environment (mostly heat related), public health (such as insects, infectious disease) and battle injuries. These receive and deserve the attention of commanders and force generators and there is no intention in this paper to deflect effort or attention from these prominent and present risks.

This paper will describe fundamental bases for the perception of risk and will show why persons often ascribe unreasonably high assumptions of risk to low probability events or hazards. Using examples, this paper will demonstrate that inappropriate assumptions of risk and inappropriate assumptions of cause-and-affect, have had profound impacts both directly on operations and on actions and outcomes in the post-operation period. This paper will focus mostly on perceptions related to assumed affects of EIHH, but will also include examples where inappropriate fears of medical countermeasures (employed to mitigate the effects of an environmental or other infectious disease threat) have adversely impacted operations. This paper will

demonstrate that once a cause-and-effect belief is entrenched that some EIHH exposure is responsible for a particular condition or malady, it is unlikely that this belief can be effectively reversed. This paper will examine current doctrine and planning which address EIHH, the success of operations and the health of Canadian Forces (CF) members. Finally, this paper will demonstrate that the only effective strategy to help reduce the operational impact of low priority hazards is prevention and for this, commanders need to better understand how these inappropriate assumptions may arise. They must use this knowledge to effectively identify and anticipate circumstances and instances which could be the genesis of an EIHH concern, and then to move effectively to address the issues to the satisfaction of the troops involved.

The title for this paper is an expression of the range of concerns and risks facing commanders and their troops in deployments. In keeping with the paragraph above about relative risks, this paper is basically an argument that the more important risks deserve our attention first. Worry not founded on facts has been a feature in deployments. Personal illness and decreases in quality of life have resulted for sufferers and enormous resources and effort have been expended in attempts to address these concerns, both after the fact and in preparation for future deployments. While there is no doubt that exposure to EIHH poses a real risk and that illness can result, it is also true that inappropriate worry about EIHH can result in illness. The latter is a waste and in recent times it is likely that the injuries and illnesses there have outnumbered those truly related to EIHH exposure. Lead bullets and lead paint can hurt us. This paper is an argument for getting our priorities right and for preserving the health and the capabilities of our forces.

To begin to address the thesis that inappropriate assumptions concerning LL-EIHH risks can affect operations, three examples of deployments and EIHH-related issues are discussed below.

In 1999, the Croatia Board of Inquiry was established to:

> Investigate whether Canadian Forces members serving in the Canadian Contingent United Nations Protection Forces (CC UNPROFOR) and assigned to the area of operations, commonly referred to as 'Sector South' were exposed to environmental contaminants in quantities sufficient enough to pose health hazards during the course of their duties[1]

The Board was established for many reasons, but the most prominent was the numbers of CF members who claimed illnesses related to toxic materials encountered in their deployment to Croatia and related theatres. The mandate of the Croatia Board of Inquiry[2] included a major task; to produce a comprehensive assessment of suspected contaminated sites (including soil, mine tailings, air and water) and seven subordinate tasks. Five of the subtasks were directly related to EIHH and the major task. Of the remaining two subtasks, one was related to administrative procedure recommendations and the final one gave the Board of Inquiry (BOI) the opportunity to make any finding or recommendation.

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[1] Canada, Department of National Defence, *Board of Inquiry - Croatia. CF Operations in the Balkans, 1991-1995* Government of Canada,[2000], http//www.forces.gc.ca/boi/engraph/home_e.asp (accessed 19 April 2008).

[2] Canada, Department of National Defence, *Board of Inquiry - Croatia. CF Operations in the Balkans, 1991-1995 – Mandate.* Government of Canada, [2000], http://www forces.gc.ca/boi/engraph/mandate_e.asp (accessed 19 April 2008).

Croatia is an industrialized country[3] and during their civil conflict because of neglect, battle damage or other factors, presented many sites and opportunities for contamination by a wide range of EIHH[4]. News reports of the day (such as[5]) mentioned soldiers feeling ill and tying this to exposures to red dirt, suspect 'potable' water, PCBs (polychlorinated biphenol), depleted uranium and other contaminants they believed they had encountered in their deployment. Sick Report affected the availability and readiness of personnel, though likely the most important impact on "operations" and Force Generation was the growing recognition that soldiers were sick after their deployment and the linkage of these illnesses, by the individuals and the media, to exposure to toxic substances. This heightened awareness of EIHH issues in subsequent deployments and as well, increased the numbers of injury claimants in the years after their Balkan deployments.

The Croatia BOI quickly recognized that stress and inadequate support capabilities and policies were important factors in the claimed injuries and medical complaints.[6] The BOI noted that while some soldiers reported being diagnosed with Post-Traumatic Stress Disorder, many were ill with no obvious cause. Though they may have professed or expressed the same symptoms, they were not all exposed to the same deployment environments, and so an hypothesis related to particular EIHH exposure was not proved. The BOI found that it could not . . . "conclude with certainty" that exposure

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[3] United States, Central Intelligence Agency, "Croatia" In *the World Factbook.* CIA, [2008], 1-13, https://www.cia.gov/library/publications/the-world-factbook/geos/hr.html (accessed 20 April 2008).
[4] Joseph L. Hughart, *Chemical Hazards during the Recent War in Croatia* Government of the United States of America, Department of Health and Human Services, [1999], 4, http://permanent.access.gpo.gov/lps21/croatia html (accessed 20 February 2008).
[5] John Geddes, "Military to Investigate Illnesses," *MacClean's* August 9, [1999], http://www.thecanadianencyclopedia.com/index.cfm?PgNm=TCE&Params=M1ARTMOO_html.
[6] Canada, Department of National Defence, *Board of Inquiry - Croatia. CF Operations in the Balkans, 1991-1995 - Summary of Evidence and Findings.* Government of Canada, [2000], http://www forces.gc.ca/boi/engraph/sustainment_e.asp (accessed 19 April 2008).

to suspected environmental contaminants was the specific cause of the illnesses observed.[7] The Croatia BOI promulgated two consistent and complementary lists of recommendations; 32 BOI Recommendations and seven Thomas Report Recommendations and reported progress on these in 2002.[8,9,10] Five of the 32 BIO recommendations are directly related to EIHH effects mitigation, as are 4 of the 7 from the Thomas Report.

Prior to, during and after the Croatia BOI, detailed studies assessed the levels of a wide range of materials in soil samples, or were devised to measure levels in veterans. Two examples are indicative. A study of soil samples to determine the presence of chemical warfare agents or their breakdown products was completely negative.[11] A second series of studies assessed levels of depleted uranium (DU). One involved a voluntary program established by DND whereby service personnel previously deployed to the Balkans or to the Persian Gulf could submit urine samples for analysis. The first study found no elevated levels of DU, but did note the variability in background uranium levels in personnel, likely linked to natural causes such as where they lived in Canada.[12]

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[7] Canada, Department of National Defence, *Board of Inquiry - Croatia. CF Operations in the Balkans 1991-1995. Final Report - Executive Summary.* Government of Canada, [2000], http://www forces.gc.ca/boi/engraph/summary_e.asp (accessed 19 April 2008).

[8] Canada, Department of National Defence, *Board of Inquiry - Croatia. CF Operations in the Balkans 1991-1995. Implementation of the Board of Inquiry Recommendations.* Government of Canada, [2002], http://www forces.gc.ca/boi/engraph/annexa_mar_02_e.asp (accessed 25 April 2008).

[9] Canada, Department of National Defence, *Board of Inquiry - Croatia. CF Operations in the Balkans 1991-1995. Implementation of Thomas Report Recommendations.* Government of Canada, [2002], http://www forces.gc.ca/boi/engraph/annexb_mar_02_e.asp (accessed 25 April 2008).

[10] B. A. LCol Sutherland, *Implementation of the Action Plans for the Croatia Board of Inquiry and the Thomas Report Recommendations. Briefing Note for the Chief of Defence Staff.* Government of Canada, [2002], 1-2, http://www.forces.gc.ca/boi/engraph/briefnote_mar_02_e.asp.

[11] James R. Hancock, Paul A. D'Agostino and Lionel R. Provost, *Analysis of Croatian Soil Samples for Chemical Warfare Agents.* Defence R&D Canada, [1999].

[12] E. A. Ough and others, "An Examination of Uranium Levels in Canadian Forces Personnel Who Served in the Gulf War and in Kosovo," *Health Physics* 82, no. 6 (2002), 527-532.

The following discussion of background levels is illustrative of a critical issue in determining exposures to LL-EIHH. Background levels of uranium in urine are normally very low and the proportion of depleted uranium, if present, must be identified against the natural uranium background level we all carry. Therefore, methods development and comparison work was conducted in preparation for further work if required, to determine which techniques were best to determine levels at the parts per trillion (ng $kg^{-1}$) level.[13] The important take away from this work is that natural background levels exist and there is interpersonal variation in levels based on factors like the individuals' physiology and where they lived prior to deployment. This is not unique to DU. It is difficult to determine small differences against background. But crucially, the key word here is small and the implication for risk is small. This is especially so when you consider that identification of an elevated level is further complicated by detection against the background of expected individual natural variability. So while detection provides an interesting technical challenge, the levels involved are extremely small and likely do not present a significant toxic challenge. It follows that assumptions of injury ascribed to such low doses of EIHH such as DU are inappropriate.

The Croatia BOI was a landmark inquiry which made many recommendations beyond the original mandate, which concerned queries about EIHH-related injuries. Its lasting legacy will doubtless be the impact it had in launching changes in health care delivery in-theatre and at home, and in the visibility it gave to stress related illness. The fact remains that many of the injury claimants associated their illnesses with some exposure to EIHH. While the failure of the BOI to confirm a link leaves open the

[13] E. A. Ough and others, "Determination of Natural and Depleted Uranium in the Urine at the PPT Level: An Interlaboratory Analytical Exercise," *Health Physics* 90, no. 5 (2006), 494-499.

possibility that some EIHH toxicity or toxicities was responsible, the bulk of the evidence says they were not. It seems likely therefore that no physically damaging exposures to LL-EIHH occurred. Further, the belief then held (and still held by many) that injury-causing exposures occurred is inappropriate. Regardless, these beliefs affected operations then and later.

The aftermath of Op Friction (Canadian contribution to the coalition liberation of Kuwait in 1991) served as a backdrop for the UNPROFOR deployment to Croatia and provided much concurrent controversy. It also provides a second example of an operation where EIHH concerns were significant among individual personnel. However, because of the very short campaign, most did not have a large impact until after the conflict. Public comment and investigations centered significantly on purported effects of EIHH (again also including chemical warfare agents and depleted uranium) and of medical countermeasures employed nationally by coalition forces, including Canada. The term Gulf War Syndrome was coined and variously blamed on vaccines and exposures to toxic materials.

While it is clear that not all of the assumed conditions and injuries were associated by the claimants with an EIHH exposure, an indication of the magnitude of he overall problem is reviewed by Engel et al.[14] The US, UK and Canada deployed respectively 700,000, 53,000 and 4,500 troops. Of these 6% of the UK veterans sought evaluation through the Ministry of Defence Gulf War Veterans Medical Assessment programme and of these fewer than 100 persons were judged to have a war-related

[14] Charles C. Engel, Kenneth C. Hyams and Ken Scott, "Managing Future Gulf War Syndromes: International Lessons and New Models of Care," *Philosophical Transactions of the Royal Society B* 361, no. 1468 (2006), 708.

condition. Thirty percent of the US veterans sought service-related benefits and 3200 had received compensation for a disability related to unexplained symptoms. Five percent of the Canadians had received disability pensions for idiopathic syndromes such as chronic fatigue syndrome, fibromyalgia and irritable bowel syndrome.

By 2006 the US had expended 250 million dollars conducting studies and reviews of the potential effects of a wide range of contaminants and other purported causative agents from the first Gulf War. Good reviews of findings and a large list of contaminants and medical countermeasures investigated, and mainly found wanting for any association with symptoms and illnesses, are found in the several reports of the US National Academy of Sciences, Institute of Medicine[15]. While a small number of associations were proved or possible in these exhaustive studies, few were related to the infectious disease, vaccines, chemical and biological agents and depleted uranium, which were the most prominent items cited by claimants. Oil fire contaminants like benzene were implicated.[16] Few of the associations involved the main symptoms reported by Gulf War veterans.[17] Again it seems that most claims of an association of illness with a LL-EIHH exposure or the use of protective medical countermeasures would be inappropriate.

Infectious disease is an environmental health hazard on most deployments and is included in the risks inherent in the environmental component of EIHH. Among the concerns persons associate with EIHH risks are side-effects of medical countermeasures

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[15] United States, Institute of Medicine, *Health of Veterans and Deployed Forces - Gulf War* (Washington DC: National Academy of Sciences,[ongoing]), http://veterans.iom.edu/conflict.asp?id=6043 (accessed 15 April 2008).
[16] ibid.
[17] Engel, Hyams and Scott, *Managing Future Gulf War Syndromes: International Lessons and New Models of Care*, 707-720

used to prevent infection by endemic (naturally present disease risks) or weaponized diseases.[18] This provides our third example of EIHH impacts on operations. One study[19] determined that malaria infections among Marines in Somalia in 1992 were due to failures to take anti-malaria medications as well as to failures to implement recommended personal protection (like sleeves rolled down). Interestingly, persons who avoid their medications have recently been shown to be more malleable concerning their beliefs related to benefits and risks.[20] It may be speculated that these individuals would be more susceptible to wide ranging sources of information and inferences, leading to inappropriate assumptions concerning risk from the supposed side-effects of medications, the disease the medicines were intended to defeat, or both.

By corollary, the personnel were more accepting of the greater risk of contracting the disease. A decade later another large outbreak of malaria required many Marines to be medically evacuated.[21] A large percentage of the force is believed to have been combat ineffective. In this case, the inappropriate assumptions about risks either involved the troops not believing the threat of malaria stated by their commanders, or being concerned about side-effects of medical countermeasure or combinations of both. Regardless, inappropriate assumptions related to an EIHH threat led to an adverse effect on an operation.

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[18] United States, Institute of Medicine, *Health of Veterans and Deployed Forces - Gulf War*

[19] Newton, James A. Jr. and others, "Malaria in US Marines Returning from Somalia," *Journal of the American Medical Association* 272, no. 5 (1994), 397-399.

[20] Paul Slovic and others, "Risk Perception of Prescription Drugs: Results of a National Survey," *Drug Information Journal* 41, no. 1 (2007), 81-100.

[21] B. Susi and others, "Rapid Diagnostic Test for Plasmodium Falciparum in 32 Marines Medically Evacuated from Liberia with Febrile Illness," *Annals of Internal Medicine* 142, no. 6 (2005), 476-477, http://proquest.umi.com/pqdweb?did=807454041?sid=6&Fmt=4&clientld=1711&RQT=309&VName=PQD (accessed 22 April 2008).

This paper will now address how individuals perceive risk and explore why and how inappropriate assumptions may result.

Assigning priority and assumption to risk is an imperfect art and science. The Oxford English Dictionary[22] defines the noun 'risk' as, "Hazard, danger; exposure to mischief or peril". In his detailed effort to relate modern risk to industrial society, Beck[23] lumped natural risks into a Personal Risk category and referred to the manmade remainder as ". . . hazards and insecurities induced and introduced by modernization itself". Commenting on the thoughts of Beck and others, Ekberg[24] concluded that our modern industrial society is overshadowed by an ethos of risk avoidance, risk consciousness and an increased awareness of living in an environment of risk. For Ekberg[25], making choices is difficult for many risk adverse people and this is leading to societal traits characterized by uncertainty and insecurity, anxiety and ambivalence. Further, since risk isn't the same as hazard and hazards are actively assessed in relation to future possibilities, Ekberg[26] states that it is no longer the risk experiences of the past which determine present decisions, but it is assumptions and predictions of the future which determine our risk planning and management strategies.

EIHH includes all of these natural and manmade hazards. In response to all of this people and other animals employ innate and learned behaviours to reason and to effect

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[22] "*Oxford English Dictionary*" In , http://dictionary.oed.com/cgi/display/50207290?keytype=ref&ijkey-4nYsRt2FPBBL6 ed., Vol. 2008 Oxford University Press, 1989).
[23] Ulrich Beck, *Risk Society: Towards a New Modernity* (London: SAGE Publications Ltd, 1992), 21 (accessed 14 February 2008).
[24] Merryn Ekberg, "The Parameters of the Risk Society: A Review and Exploration," *Current Sociology* 55, no. 3 (2007), 344.
[25] ibid., 346
[26] ibid., 353

solutions and assumptions concerning risks as they perceive and rank them. In addition, people factor-in societal and other determining strategies to assign and essentially to prioritize risk. We will see as these arguments are developed further, how these and other factors can lead to inappropriate assumptions about LL-EIHH hazards.

It is important to note that many factors other than thoughtful and rational processes based on understanding the merits and data, can affect our ability to reason and to prioritize risk. It is also instructive to note, that to understand our approach to EIHH, many parallels and insights are derived from looking to the worlds of business and of psychology. When discussing the behaviour of investment leaders, Harvey[27] cautions that while orthodox economic thought is based on the idea that all economic activity is due to deliberate choice, we must consider also that "because we are social animals, the collective behaviour of humans must be understood in terms of the cultural forces at work". Successful investors do not make decisions based just on the numbers and they do violate rational choices. This example from commerce can be considered also to illustrate the importance of collective and other behaviours in assumptions and personal decisions concerning risk from LL-EIHH.

Moving specifically to health risks and environment, it has been shown that we employ a limited number of logic principles to reduce complex tasks and that we gain an evolutionary advantage from reliance on culture and peers[28]. While admitting that risks are very diverse, Fischhoff has proposed four factors people use as a potential

[27] John T. Harvey, "Heuristic Judgement Theory," *Journal of Economic Issues* 32, no. 1 (1998), 47.
[28] ibid., 48

quantitative summary of risk;[29] 1. Knowledge, 2. Dread, 3. Numbers of persons affected, 4. Degree of Environmental Impact. There is considerable subjectivity here which becomes part of the overall risk assessment a person makes. It is interesting to note that in a comparison of risk perception among persons in Korea, Japan and the United States,[30] perceptions related to 'dread risk' and 'unknown risk' where similar. This suggests that the three cultures share common perceptions on environmental risks, and supports a contention that these decisions and processes are more deeply seated in our behaviours and psyche than can be accounted by cultural influences alone.

Framing is one of the issues Fischhoff confirms is important to avoid.[31] In this, even in the presence of good information, persons adopt subjective strategies which categorize issues. Ultimately, based on personal assumptions, risks are categorized or framed and this may not be helpful in deciding how important a risk really is. When we frame risks we fail both to use and to cope with the mass of information, and also to view it from a range of perspectives. People may 'frame' the issues in too simplistic terms, limiting their attention and proving too sensitive to less relevant influences.

This framing process may also favour inappropriate assumptions concerning the reality or the magnitude of a risk. It has been suggested that framing effects resemble perceptual illusions more than they do computational errors.[32] Gonzalez *et al*.,[33] have used the powerful medical diagnostic tool of functional magnetic resonance imaging

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[29] Baruch Fischhoff, "Ranking Risks," *Risk: Health Safety and Environment* 6 (1995), 199, http://www heinonline.org/HOL/PDF?handle=hein.journals/risk6&colection=journals&id=201&print=12&ext=.pdf (accessed 20 April 2008).

[30] Yong-Jin Cha, "Risk Perception in Korea: A Comparison with Japan and the United States," *Journal of Risk Research* 3, no. 4 (2000), 321-332.

[31] Fischhoff, *Ranking Risks*, 194

[32] Daniel Kahneman and Amos Tversky, "Choices, Values and Frames," *American Psychologist* 39, no. 4 (1984), 343.

[33] Cleotilde Gonzales and others, "The Framing Effect and Risky Decisions: Examining Cognitive Functions with fMRI," *Journal of Economic Psychology* 26 (2005), 1-20.

(fMRI) to study brain activity in human volunteers presented with positive and negatively framed options. They found that individuals examining various alternatives try to make a good decision while expending minimum cognitive effort. Simplistically, certain brain regions may be considered to be involved more with reasoning and knowing (cognition), while others are associated more with activity more related to emotion and imagery. These authors noted that the imagery 'side' was involved more when choosing between risky versus sure options. These and other findings above do not suggest that persons will always adopt the best strategies or make the effort to be truly informed about risk. We can assume also that they may not necessarily make appropriate assessments for themselves. Finally, they may not avoid the pressures of society and peers when making judgments about normally obscure and complex questions such as the risk from LL-EIHH and inappropriate assumptions and beliefs my result.

Complex situations present a potentially overwhelming cognitive and reasoning burden. It has been shown that persons employ both innate and learned strategies to arrive at a conclusion. Bias and previous beliefs are a significant factor in the final decisions. Brewer confirms[34] that we have an extraordinary capacity to recognize patterns, to match timing and occurrence and to integrate complex, multi-sensory information. However, while these skills are essential in interacting successfully with the immediate environment and in performing tasks, we may also use and extrapolate these strategies inappropriately when dealing with highly complex phenomena where our direct experience is limited. These and other factors and a tendency towards a simplification strategy to expect certain occurrences (congruent with previous experiences or decisions)

[34] Jeffery D. Brewer, *Risk Perception and Strategic Decision Making: General Insights, a New Framework, and Specific Application to Electricity Generation using Nuclear Energy* (Albequerque: SANDIA National Laboratory,[2005]).

underlie many decision making strategies and biases. One can anticipate some of the resultant decisions to be incorrect or inappropriate.

It is important next to identify some of these biases and other issues, and to evaluate their importance in how people make decisions about LL-EIHH. Siegrist and Cvetkovich[35] extended previous observations that negative information (bad news, claims of toxicity) about a hazard, have a larger effect on reducing trust (and thereby favouring assumptions things are unsafe), than positive information had on increasing trust. They found that regardless of the credibility of the information source, reports and results which indicated a health risk were more trusted and believed than ones which indicated little risk. Further, this bias (for acceptance) for negative information increased with claims of increasing health risk. Perversely therefore, the greater the claim to know or to show higher risk and adverse affects, the more the claims were believed. Finally, when using the example of a food additive, they found that even where the preponderance of data supported no or very low risk, people were more accepting of animal experimentation which showed some hazard. The authors' interpretation[36] of the latter shows that animal tests scare the public but conversely are unlikely to convince people there is no danger. Overall, they conclude[37] their . . . ."Observed asymmetry between positive and negative research results may be one reason people are afraid of many of the hazards they are faced with in modern society".

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[35] Michael Siegrist and George Cvetkovich, "Better Negative than Positive? Evidence of a Bias for Negative Information about Possible Health Dangers," *Risk Analysis* 21, no. 1 (2001), 199-206.
[36] ibid., 205
[37] ibid., 199

Brewer[38] places this in context by saying it is akin also to self-perception as a winner or loser. This is understandable because of the importance of ignoring negative stimuli (resulting in a wide range of affects including; danger, discomfort or embarrassment). People erred on the side of caution because the cost of being wrong about negative effects, were seen as more important than the perceived benefit of being wrong about positive effects. Therefore they were inclined to believe the claims or data showing risk. These factors speak also to a contention in this paper that once a belief is entrenched that some EIHH is responsible for a negative outcome, that belief is very difficult to reverse, since it follows that even multiple studies showing no risk, will not supplant the belief and the preference for claims showing risk. The discussion above also illustrates some important factors in how the original opinion about risk and an assumed LL-EIHH cause and effect are developed.

Next we will consider two aspects of control and their importance to assumptions concerning risk. The first aspect of control considered here speaks further to underlying reasons for personal decisions. The second aspect of control described here for the first time in this paper, illustrates something of the military context and provides some insight into mitigation strategies for LL-EIHH effects on operations.

The ability to trust oneself and others is a critical factor in most decisions[39]. People will accept a higher degree of voluntary risk than they will a higher involuntary risk. Two hypothetical scenarios illustrate this point. In the first example, let us assume that persons may accept a mission to drive in a Light Armoured Vehicle (LAV) in an area

[38] Brewer, *Risk Perception and Strategic Decision Making: General Insights, a New Framework, and Specific Application to Electricity Generation using Nuclear Energy*, 34
[39] ibid.

known for previous suicide bomber attacks. They may accept this voluntary risk because they trust themselves and their team or group comrades, they trust the vehicle and they trust the Command and Control systems which have been implemented to assess the risks and choose a route. They will feel control in accepting the risks. In a second hypothetical example, they may be less accepting of risk when told (involuntary – less control) to set-up temporary quarters inside an abandoned factory, or to establish an observation point (OP) in a site with suspicious features (like refuse, things that smell, oily wastes, etc), even if their training and their trust in commanders tells them that it is the right place (protected, effective) for the OP.

Brewer also states that the perceived nature of injury or death is an important contributing factor to the perception of voluntary and involuntary risks[40]; with the swift being preferred over the lingering. This is consistent with the views expressed earlier from the work of Fischhoff[41] and accounts for the dread factor which he lists. The key elements here in accepting risk are control and self-perception of the degree of control one is free to exert. These can surely play to affect assumptions concerning the priority and the magnitude of risks from LL-EIHH. Our exposure to LL-EIHH is typically involuntary, or worse occult and not obvious at the time of exposure. Later, recognition that an exposure may have occurred will be seen negatively and as something beyond our control. These factors may perhaps increase the chances for inappropriate assumptions concerning risk.

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[40] ibid.
[41] Fischhoff, *Ranking Risks*, 199

To this point, most of this paper has considered individual and group processes in assumptions about risks. Commanders are individuals and susceptible to the same influences. They are also influenced in their approach by their command experiences and by their perception of their options and impact on a situation.

The second aspect of control cited here, is included to make connections to a military context and begins first with some statements of principles. Pigeau and McCann have repeated their concepts of Command and Control in several fora and while their intent is to open a dialogue with Canadian Forces (CF) leadership on research in Command and Control, their contentions about control by individuals including commanders are relevant to the assumptions about risk discussed in this paper.

Pigeau and McCann define Control as; "those structures and processes devised by commanders to enable it and to manage risk".[42] Aside from commanders, it is possible to suggest here that individuals and groups employ similar factors to control and to manage risks. Controlling involves monitoring, carrying-out and adjusting processes that have already been developed, while commanding involves creating new structures and processes, establishing the conditions for initiating and terminating action and making unanticipated changes to plans[43]. Pigeau and McCann also describe two groups of Commanders; Type I and Type II[44]. The former enforce discipline (such as in training or force development scenarios) but have no authority to place troops in harms way. The Type II commander has the authority to place persons in harms way in an approved

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[42] R. Pigeau and Carol McCann, "Re-Conceptualizing Command and Control," *Canadian Military Journal* 3, no. 1 (2002), 56.
[43] ibid., 56
[44] Ross Pigeau and Carol McCann, "What is a Commander?" In *Generalship and the Art of the Admiral: Perspectives on Canadian Senior Military Leadership*, eds. Bernd Horn and Stephen J. Harris (St. Catherines, Ontario: Vanwell Publishing Limited, 2001), 98.

operation. Clearly since the thesis of this paper involves affects on operations, it is the Type II commander who is central to the following discussion which considers the reactions and responsibility of command and commanders related to EIHH.

It is important to consider the conflict a field commander, who has also likely performed Type I command functions, may feel in relation to EIHH in an operational theatre. In garrison, a Type I commander has many responsibilities and rules to satisfy concerning workplace health and safety. In the field, where little of the supporting safety infrastructure or staff typical of a base in Canada are in-place to assist and the conditions are foreign, or worse, well representative of a third world site, the field commander can see their responsibility to address LL-EIHH concerns as overwhelmingly impossible.

Responsibility is the third dimension of command elaborated by Pigeau and McCann[45] (among Competency, Authority and Responsibility). They see responsibility divided into two parts. The first is extrinsic responsibility which is externally imposed and involves the obligation for public accountability. Extrinsic responsibility is associated with personal authority. Personal authority is earned from superiors, peers and subordinates and is returned through trust and commitment, when accepting the leadership of the commander. But while the commander is clearly accountable to those involved in the mission, extrinsic responsibility also includes the commander's willingness to be accountable and to take responsibility for the legal authority which comes with the position[46]. Intrinsic responsibility is the second component and is described best as the degree of self-generated obligation to the mission[47]. The

[45] Pigeau and McCann, *Re-Conceptualizing Command and Control*, 59
[46] ibid., 59
[47] ibid., 60

expectations here are high, as intrinsic responsibility is seen as the primary driver for the values, effort and creativity a commander brings.

At face value, looking at the issues regarding the possible effects of LL-EIHH on a mission, an operational commander might reasonably assume that for most except infectious disease, the levels of EIHH toxins and contaminants would be too low to have a meaningful toxic affect on troops during the course of the deployment. Besides, the task to protect troops from all toxic threats would seem overwhelmingly impossible and so commanders might not assume the extrinsic responsibility for this task, or choose to exert sufficient intrinsic responsibility to deal creatively with the issues. But LL-EIHH issues have affected operations and as we will see later, there are command responsibilities regarding EIHH and there are strategies to address them.

Canadian Forces Force Protection doctrine[48], Health Services Support to Operations doctrine[49] and Risk Management doctrine[50] are not helpful to assist commanders to know what are their directions and options concerning LL-EIHH, other than confirming the overarching responsibility and accountability to protect the force. Each of these documents is silent on the potential effects of LL-EIHH on operations as described in this paper. A word search in the recently updated Risk Management doctrine[51] fails to reveal a single hit for Environmental Hazard, Toxic Industrial Material (TIM) or Toxic Industrial Chemical (TIC). This doubtless is consistent with the intention to focus on the most important threats and risks in operations. The reader is reminded that

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[48] Canada, Department of National Defence, *CF Joint Force Protection Doctrine.* Joint Doctrine Manual,[2006] (accessed 24 April 2008).
[49] Canada, Department of National Defence, *Health Services Support to Operations.* Department of National Defence,[2007] (accessed 24 Apr 2008).
[50] Canada, Department of National Defence and B-GJ-005-502/FP000, *Risk Management for CF Operations.* DND,[2007] (accessed 24 April 2008).
[51] ibid.

as stated on page 4 in this paper, there is no intention here to divert effort or attention from these important and present threats. However, perhaps thought should be given to how LL-EIHH may be portrayed in these documents, since operational impacts have resulted and commanders need some assistance to know where they can and should start.

Each doctrinal document reviewed for this paper, if it discusses environmental hazards, lumps these with Chemical, Biological, Radiological and Nuclear (CBRN) issues. This is unfortunate because significant CBRN incidents or attacks are normally understood by troops and commanders as special, very low probability events. Combining all of EIHH with CBRN does not serve well the more numerous and immediate Force Health Protection and other operational impacts of acute toxic risks from frankly dangerous levels of TICs or TIMs, or from endemic infectious hazards. This combination with CBRN also provides no separate consideration, visibility or direction for the known LL-EIHH effects on operations or for the concerns discussed in this paper.

Chapter 18 of the Direction for International Operations (DDIO)[52] does provide specific direction for EIHH and Public Health Concerns (PHC) on operations. The Aim stated in Section 1802, page 18-1 is to manage the exposure of CF troops to EIHH and Public Health Concerns, without undue risk to health or safety. The directive clearly states that all risks will not be eliminated. The Concept section 1805, page 18-3 states that CF personnel may be exposed to a wide range of EIHH and PHC, both as natural occurrences in the environment and as a result of the effects of humans (battle or other damaged infrastructure, poor local practices, etc). Page 18-5 specifically states that . . .

[52] Canada, Department of National Defence, *Direction for International Operations.* Government of Canada, 2006, Chapter 18.

"exposure control will include avoidance of potential EIHH or PHC whenever operationally achievable".

Unfortunately, from the standpoint of this paper, the EIHH / PHC mitigation strategies offered to the commander in the DDIO all involve reference to specialist medical and preventative medical staffs and do not suggest any other approaches. Specifically, there is silence on strategies where the commander can assume more leadership. As will be discussed below and in the conclusion, leadership in these issues may well increase confidence and trust in troops, and serve to reduce inappropriate assumptions of risk, especially concerning LL-EIHH.

One possible approach to managing the issues related to TICs, TIMs, certain infectious diseases and other LL-EIHH in-theatre, begins with noting the Axioms of Force Protection in Section 106 of the Force Protection manual,[53] relating to Economy of Effort and with remembering the direction in the DDIO,[54] concerning avoidance when operationally achievable.

As clearly stated in the Force Protection manual, there will never be enough resources to protect every asset and more critical assets and operations need to be a focus for available resources. These resource distribution decisions are usually never absolute. The most important element usually does not receive all of the resources, though certainly because of their perceived priority; there will be elements which will receive none. If some of the reason why attention to LL-EIHH in operations is zero or low, is because of the perception that it is just too big and too open-ended a topic to warrant

[53] Canada, Department of National Defence, *CF Joint Force Protection Doctrine*, 1-3
[54] Canada, Department of National Defence, *Direction for International Operations*, 18-5

productive attention, the following suggestion may be useful in providing a construct to deal with the problem.

The concept of ALARA (As Low As Reasonably Achievable) was adopted some time ago by regulators and ionizing radiation specialists[55] attempting to establish safety guidelines for the general public and for persons working with radioactive materials or radiation emitting devices. ALARA was proposed to define a very low threshold dose, well below the dose known to cause any harm, and crucially, below which it would make little sense to make an additional effort to reduce exposure levels further.[56] While there is still debate about whether there truly is a "no-effects" dose, there is no doubt that there is a very large difference between the doses which can be demonstrated to cause damage and those which are established as 'safe', or in realm of very low probability of health and safety impact, above background and the normal incidence of injury or disease.

For the general population the ALARA radiation dose limit is set close to this normal and largely unavoidable background level, which we receive routinely or naturally from the environment and other sources. Therefore it is easily 'Reasonably Achievable' to set the current safety limits where they are and understandable why efforts to reduce levels further are not productive. There is a second ALARA category which permits higher levels of exposure for persons who must work with radiation as part of their profession or vocation. These doses too are set well below any toxic threshold. Here too it is accepted that there is a diminishing benefit from further reducing all exposures, as long as they are consistent with the limits and with the details of exposure time and dose accumulation understood by rule or best practice. The occupational doses are

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[55] Eric Hall J., *Radiation Biology for the Radiation Biologist* (Philadelphia, PA: J.B. Lippincott Company, 1988), 510.
[56] ibid., 515

accepted as safe, though naturally, reductions to the levels of background are preferred, and interestingly, that is what typically achieved. The higher dose limits simply recognize the reality of an occupation and provide some rational space for safe occupational exposure.

Since ALARA is compatible with Economy of Effort as described above from the Force Protection manual and is also compatible with the DDIO direction concerning avoidance when operationally acceptable, ALARA may be an occupational concept troops can accept when they consider the commander's intent and attention to EIHH issues. To assure that trust is maintained and developed, it will be important for the commander to clearly set the intent of such a policy and to manage how it is implemented and promulgated. The 'diminishing return' part of the ALARA concept must not be, nor be seen to be, an expression that something is just not worth the effort. Instead, it is a simplification and an approach based on expression of the preponderance of accepted facts concerning safety and the low levels of toxicity or other adverse features of EIHH. The ALARA approach can both use and augment the trust so important in teams and so important in command. Since trust development is already an important part of training and readiness, incorporation of the ALARA concept could be accomplished inside existing systems of support and training regimes.

While clearly imperfect, established limits are set to be safely well below those which can be shown to cause harm and below those where an increased rate of disease can be demonstrated above that which occurs normally in the population. Even where detected EIHH levels are higher than set limits in the environment, other issues such as routes of contamination (skin absorption, inhalation, ingestion, etc) and exposure time are

important to any consideration of the toxic risk. Staying below the established thresholds all of the time may not be possible. This would worry any of us in the exposure group. But as long as the doses are within the realm of LL-EIHH levels, safety is still relatively high and it may not be reasonable, or operationally acceptable, for the moment, to eliminate all exposure to the risk. This is a risk-benefit question personnel can understand. By analogy, troops will understand that command can provide a vehicle resistant to all possible Improvised Explosive Devices (IEDs) or a ship's Operations Room which is protected from all sea-skimming missiles. They will also know that the vehicle will not move and that the ship will not float or manoeuvre well. The objective of complete protection is not reasonably achievable. In this context, allowance for some EIHH exposure may be acceptable and understood by operational personnel.

Continuing with the examples and insights provided from radiation biology and physics, it is important to note that the science of radiation biology and knowledge of the effects of prompt ionizing radiation on people and other animals was relatively far advanced earlier, than was similar knowledge related to toxic substances. However, all of these data were[57] and remain,[58] sufficient only to say that absolute risks are not known because the effects are attended by too much variability and too little data. Since the effects of lower doses are so small, only studies of large numbers of persons, over very long times can determine if there is harm. One such dataset exists and the effects in Hiroshima and Nagasaki from the two atomic bombs in 1945 are now as clear as they

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[57] Alison P. Casarett, *Radiation Biology* (Englewood Cliffs, California: Prentice-Hall Incorporated, 1968), 338.

[58] United States, National Academy if Sciences, *Health Risks for Exposure to Low Levels of Ionizing Radiation: BEIR VII - Phase 2*, 6

will likely be[59,60]. Statistically significant increases in certain cancers, above that which would normally be seen in a matched population, have been observed and suggestions for the association of other symptoms with radiation exposure have been made.

It is important to note that the Hiroshima and Nagasaki populations are unique, not just because they lived at the only nuclear weapons targets, but because epidemiologically they are defined and traceable through exhaustive studies beginning in the 1940s, and because many were exposed to high doses. High doses assist in identifying risks. Scientifically, these high dose cohorts are important because the vast majority of the exposures were immediate and short, and so the potential effects of the ionizing radiation were maximized and conducive to less ambiguous study. It follows also to say that if only large studies of well-controlled populations, exposed to a wide range of very low to high doses, are needed to identify significant effects of a hazard such as ionizing irradiation, "Is it any wonder that the effects of LL-EIHH are unproved and likely not different from the normal incidence of disease?". It must be said that the authoritative US National Academy of Sciences report[61], for a variety of reasons, did decide to support a model which assumed no lower threshold for a damaging dose (so any exposure, any time is a potential hazard). This is scientifically prudent and also is consistent with what most of the public believes.

Why is this discussion important to the topic of LL-EIHH in military operations? Normal *v*ariability among persons and hazards and the absence of distinct data to set

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[59] Robert W. Young and George D. Kerr, *Reassessment of the Atomic Bomb Radiation Dosimetry for Hiroshima and Nagasaki. DS02* (Japan: Radiation Effects and Research Foundation,[2005]), http://www rerf.jp.

[60] United States, National Academy if Sciences, *Health Risks for Exposure to Low Levels of Ionizing Radiation: BEIR VII - Phase 2*, 1-424

[61] ibid.

absolute risk is a consistent feature across all of TIC and TIM toxicity. Further, like the situation with radiation, the difference between the effects of high, frankly toxic effects of higher dose TICs and TIMs and the potential effects of LL-EIHH are even more murky. If the toxicologists cannot quote unequivocal data concerning LL-EIHH effects, commanders certainly cannot rely on their staffs to call-up a trusted number or rule. We need another approach to handle the issue in operations and to convey to troops both the reality of the risks, the reality of the safety margins and the understanding / intent of the commander. ALARA can form a framework for a commander's approach to LL-EIHH. Troops will understand the principles and their articulation. Further, in-operation effort mandated by the commander to address LL-EIHH concerns and their follow-up, serves part of a strategy this paper is advocating; to communicate with troops and reduce the risk that worries about EIHH become entrenched and prominent, and potential negative affecters of operations and of troops' health.

Two more items about ALARA deserve special mention. First, ALARA is now a poor courtroom strategy. Courts rule on reasonable doubt and since it is not honest to attest that exposure A absolutely did not result in disease or symptom Y, then reasonable doubt is invoked and reasonable effort doesn't count. It is not clear where Ombudsmen and Boards of Inquiry will always fall. But unless ALARA is somehow embraced in CF doctrine, it is likely not prudent to discount reasonable doubt. However, the thesis in this paper espouses doing more to understand and to mitigate assumptions concerning LL-EIHH, before they become operational concerns and issues. It follows therefore, that ALARA is not intended as a defence if injury is claimed. It is too late if injury is claimed.

There is a likelihood of operational impact and so the issue is moot to the thesis espoused here.

Another issue important to this discussion is the meaning of an acronym unique to this paper which we will call ALARA-2 (As Low As Recently Acceptable). While ALARA is an acronym for As Low As Reasonably Achievable, in ALARA-2, a particular contaminant, toxin or hazard, usually through no particular fault or reason, is unexpectedly identified for attention and action. What was previously Reasonable and Achievable (ALARA) now becomes important, dangerous and unacceptable for whatever reason. In a commercial / civilian sense, this usually involves something where the public profile has been increased and dire assumptions of risk become commonly-held. The recent (April 2008) example of bisphenol A (BPA), a chemical involved in the manufacturing of hard plastic (polycarbonate) drinking and food containers is a good case-in-point. Media and public interest in BPA had been increasing. On April 18, 2008, the Minister of Health announced that, subject to a 60-day period of public comment, Health Canada would ban BPA in products used as baby bottles.[62] Earlier, in anticipation of a ban, retailers were reported to be removing many plastic containers containing BPA from their shelves[63] regardless of the expected complaints from industry[64]. What happens next with BPA and how comfortable Canadians will feel about the advice they will receive from their Government and other sources will likely depend, at least in-part, on the continuing nature and degree of interest associated with this issue. Will this escalate and require a ban on other sorts of containers? Will the issue spill-over to claims about

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[62] News CBC, "Bisphenol A: FAQs," http://www.cbc.ca/news/background/health/bisphenol-a.html (accessed April 20, 2008).
[63] News CBC, "More Stores Pull Bisphenol A Plastics from Shelves," http://www.cbc.ca/canada/story/2008/04/17/bisphenola-stores html?ref=rss (accessed April 19, 2008).
[64] ibid.

related or to unrelated chemicals? What is likely in this debate is that there will be little detailed comment on the relative toxicity of BPA in relation to other plasticizers where data also shows potential harm. Cynically, it is just BPA's turn and that is the way it is.

The media are certainly important in these discussions and assumptions concerning risk, and media including internet access are available to troops deployed and at home. A simple Google search of "toxins and environment and cancer" conducted 20 April 2008 yielded over 376,000 hits and another for "viruses and cancer" yielded more than 232,000. This doesn't prove much except papers and reports and postings employing these search terms are numerous. But it is interesting to look at the lists and see how many are from special interest groups or advocacy groups, and that they are almost universally negative and even alarmist. As we have seen above, negative information helps to fuel inappropriate assumptions of risk.

The discussion in this paper will now turn to specific affects of the media on public opinion and assumptions concerning risk. It is possible to assess how much reporting of a hazard, risk or event affects actual claims of injury. Vasterman, et. al.[65] have reviewed the impact of media reporting of several events and disasters, on heightened concern expressed by a population and on the numbers of persons reporting symptoms to health professionals. They discuss media as 'frame-setters', leading what parts of a story or issue are presented.[66] In agreement with Fischhoff,[67] they also support the importance of the attention and intensity of interest people assign when considering

[65] Peter Vasterman, Joris Yzermans and A. J. E. Dirkzwager, "The Role of the Media and Media Hypes in the Aftermath of Disasters," *Epidemiologic Reviews* 27 (2005), 107-114.
[66] ibid., 111
[67] Fischhoff, *Ranking Risks*, 193

what is important. This is also important when considering different sources of information. Separately and together, these factors affect assumptions concerning risks.

Basically, people assume that important risks will be reported and if things are interesting and important to others, they must be worthy topics. As their original contribution Vasterman et. al., studied the aftermath of the 1992 crash into an Amsterdam residential district of an El Al wide-bodied aircraft. They plotted over more than one year,[68] the numbers of persons presenting to the Amsterdam Medical Centre who claimed health problems related to the crash. They related these data to the numbers of media reports of different EIHH risks which were claimed in the months after the crash and to the reports surrounding the Parliamentary Inquiry which occurred one year later. The numbers of self-reported health complaints were positively correlated with spikes in the numbers of media stories about the crash, and with the numbers of reports of purported contaminants and their presumed effects.

It is useful to point-out that the media attention was focused on intrigues and possible health effects of; depleted uranium used as a part of the aircraft's structure, chemical cargo including purported chemical warfare agent precursors, chemical residues of explosives and other items. All of these named EIHH items are familiar to the discussion earlier in this paper. Each of these has been invoked in health effects claimed by operational military populations. Therefore, these seemingly unrelated events like civilian aircraft crashes provide additional sources of information (of whatever value) and searchable material, which can reinforce concerns about toxicity of LL-EIHH and contribute to misconceptions about risk.

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[68] Vasterman, Yzermans and Dirkzwager, *The Role of the Media and Media Hypes in the Aftermath of Disasters*, 113

The following discussion is important to the contention that once a cause-and-effect belief is entrenched that some EIHH exposure is responsible for a particular risk, condition or malady, it is unlikely that this belief can be effectively reversed. Fischhoff in *Ranking Risks*[69] states that, "once an issue attracts attention; group processes can take-on lives of their own, generating further clues as to the magnitude of a risk". These group dynamics include assumptions that if something is reported with authority, then it must be important. Persons may also make judgments of the value of information based on their perception of the information provider. If institutions are seen to be acting out of self-interest, or too little interest, then there are assumptions they are hiding something.[70] Brewer[71] discusses an anti-science bias. Beck[72] goes further and describes false conclusions which can be derived from animal toxicology experiments. None of this helps to increase the trust of the population in the specialist advice available to them, as they form their assumptions concerning risk.

Technology can and does reduce risk. The increased life expectancy we enjoy is a testament to technology's advantages. But peoples' confidence in technology and in the experts which defend it is not high. For most people, access to the detailed information and facts is not helpful. Two linked issues discussed below, are among the factors which militate against persons changing strongly-held assumptions about risk. First information on toxicity is complicated and typically incomplete. Secondly, scientists and regulators are loathe to make definitive statements attesting no or very low risk, even if that is what of the data say. The scientist or expert is always looking for more data, or concerned

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[69] Fischhoff, *Ranking Risks*, 193
[70] ibid., 193-194
[71] Brewer, *Risk Perception and Strategic Decision Making: General Insights, a New Framework, and Specific Application to Electricity Generation using Nuclear Energy*, 29
[72] Beck, *Risk Society: Towards a New Modernity*, 68

about appearing too unprofessional, or concerned about personal liability considering how future court cases may go. An interested citizen looking at this is not informed by the detailed datasets and not encouraged by the scientists' hedging statements. In an environment of duelling experts and media headlines, there is little wonder people pursue their negative biases and hold firm to assumptions of risk which may be inappropriate.

In many situations where injury by EIHH is believed, it is clear that people are genuinely sick. This reinforces, in the mind of the ill and in the minds of the worried, an adverse association with an EIHH exposure. While the science might say that the probability is tiny that a LL-EIHH exposure was the cause of the claimed or proved illness, the fact that seemingly large groups of people are unwell is the focus, and also seen as the proof. A three-year follow-up of persons in New York City showed a correlation with doctor-diagnosed cardiovascular ailments after September 11, 2001.[73] This was not related to proximity to the event or to exposure to EIHH hazards from the World Trade Centre site. Another recent study assessed Chernobyl disaster sequelae in former Soviet Union persons who immigrated to the United States.[74] The study found that both geographic proximity to the 1986 destruction of the reactor and perception of radiation risk, were long-term indicators of the individuals' current psychological health and distress. This and other studies show that perceived exposure to stressors like radioactive contaminants, toxins and pollutants perpetuate their impact. In this case, the belief of having been irradiated is a stressor which persists and manifests as low-grade mental health symptomatology. Whether there is a diagnosis or not, people are sick and

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[73] E. A. Holman and others, "Terrorism, Acute Stress, and Cardiovascular Health," *Archives of General Psychiatry* 65, no. 1 (2008), 73-80 (accessed 10 January 2008).

[74] RoseMarie Perez-Foster and Marjorie F. Goldstein, "Chernobyl Disaster Sequelae in Recent Immigrants to the United States from the Former Soviet Union (FSU)." *Journal of Immigrant Health* 9 (2007), 115-124.

their EIHH hypothesis and assumptions concerning risk, inappropriate or not, provides proof of LL-EIHH as the culprit. If inappropriate assumptions concerning risk such as those demonstrated in the two studies and others above become important and entrenched during operations, it can be assumed that they will affect operational and force generation outcomes.

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This paper has shown that assumptions of injury due to exposure to environmental and industrial health hazards, impact operations and are founded largely in inappropriate decisions and processes concerning risk. Through integration and consideration of a wide range of scientific and other literature, some of the processes behind the formation and maintenance of opinions concerning risks have been demonstrated. The concept of ALARA has been introduced as an option to assist commanders to address some of the hard issues. ALARA is a concept doctrine writers might well consider.

At its heart, assumptions concerning the priority and magnitude of risk are a people issue. Dealing with perceptions of risk and reducing their impact on operations is a command and policy issue for an organization like the CF. Command and policy are also directed at people. Solutions especially to issues like the risks from LL-EIHH will not come mostly from technology. The roles and experiences of the Canadian Forces over the last 20 years have been increasingly in peacemaking and combat in failed and failing states. Deployments to future missions in battered industrial states and or in states with high risk from endemic disease seem quite likely. Therefore besides the risks of combat

and the ever present risks from Public and Occupational Health factors, CF personnel will be in heightened EIHH risk environments. These risks will vary from immediate toxicity of high volume TICs and TIMs, to very low or zero toxicity from LL-EIHH. It is essential to keep the relative risks in perspective.

Currently, CF personnel deploy with personal fears and biases concerning risks in the deployment environment which are not supported by facts. Based on arguments presented in this paper, they also deploy with a readiness and capability to form or accept inappropriate assumptions of risk. It makes no sense to accept risks from bullets and worry yourself sick about much smaller or zero risks from LL-EIHH. Command must be innovative and involved to attempt to reduce the instances where these inappropriate assumptions form, and adverse effects on operations occur. If this can be accomplished through doctrine and command responsibility, commanders will see improvements in operational capability and improvements in operational capabilities and health protection for troops. The advantages for troops include better understanding of the true nature and priority of the risks before them and an overall improvement in their health and well-being.

The Director General Health Services is now responsible for Force Protection concerning environmental and industrial health hazards. Great strides have been made since the report of the Croatia BOI in March 2000, particularly in the area of Force Health Protection (FHP) and in Operational Medicine in deployed Role 3 Casualty Care. However, the latter is not intended to address LL-EIHH concerns and the FHP component is understandably quite occupied in-theatre with classic public health / camp hygiene programs including; potable water quality assurance, food safety and production

activities, and pest and biting insect control. While this paper has consistently stated these issues in operational medicine and FHP should not give-up resources or emphasis to address the LL-EIHH issues and concerns described in this paper, it is clear something more must be done if concerns about perception and LL-EIHH are to be addressed.

FHP is concerned with assessing health risks prior to deployments and with updating the assessments as deployments proceed. The Environmental, Industrial Health Hazard Specialty Support Team (EIHH SST) is an important asset for conducting human and environmental health assessments on deployed operations. The teams can be filled with environmental engineering, public and occupational health and radiological survey specialists, supplemented by occupational hygienists and preventative medicine technicians (PMed tech), supported by FHP medical and scientific experts. By rule, these teams conduct pre-deployment and end-deployment assessments. Importantly, these teams can be assembled and deployed to address and assess threats or hazards as they are identified. This last capability is important to making a preliminary assessment and to return samples to Canada for further assessment of EIHH concerns. Additionally, PMed tech deployed with each ROTA are available in-theatre, to conduct preliminary assessments and consultations, although most of their time is tied to daily public health duties.

It is recommended that as the shortfall in PMed Techs and in senior MedTech (who have additional training in Occupational Health) availability continues to be addressed, more time and personnel be available for outside the wire activities and for encampment activities related to concerns expressed by commanders or other operational personnel, about non-routine public health issues such as possible EIHH hazards. Just as

the Physician Assistant / senior MedTech functions in ships, these personnel can be envisioned in an 'eyes and ears' role and as a liaison for the commander with troops. There is also an important role to be played here by these specialists, in providing ready comments to troops about their risk perceptions and where necessary to take samples for assessment. It is also recommended that the deployable capacity for chemical detection be augmented and a capacity for biological detection be provided. It is understood that these field capabilities would be less than definitive and that further analysis out-of-theatre would be required. However, the positive message these capabilities would provide to troops in the field concerning the level of commitment and capacity their commander has for their well-being would be helpful. It is not recommended that routine and constant sampling be undertaken as this is unlikely to anticipate potential EIHH claims and issues, is cumbersome, logistically very difficult and is labour intensive. Importantly, it is considered that routine sampling, while likely contributing little to eventual detection issues concerning LL-EIHH, may have a negative impact on trust and worry.

Much has been written in the last 10 years about stress in deployments and strategies to reduce stress-related injuries. Many of the suggestions are quite generic and applicable also to reduce the probability that inappropriate concerns about EIHH may result. Therefore this literature can exert additional positive impacts on health and operational capability. As mentioned above, in essence, inappropriate assumptions about risk are a people and a policy problem. Many of the solutions are also about people and policy and an institution like the CF is particularly well-suited to reinforcing and implementing what is needed. The role of unit cohesion, trust and confidence in

leadership are often cited,[75,76] as important in reducing the impact of stress. Hatton confirms that emphasis on the human component is the most important aspect of command.[77] The same can be said about unit cohesion and confidence in relation to EIHH concerns, especially as it relates to trust and confidence in the intentions, attention and concerns of the commander and the institution of the Canadian Forces.

It is important to state that in this instance, 'commander' means the overall mission commander. This is not a responsibility and task which can be delegated solely to the Health Services chain, without first beginning with the commander. The commander sets the tone for command at all levels and this is important to the required unit cohesion and trust which is the main defence against stress, including concerns about EIHH.

As this paper has shown earlier, once inappropriate assumptions concerning LL-EIHH are entrenched, they are difficult to defeat and non-specific illness results. It follows from this that a policy akin to treatment of these assumptions will fail. Further, in extreme cases the mission can fail. If treatment is the approach, we will be left also to treat and to contend with the illnesses and quality of life deficits which result. Prevention is the method of choice here and this must occur early in the cycle, before concerns are entrenched. Education of commanders and education of personnel is required. Policy and recognition of the realities and requirements are needed. Failure to make these changes will result in more instances of perceived injury and more impacts on the operational and

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[75] Terry Copp, "Stress Casualties and the Role of the Commander" In *Generalship and the Art of the Admiral: Perspectives on Canadian Senior Military Leadership*, eds. Bernd Horn and Stephen J. Harris (St. Catherines, Ontario: Vanwell Publishing Company, 2001), 333.

[76] Richard A. Hatton, "Stressors and Stress on Peacekeeping Operations: Implications for Operational Level Commanders" In *Generalship and the Art of the Admiral: Perspectives on Canadian Senior Military Leadership*, eds. Bernd Horn and Stephen J. Harris (St. Catherines, Ontario: Vanwell Publishing Company, 2001), 303.

[77] ibid., 301

force generation capacity of the CF. Failure will also provide negative examples which will affect future operations, while leading to real illness and the attendant personal and

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