LEGITIMACY THROUGH PUBLIC PARTICIPATION IN RISK POLICY MAKING: A CASE STUDY OF WATER QUALITY OBJECTIVES FOR TRITIUM IN ONTARIO

by

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ABSTRACT

The dominant social values and perceptions of the 1970s, which guided the development of institutional and procedural frameworks for risk policy making in Canada, have changed since that time. Over the last decade, the public has signalled problems with the perceived legitimacy of frameworks for risk policy making which involve closed negotiations between government and industry, and which rely heavily on the recommendations of a select group of scientific experts. Consequently, decision makers are adopting participatory policy making processes in attempts to restore public perceptions of legitimacy. This thesis examines the nature of public participation in risk policy making and evaluates the extent to which this type of approach, as it is designed in the context of a case study, addresses problems of legitimacy.

On analyzing submissions from a public consultation on a drinking water guideline for tritium, it was found that decision makers failed to recognize the prevalence of legitimacy concerns, and thus did not design the process of public participation to address these issues. In employing a process of public involvement which resulted in no significant redistribution of influence over decision making, and in assuming that public concerns could be allayed by providing more technical information regarding risk assessment techniques, decision makers failed to recognize the changing social context for decision making on risk issues. If present trends in public values and perceptions continue, policy domains like that of radiation health protection, which employ closed, science-based decision processes, will be confronted with more pronounced problems of legitimacy which call for radical changes to both the social and the scientific assumptions which underlie risk policy making.

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LIST OF ACRONYMS

ACES	Advisory Committee on Environmental Standards
BEIR	U.S. NAS Committee on the Biological Effects of Ionizing Radiation
CANDU	CANadian Deuterium Uranium
EAA	Environmental Assessment Act
EAAC	Environmental Assessment Advisory Committee
GCDWQ	Guidelines for Canadian Drinking Water Quality
ICRP	International Commission on Radiological Protection
MAC	Maximum Acceptable Concentration
MoEE	Ontario Ministry of Environment and Energy
NCRP	National Commission on Radiological Protection [check]
NGS	Nuclear Generating Station
ODWO	Ontario Drinking Water Objectives
ONSR	Ontario Nuclear Safety Review
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
U.S. EPA	United States Environmental Protection Agency
U.S. NAS	United States National Academy of Sciences
WHO	World Health Organization

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Chapter One

INTRODUCTION

1.1 THE PROBLEM

There are few, if any, areas of social policy which involve interest and value conflicts as intense as those which arise in the context of managing technological risks to human health and the environment. In this age of rapid technological change, our society is far from uniformly accepting of the ecological changes, both known and suspected, brought on by technologies which alter the dynamics of natural systems. Although it is difficult not to marvel at the enormous potential of technology to streamline industrial processes, enhance the capabilities of modern medicine, and even simplify the undertaking of tasks common to daily life, the necessity to manipulate natural systems in order to achieve this potential can be unsettling. Individuals view risk problems very differently from one to another. For one, different groups in society approach risk problems from varying perspectives since not everyone stands to gain or lose equally from technology related risks. Moreover, individual values, in terms of our own risk aversity and how we perceive the appropriate ranking of social priorities, profoundly affects the extent to which a risk is deemed acceptable.

For determinations of risk acceptability which affect society as a whole, Canadian democratic tradition dictates that risk management be the charge of governmental decision makers. The public relies on government agencies, through both policies and actions, to guard the safety and security of individuals and communities at risk from exposure to technological-related hazards. This expectation, in concert with the many other responsibilities of government, presents decision makers with many challenges. As Nelkin (1977, 11) explains,

> [decision makers] must define acceptable levels of risk and weigh these risks against the benefit of new technologies in the face of diverse judgments about what constitutes a 'good society.' And they must balance national interests with local or regional demands, practical constraints with ideological arguments, long-term concerns with short-term imperatives, technical possibilities with social considerations.

These dilemmas are essentially irresolvable in any large heterogeneous society. Consequently, tradeoffs among interests in society are often necessary. Such tradeoffs are generally determined within the context of the institutional and political frameworks for decision making on specific risk issues.

In Canada, the decision making frameworks for many risk management policy domains were conceived in the 1970s, during the early stages of the environmental movement in North America. The institutional and procedural arrangements for developing and implementing many environmental and risk policies emerged at a fairly rapid rate during this period while political pressure on decision makers to act on public concerns was particularly intense. These frameworks were generally characterized by exclusive, confidential processes of negotiation among government agencies, scientists, and industry (Hoberg 1993). Historically, in this framework, scientists acted as influential policy advisors. Reference to scientific facts and arguments formed the primary basis of policy legitimacy (Salter 1988; Brunk et al. 1991); and, the widely held social perception of scientists as neutral and objective observers in the political context served to validate the closed, confidential bargaining process.

Since the early 1970s, until the late 1980s when environmentalism again emerged as a prominent social concern on the political agenda, a number of changes occurred within the social context of political decision making on the environment. For one, the public began perceiving that business interests have largely dominated the policy negotiation process. Consequently, public confidence in the government's ability to defend public and environmental interests has declined (Hoberg 1993, Jasanoff 1986). Another change, attributed in part to the decline in the public's confidence in government, involves the broad social conception of how democracy is achieved in decision making on the environment (Doern 1990, Owen 1993). Public acceptance of a strict representative model of government is being replaced by public demands for a more active and effective role in social decision making.

The other significant change involves the public's perception of the appropriate role of science in political decision making. The positivist view of science, which flows from the perception that scientific processes are objective and politically neutral, dominated society during the early 1970s and underpinned the legitimating role of science in decision making. Since that time, this perception has become less prevalent. Citizens are becoming increasingly aware of the extent to which social and political factors influence scientific activities (Edge 1995, Jasanoff 1990). These changes in public perception have effectively challenged the legitimacy of the closed, confidential process of decision making, and have caused decision makers to seek out processes which are more transparent and open to involvement from the general public (Hoberg 1993).

Despite the "crisis of legitimacy" (Hoberg 1993) plaguing many policy domains which follow the closed, confidential model of decision making, participatory approaches are often criticized and resisted by certain constituents of the policy community. Participatory processes, it is argued, can frustrate the capacity of government to act on a policy problem by slowing, or even immobilizing, the decision making process when complex conflicts in values prove irresolvable (Doern 1990, Nelkin 1977). By increasing the number of participants involved in the process, the potential for a greater number of disagreements is also increased (Nelkin 1977). Moreover, attempts to adequately inform the public on the issues in the debate, and accommodate the range of concerns of the various interests represented, can significantly delay the timing of a decision and, accordingly, the total cost of the process itself (Jasanoff 1986).

These are certainly legitimate concerns in the context of designing suitable participatory processes. However, there are also other more practical reasons why some groups may resist demands for a more open decision making process. A process which relies heavily on the information and recommendations provided by scientific experts also extends to those who are principally involved in generating and disseminating knowledge in that field a significant proportion of the balance of political power and influence over policy (Robinson 1992). By opening up the decision making process to public involvement, that influence is potentially lost or significantly reduced. Consequently, the scientific community, and those whose interests are favoured by the closed, science-based system of decision making, are systemically disinclined to support such an approach (Nelkin 1979).

There is also one additional issue of concern in regard to process design. In a policy domain suffering from a lack of legitimacy due to its closed confidential approach to decision making, participation can be an effective method of shifting the balance of political power in decision making away from technical elites in a direction which is more representative of the diversity of interests in society with respect to that policy. However, simply introducing public involvement does not guarantee that this shift will result (Jasanoff 1986). As Parenteau (1988, 4) notes, "participation. . .develops its own methods and generates its own internal dynamic." It is possible that rather than alter the political relationship among actors, participation may simply provide a forum in which to dramatize existing relationships, thus having no real effect on the decision making process. Consequently, the goal of participation--with respect to addressing the problems of legitimacy facing risk policy domains--will not be achieved.

Therefore, there are two important categories of impediments to a successful participatory process of decision making: First are those which arise naturally due to the complex technical language of risk problems, and the often variable values and interests of participants; and, second are those which are attributable to the inevitable resistance demonstrated by constituents who tend to be served by the traditional closed, science-based approach. One of the greatest challenges facing decision makers who are either compelled, or choose voluntarily, to introduce public involvement to a traditionally closed, science based process, is overcoming these inherent and systemic impediments to effective--understood here to mean capable of achieving its objectives--participation. Consequently, with public pressure for a more substantive role in decision making intense, the process design, specifically how well it addresses both public demands and the potential problems, is of fundamental importance (Doern 1990).

The matter of designing effective participatory processes is not only complex, but necessarily iterative. Moreover, although achieving legitimacy in decision making is a fundamental goal, risk management decision makers must also consider the broader economic and social implications of a particular policy direction. Consequently, this study focuses on one elemental issue in the process design debate: the sensitivity of the method of public involvement to the problems of legitimacy which underlie public pressures to engage more directly and effectively in policy development. Decision makers may not fully understand the social and political issues driving this observed procedural change, or these issues may become obscured as agencies experiment with alternate modes and degrees of public involvement. Such misinterpretations can be politically costly if they fuel the intensity of public controversy. Moreover, where public involvement fails, or the costs do not appear to justify the benefits, arguments against participation are bolstered, and future efforts to involve the public may be thwarted by opponents of the approach.

1.2 STUDY GOAL AND OBJECTIVES

The goal of this study is to assess whether public involvement, as it has been structured in Canada, addresses the issues underlying the problems of legitimacy argued to be afflicting closed, co-operative, science-based approaches to risk policy development. This goal addresses an issue which is fundamental to the matter of designing effective participatory processes for risk policy making. The particular question of what constitutes an effective process is not presupposed. However, it is assumed that however defined, an effective participatory process must necessarily follow from adequate and appropriate consideration of the factors which provided the impetus for this type of approach.

A case study is employed to provide an empirical basis for the study. The case study chosen involves a health protection policy which has evolved within a traditional, science-based decision making framework. This particular framework has not changed notably since it was first developed in the late 1960's. However, in 1994, a participatory process was introduced to the framework.

The study goal has been broken down into three specific and successive objectives. The first objective is to compare a few specific aspects of the approach to decision making for the case study policy before and after public participation is introduced. This bi-temporal study will compare an example of policy making under the traditional approach to that of the participatory approach utilized in 1994. These specific aspects include the nature of the institutional decision making process, the issues raised, and the effective and perceived appropriate role of science in decision making. The second objective is to identify, from the information obtained through the bi-temporal study, the problems of legitimacy which appear to characterize the closed, science-based approach to decision making traditionally utilized to develop the case study policy. The context for establishing what constitutes a problem of perceived legitimacy will be provided by arguments presented in the literature in relation to environmental policy making generally. On identifying specific problems, the third objective is to evaluate the congruence of the participatory approach with the identified legitimacy problems.

1.3 STUDY APPROACH

The study goal and objectives described in the previous section follow from a few critical assumptions. The first is that congruence--of process design with public concerns regarding legitimacy--is a necessary condition for a process to be effective in terms of meeting the objectives of both decision makers and the public. Second, it is assumed that the problems of legitimacy argued to be affecting processes of decision making for risk policies generally are prevalent in relation to the case study. And third, it is assumed that the case study is representative of participatory processes utilized in other risk policy areas. Consequently, it is a useful model on which to draw for lessons regarding how to design participatory processes so that they may be responsive to the expectations of both decision makers and the public.

1.3.1 The Case Study

A number of characteristics of a case study were identified as being important for undertaking the objectives described above. First, the subject matter of the policy should be highly esoteric and science-oriented. Second, the decision making process in this area should have a long and relatively consistent history of insulation from direct public involvement and scrutiny. Third, the actors, institutions and the rules which govern their inter-relationships should exhibit consistent characteristics over time. And fourth, the introduction of public involvement in decision making should be fairly recent and novel.

The case study chosen involves the establishment of drinking water guidelines for radioactive elements or radionuclides. In Canada, drinking water guidelines are developed jointly by federal, provincial and territorial health ministries. From this joint process, the federal health department publishes the *Guidelines for Canadian Drinking Water Quality* (GCDWQ). However, health protection is a power assigned to the provinces in the Canadian constitution. Therefore, the GCDWQs function as policy advice to the provincial ministries which publish their own drinking water protection policies.

In Ontario, this policy is reflected in the *Ontario Drinking Water Objectives* (ODWOs). The parameters--or maximum acceptable concentrations of contaminants--listed in the ODWOs are generally established to exactly reflect the values specified in the GCDWQs. This is especially the case in relation to the radiological parameters for which the provincial health ministries have little or no specialized expertise. In fact, there are very few government scientists in Canada with expertise specifically in the area of health effects from exposure to radiation. The radiological parameters historically have been based on recommendations emanating from radiation research agencies in the international community who specialize in studying health effects of exposure (Health Canada Official 1994). When these values were last revised in 1979, the framework for decision making involved no public input, and was dominated by the recommendations of scientific experts with the federal government and international scientific agencies. The approach to decision making prevalent at this time will represent the traditional approach in the analysis.

There are five radionuclides listed in both sets of guidelines. These are: cesium-137, iodine-131, radium-226, strontium-90, and tritium. Usually, all five parameters are adjusted simultaneously since most of the scientific assumptions which underlie each particular value are common to all. However, in 1994, in response to a local political issue in Ontario, the Ontario Ministry of the Environment and Energy proposed an interim ODWO for the radionuclide tritium, and established a participatory process to review its proposal. This process was a radical departure from the traditional decision making process for setting radiological guidelines for drinking water. The participatory process essentially involved an advisory committee to the ministry soliciting written submissions in response to a Rationale Document prepared by the ministry to defend its proposed change to the guideline. The written submissions provided by public, interest group, and industry respondents are used to provide the essential information regarding perceived legitimacy for the case study. The approach to decision making characterized by this process and its place within the broader context of decision making for drinking water policy will represent the change to be assessed in the analysis.

1.3.2 The Framework for Analysis

The case study builds on a number of theoretical arguments, derived from the literature, about the nature of relationships among political actors and the public, and of their role and influence within the socio-political framework for policy decision making on risk. These theoretical arguments are presented in the second and third chapters of this thesis. The second chapter first explores the macro-political framework for risk management to provide the cultural context for risk policy making in Canada, and then analyses the micro-political framework which characterizes the specific context for decision making in relation to the case study policy. The third chapter deals specifically with how societal perceptions of both the mechanics of science, and its place within society, influence the role which science plays in the development and justification of social policy. Both chapters discuss the dynamics of these types of relationships in terms of how they have changed over the period of the case study.

The case study and analysis are presented in the fourth and fifth chapters of the thesis. A graphic analytical framework is developed to facilitate the analysis of issues and arguments presented by respondents in the participatory process. The first specific objective of the study is addressed in the fourth chapter of the thesis which summarizes the information obtained through the case study. The information provided by the case study is then analyzed, in the fifth chapter of the thesis, in the context of the theoretical arguments developed in the second and third chapters to address the last two specific objectives of the study. This empirical study is assumed to provide a sufficient basis on which to interpret general trends in decision making on risk policies, and to suggest possible strategies for addressing a changing social context for decision making. These changes appear to include increasing demands for a more direct and effective public role in decision making.

Chapter Two

RISK MANAGEMENT IN CANADA: ASSESSING THE TREND OF INCREASING PUBLIC INVOLVEMENT IN DECISION MAKING

2.1 OVERVIEW

In the late 1960's and into the early 1970's, environmentalism was a new and emerging social phenomenon drawing considerable political attention. Hoberg (1993) describes this period as the "first wave" of environmentalism. Characterized by shifting societal values away from the economic materialism of the previous generation, this period saw the establishment of formal institutional structures to address specific issues of environment within the broader political framework. At the outset, however, both the federal and provincial governments lacked the formal institutional structures with which to develop and administer protective policies. These structures emerged at a fairly rapid pace as many key departments, agencies and statutes began forming over the next several years. This rapid institutional transformation is described by Hoberg (1993, 313):

> At the federal level, the twenty-eighth Parliament, which lasted from 1968-72, enacted nine new environmental statutes, including the Clean Air Act, Canada Water Act, and amendments to the Fisheries Act. A new federal department, Environment Canada, was created in 1971. Provincial governments also responded with a wave of new statutes, agencies and regulations. Ontario passed its Environmental Protection Act in 1971, and Quebec its Environmental Quality Act in 1972.

This period was a defining era for Canadian environmental politics. Consequently, the dominant social and political values of this decade were reflected in the design of these key institutional and procedural arrangements.

These dominant social values of the first wave of environmentalism are particularly apparent in the political processes whereby environmental policies were developed, including the designation of key actors and the factors which lent legitimacy to the decisions. Government agencies were established to administer new environmental legislation, and to undertake research in support of that administration. Much of this research was undertaken by government scientists with a mandate to address particular areas of public policy since new statutes, aimed at protecting health and environment, dramatically increased regulators' demands for scientific information (Jasanoff 1990, 39). Public concerns focused on the need to take immediate and definitive action, and prescribed a leading role for government in this regard. Moreover, environmental and other advocacy groups were beginning to organize and lobby around particular issues of concern. And although societal values with respect to many issues of environment have changed since this period, many of these arrangements, particularly in areas of risk management where the scientific information tends to be highly esoteric, still exist.

There are two significant defining features of the early approach taken to managing risks. The first feature is a product of the broader political culture. Environmental policy development processes in Canada have essentially involved confidential negotiations between government and industry and very limited participation by the general public and other interest groups (Hoberg 1993). The second feature stems necessarily from the technical nature of most environmental and risk problems. Decision makers have relied heavily on formal, disciplinary scientific information to inform and support policy decisions. Not only do decision makers require the advice of technical experts to make informed policy choices, but to a great extent, they have relied on the public perception of science as an objective and value-free enterprise to legitimate decisions involving often difficult social tradeoffs. Consequently, scientists have assumed a very important social role as policy advisors, a role which has effectively altered both the processes and the applications of science (Salter 1988).

Over the last decade, there has been a distinct trend in Canadian environmental policy development toward greater use of citizen panels, assessment tribunals, consultations and consensus building processes (Jasanoff 1986, 55; Hoberg 1993, 311). Public and interest group pressures have compelled many regulatory agencies to make their decision processes more transparent, and more accessible to non-business interests. Not all areas of environmental policy, however, have been equally affected by these types of pressures. Many risk management policy development processes have continued to follow the closed, cooperational, science-based approach, maintaining a decision making environment based on the dominant social values of the early environmental movement.

This chapter provides an overview of the political, social and cultural framework which characterizes risk management decision making in the context of the case study. The dynamics of this framework are also discussed in terms of a few key explanatory theoretical concepts. These concepts, along with those developed in the next chapter, will be invoked to assist in the analysis of the case study. And finally, temporal changes in the forces acting on this framework--specifically the observed trend in environmental decision making toward greater use of participatory processes--is discussed.

2.2 POLICY ANALYSIS: TERMS AND CONCEPTS

Public policy is a term which is defined often and with varying emphasis on its different aspects. However, the most notable aspect of policy is the ultimate action or decision of government which ensues from an interactive social and political process. The action is the visible response to a matter on the public agenda (Atkinson 1993, 18; Stanbury 1993, 54). Public policy, however, is conceptual as well as concrete in nature. The essence of public policy as a concept is captured by Atkinson (1993, 19) who asserts the following:

> [P]olicy is a theoretical construct. It is a course of action, yes, but action that is anchored in both a set of values regarding appropriate public goals and a set of beliefs about the best way of achieving those goals.

For the purpose of this study, therefore, public policy is defined as an abstract concept of the appropriate path for society to follow on a specific public issue or problem, which is embodied in the values and preferences of society as interpreted by decision makers, and expressed through the explicit decisions and actions of government.

The ultimate course of action taken by government can assume one of several forms. Risk management policies, whether they be directed at human health or environmental protection, typically involve some form of either legally enforceable regulation or standard, or non-binding guideline or objective which asserts some degree of control over either social or economic activities. These different types of policies are endowed with varying degrees of legal and moral force. In theory, *regulations* "occur when the more coercive powers of the state are used to back up norms of conduct. In this political sense, both statutes or legislation as well as so-called subordinate legislation [are] regulatory in nature." Similarly, *standards* "are usually viewed...as statements arising as subordinate legislation, setting out upper or lower health and safety limits or setting out procedures that must be followed. In this sense they are rules of behaviour backed up by sanctions that apply if the standards are not met"

(Doern and Phidd 1983, 306).

Guidelines are unlike regulations and standards in that they are usually not underpinned by statutory force or the threat of legal penalties. Although there may be other practical or economic reasons for utilizing this type of policy instrument, guidelines, "in the health and safety field,...are often viewed to exist because of the presence of greater scientific uncertainty or because it is agreed that there is no safe threshold limit; that is, a point of measurement within which something is 'safe' and beyond which something is 'unsafe'" (Doern and Phidd 1983, 307). This type of policy demands voluntary compliance. As such, it must exhibit moral force and hence be perceived as legitimate among those to whom it applies. According to Doern and Phidd, understanding the distinctions between *regulations*, *standards*, and *guidelines* is crucial to managing risks according to democratic principles. Adhering to the principle of equal treatment under the law becomes more difficult as the information underlying policy becomes more uncertain and subject to differing interpretations. Therefore, greater uncertainty in information should result in more flexible and interpretable policies.

The Guidelines for Canadian Drinking Water Quality (GCDWQ), and similarly the Ontario Drinking Water Objectives (ODWO), fall into the third of Doern and Phidd's policy categories. Both policies prescribe principles for the quality of drinking water without the licit force of the other two policy types. According to Doern's assessment of the role of these policy types in addressing differing policy problems, the highly uncertain and changing nature of environmental problems generally, and drinking water quality parameters specifically, appears to render policy in this area well suited to this category. There is a high degree of inherent uncertainty in estimating, quantitatively, such unexplicit factors as "safe" levels of contaminants and "aesthetically acceptable" characteristics of drinking water. Consequently, the ODWOs are qualified in the following excerpt from the document's introduction:

> The Drinking Water Objectives described herein have been derived from the best information currently available. The development of drinking water objectives, however, is a continual process. The understanding of the complex inter-relationships that determine water quality and the physiological effects of parameters present in water continues to grow. Society continues to introduce new chemicals into the environment that have a potential to contaminate drinking water supplies. Objectives are reviewed as new and more significant data becomes available. (MOEE 1994)

This policy is also directed primarily at public sector municipal water treatment facilities which, since they are not profit seeking, have little incentive to resist compliance with the policy.

Any analysis of policy necessarily requires consideration of not only the final decision of government, but of the philosophies and processes which come into play during its formulation. Salter and Slaco (1981, 32) describe policy creation as "the chain of events, decisions, actions and deliberations through which a 'policy' emerges." There is no one model which can fairly represent the process of decision making for all types, or even one single type, of policy issue. The formal process, including the procedures for presenting, reviewing and determining acceptance of a proposed policy, and the hierarchy of authority within and among government departments and agencies, are certainly important factors in determining how decisions are made.

Drinking water quality falls into the very general policy domain of health protection. Radiation guidelines for drinking water are more specifically related to the domain of health protection from radiation. A *policy domain* is delineated by the bureaucratic organization of government departments, and each involves "different actors, different coalitions, and different patterns of interaction" among them (Atkinson 1993, 37). Decision making within each policy domain is shaped by the complex interactions and relationships between actors both internal and external to the explicit policy development process. These interactions can be described in terms of two key concepts: policy communities and policy sectors. A *policy community* is a map of all actors involved in policy development including, along with the core government department and interest groups, other "related departments, knowledge networks, and international entities" (Doern and Conway 1994, 10). The policy community encompasses the whole range of social actors with an interest in the policy whose values and perspectives vary. A *policy sector* is, more narrowly, "a matrix or cluster of government organizations which regularly interact and compete in an effort to defend or promote their policy interests" (Doern and Conway 1994, 11). This includes those government agencies which contribute to a particular policy decision process with such inputs as research, resources, and policy advice.

One further concept of importance to this study, which is a subset of the policy community, is the *scientific community*. Salter and Slaco define this concept "for convenience" in their 1981 study of how science is affected by the employment of public inquiries in policy development. This definition is particularly useful here for similar reasons recognizing that science in the policy context is far from homogeneous and given the lack of consensus in the literature as to what constitutes science. Their definition is as follows:

> We define . . . [scientific] community as being composed of scientists in universities, industries and government who have had formal scientific training and who occupy positions for which that training is a prerequisite. We include social scientists and economists who consider their work to be scientific, in that they use 'scientific methods of inquiry' in their study and research. (Salter and Slaco 1981, 31)

Scientific community, therefore, is defined broadly to include all those who assert formal expertise in an area which follows recognized and standard procedures for research.

2.3 THE MACRO-POLITICAL FRAMEWORK: RISK MANAGEMENT IN THE CANADIAN CONTEXT

Canada is not unlike other nations in that risk management is a growing concern among members of the general public and, consequently, for decisions makers who must address variant and changing concerns in their policies. However several studies suggest that different countries do not always choose similar strategies for dealing with the same types of problems (Brunk, Haworth and Lee 1991; Harrison and Hoberg 1994; Nelkin 1977). The variations in approach to policy problems are attributed largely to the differing characters of political systems and the distinctive dynamics among the actors involved in decision making. A unique character of decision making exists not only for each country, but is prevalent in the policy decisions of each policy domain within that country. The character of decision making is defined by such variables as who is involved or excluded from the process, how scientific information is produced, validated and applied (Jasanoff 1986), where accountability and responsibility rests, and how responsive the process is to change. These variables combine to provide what will be referred to herein as the "framework" for decision making.

2.3.1 Canadian Political Culture and Scientific Debate

Sheila Jasanoff (1986, vi, 56) describes the concept of "political culture" as the institutional and procedural arrangements of a country's political system. This concept encompasses such factors as how political authority is allocated among levels and branches of government, what mechanisms exist to involve, or inhibit involvement from, the public in decision processes, and the extent to which the legal framework of government exposes decision processes and rationales to public view and direct accountability. Jasanoff attributes patterns of interaction among decision-makers, scientists, and the lay public, in terms of their role and influence in the decision making process, to the nature of these characteristics. The patterns of interaction among these groups in turn affect the extent to which competing views on scientific issues are aired and weighed in the decision process.

Canadian decision processes, particularly those involving risk management, are often characterized as "informal, confidential, consultative, and cooperative" in contrast to the those of the U.S. which have been labelled "formal, open, adversarial, and confrontational" (Jasanoff 1986, 56). These cultural differences reflect a broader distinction between Canadian and U.S. political and institutional traditions which are important in shaping relationships between the state and society. For example, the U.S. constitutional system discourages government agencies from exercising arbitrary powers. Consequently, decision making rules and procedures tend to be very detailed, providing an effective role for the judicial system in arbitrating policy conflicts (Harrison and Hoberg 1994).

This judicial nature of U.S. policy-making provides numerous formal avenues for the public to intervene and affect policy development as well as challenge existing policies. For the most part, these formal avenues are not available in Canada. The resulting effect is such that government scientists are rarely challenged effectively by individuals or groups external to the decision process, and very little scientific debate over such matters as methodologies, assumptions, and results occurs during the development of public policy.

The cultural dynamic concerning which groups influence debates over public policy is discussed further and more generally by Stanbury (1993, 64) who asserts that the most significant "battlefields" for debating public policy in the Canadian system of government, occur "behind closed doors [and] prior to the time a policy receives the approval of cabinet or fails to gain it." Consequently, the bulk of scientific debate, as well as resolution of other important issues, has already occurred before a proposed policy is made public. When a ministry, therefore, extends a proposed new or revised policy for public comment, it is often only at the very final stages of its development after most of the key issues have been resolved to the satisfaction of the government departments and agencies involved. At this stage, arguments in favour of a particular policy direction are well fortified and have most likely garnered the support of a broad base of government officials and scientists. Policy opponents therefore approach the policy debate from an inherent disadvantage, even when a forum for discussion of these issues is provided through consultation or public hearings.

2.4 THE MICRO-POLITICAL FRAMEWORK: RADIATION HEALTH PROTECTION

Unlike many other environmental policy domains which often experience ambiguous and overlapping jurisdictional boundaries, radiation health protection policies are developed and administered by very few government departments and agencies with limited jurisdictional overlap. The policy sector, therefore, is relatively small. This characteristic is extremely significant to radiation health protection in Canada in that there is little or no inconsistency among policies administered by different departments, in terms of the assumptions, calculation methods, and acceptable risk factors which underpin them. From emission limits for nuclear power stations to drinking water guidelines, recommended public exposure limits are consistent and rely on the same international studies and assumptions.

2.4.1 The Policy Sector

At the core of radiation health protection policy in Canada is the Atomic Energy Control Board (AECB). The AECB is a federal regulatory agency directed by Natural Resources Canada (formerly Energy, Mines and Resources Canada). It receives its authority from the *Atomic Energy Control Act* which specifies that the agency oversee all health, safety, security and environmental matters relating to nuclear energy development and production in Canada (Government of Canada 1993). The AECB holds exceptional autonomy over nuclear power regulation such that Canadian nuclear power facilities are exempt from mandatory compliance with essentially all other environmental emissions policies administered by Environment Canada or the provincial environment ministries (AECB Official 1996).

As Figure 2.1 illustrates, this scenario contrasts with the U.S. situation in which the Nuclear Regulatory Commission (NRC), the Environmental Protection Agency (EPA), and the Department of Energy (DOE) under the *Atomic Energy Act* all have regulatory authority over some aspect of the nuclear operations and emissions control policy domain. In contrast to the Canadian regulatory framework for emissions, the U.S. EPA has a mandate to regulate environmental contamination including radiation. Moreover, other nuclear industry related regulation is also divided between the NRC and the DOE. The NRC is responsible for

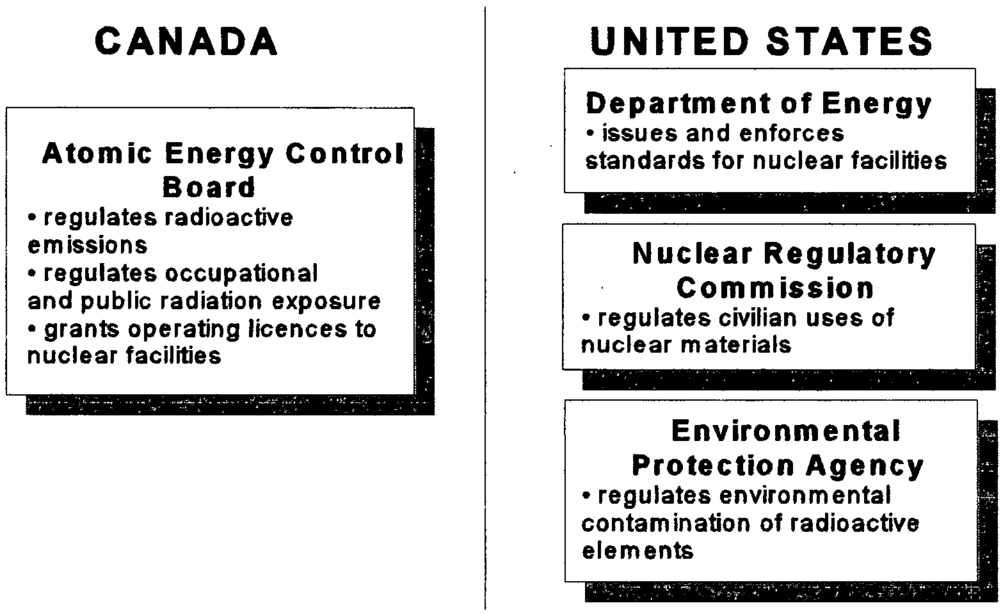


Figure 2.1: Canadian and U.S. Federal Nuclear Regulatory Agencies

regulating civilian uses of nuclear materials while the DOE issues and enforces safety and emissions standards for nuclear facilities. A U.S. General Accounting Office report (1994) suggests that overlapping regulatory jurisdiction between the Environmental Protection Agency (EPA) and the Nuclear Regulatory Commission (NRC), and a lack of coordination and agreement among departments as to what constitutes an acceptable risk to the public, is responsible for the discrepancies among policies.

Under the authority provided by the *Atomic Energy Control Regulations* to grant operating licences to nuclear facilities, the AECB regulates public exposure to radioactive emissions. As a condition of licence for a facility, the Board imposes a "derived emission limit" (DEL)--in the form of a binding regulation--on the release of radioactive materials into the environment. This DEL is calculated according to the criterion that the most exposed member of the general public will receive an expected dose of no more than the fixed legal limit of radiation from all pathways. DELs are calculated on an individual plant basis, and as a precondition to the licence, the plant must undertake a full analysis of potential pathways for general public exposure. Once the pathways are identified, the DEL is set such that public exposure will not exceed a specified annual legal limit.

Health Canada's role in the policy sector is primarily to provide research support and policy advice to the other government departments and agencies which hold jurisdiction to develop policies on matters relating to the protection of human health. This function is carried out specifically by the Radiation Protection Bureau. Research scientists at the Radiation Protection Bureau work cooperatively with research scientists at the AECB to develop the health based criteria which underlie the Board's regulations (AECB official). With respect to drinking water guidelines, they provide the most influential recommendations as to appropriate radiation parameters in the federal CGDWQs (Health Canada official); this policy in turn functions as policy advice to the provinces in developing their own guidelines. The radiological parameters of the GCDWQs are derived on the assumption that most people will received ten percent of their total annual dose of radiation from drinking water. Consequently, the annual allowable dose of radiation, on which the radiological drinking water guidelines are based, is one tenth of the annual legal limit specified in the *Atomic Energy Control Regulations*.

As was discussed earlier, the provincial and territorial governments hold jurisdiction to set policy with respect to drinking water quality. For the most part, however, the federal recommended guidelines are unquestionably adopted into policy as guidelines for municipal water treatment facilities. Each jurisdiction does, however, possess the authority to adopt a

Table 2.1: The Policy Sector for Radiation Health Protection in Canada		
GOVERNMENT AGENCY	*FUNCTION*	*POLICY*
Atomic Energy Control Board	Regulation (binding on nuclear power facilities): • public exposure from emissions • occupational exposure • radioactive emissions • environmental impacts Research	*Atomic Energy Control Regulations*
Health Canada	Research Policy recommendation	*GCDWQ*
Ontario Ministry of Environment and Energy (and all other provincial Environment Ministries)	Regulation (non-binding on water treatment facilities): • public exposure by drinking water pathway	*ODWO* (in Ontario)

policy which differs from the federal guidelines. An overview of the radiation health protection policy sector is provided in Table 2.1. The allocation of jurisdiction and function in this policy sector has remained remarkably consistent over the last twenty years, during the period of this study.

2.4.2 Bipartite Bargaining As Policy Style

Where the concept of "political culture" describes a decision making environment in terms of the institutional and procedural arrangements of the political system as a whole, the concept of policy (or regulatory) "style" describes, similarly, these arrangements in a specific policy domain. Hoberg (1993, 310) describes this concept as "a package of interests, institutions, and ideas" forming the political context for decisions. The interests referred to are those of groups in society which actively participate in the process of policy development. In a closed decision process, interests may be limited to government agencies and organized business. In an open process, environmental and citizens groups may be included. Institutions include all relevant government agencies or departments, "including the rules that govern their operation and the capacity they embody." And finally, the ideas referred to are the political values and philosophies which guide regulators in deciding what a policy should look like, and what formal process should be employed to develop it. These variables define the political norms of policy development. They also reflect certain aspects of the broader political culture.

As was discussed earlier in this chapter, new government agencies and legislation formed abruptly in the early to mid-1970s in response to the environmental movement of that period. The policy style which would describe most environmental policy domains in Canada then, and many risk management domains still today, best resembles Hoberg's "bipartite bargaining" model. As he explains,

> This policy style is characterized by closed, co-operative negotiations between government departments and industry. For the most part, environmentalists were excluded from this bargain because they lacked the organizational sophistication and clout to inspire state officials to invite them into the process. They also lacked the legal and procedural rights to pry the doors open (Hoberg 1993, 314).

By way of comparison, the legal framework for risk management in Canada provides regulators with more discretion and fewer procedural requirements than does the U.S. framework. Harrison and Hoberg (1994) explain that where the U.S. *Administrative Procedures Act* forces decision makers to respond pro-actively to potential critics, the absence of any comparative legislation in Canada has allowed decision makers to resist demands for public involvement and avoid comprehensive evaluations of policies by groups external to the policy development process.

The key players representing interests in this style of decision making are government, as representative of environmental and public interests, and industry for economic concerns. "Industry" in the context of radiation health protection policy, however, is unique. It is primarily anthropogenic sources of radiation which have the potential to approach recommended limits in drinking water although uranium ore may, in some geographic areas, contaminate groundwater. Tritium, a hydrogen based radionuclide which cannot be removed from water, is the most significant emission from nuclear stations which is likely to affect drinking water. Because any changes to radiation health policy involving tritium may have implications for allowable emission levels, it is the Canadian nuclear industry, particularly in Ontario, which represents economic concerns. Atomic Energy of Canada Limited (AECL) is a crown corporation which manufactures and sells nuclear reactors in Canada and abroad. It is owned by the same level of government which is also responsible for regulating its operations, including radioactive emissions based on public exposure limits. Both air and water borne emissions are regulated independently of drinking water by the AECB. Moreover, Canada's nuclear operators are also crown owned at the provincial level. This unique relationship between government and industry, in which government has both a political and an economic stake in the success of that industry, calls into question the ability of government agencies to fairly and adequately represent social and environmental interests in the bargaining process. Confidential and exclusionary decision processes, especially in such cases as this where the interests of government and industry overlap, preclude an important and effective system of checks and balances and leave greater opportunity for significant concessions to industry by government agencies.

Although the role of AECL and the nuclear utilities is not explicit in the decision making processes for radiation health protection policies, both of these groups support and endorse the risk information and recommendations provided by the international scientific community. International research agencies such as the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and the United States National Academy of Sciences' Committee on the Biological Effects of Ionizing Radiation (BEIR) study the effects of ionizing radiation on human health using data primarily from the survivors of the Hiroshima and Nagasaki nuclear bombings in Japan in 1945. These agencies' findings are in turn used by organizations such as the International Commission on Radiological Protection (ICRP) and the World Health Organization (WHO) in formulating recommendations as to protective policies in this domain (MoEE 1993). These recommendations form the basis of radiation health policy in Canada and other industrialized nations.

Under the political, institutional and cultural frameworks which characterize traditional radiation health protection policy making, decision makers have enjoyed prolonged insulation not only from public involvement, but also for the most part, from effective opposition and scrutiny. In explaining such exclusivity in decision making, Atkinson (1993, 37) asserts the following:

> Some policy domains seem to be relatively insulated from external political forces. In these domains public officials are not under heavy obligations to consult or to compromise with other political actors. Policy choices seem to be a function of the distribution of power within state organizations rather than the organizational capacity of societal forces.

As was discussed earlier, both the power to govern, and the expertise to consult, on radiation health issues is unambiguously concentrated at the federal government level. Provincial jurisdiction to regulate drinking water quality has traditionally done little to weaken federal authority in this area. Similarly, over the last twenty years, as the organizational capacity of environmental groups has improved such that they achieved some success in gaining access to the decision making arena in other environmental policy domains, radiation health policy remained relatively impermeable. Even public inquiries into nuclear power policy issues--the Porter Commission in 1975 and the Ontario Nuclear Safety Review in 1987--were extremely limited in scope, and did not provide for extensive public debate regarding the assumptions and methodologies followed in developing health based policies (Dooley and Robinson 1987; Fraser 1990).

2.4.3 Drinking Water Policy

Radiation health protection, of which drinking water is a sub-component, is the primary policy domain being examined in this study. However, drinking water policy in Canada also crosses into the domains of chemical and microbiological health protection. An entirely different set of institutions, actors, and political nuances characterize the development of these other parameters. However, these are outside the scope of this study and have only a limited bearing on how radiological parameters are set. Drinking water quality, therefore, is a policy issue unique within the broader policy domains of radiation, chemical and microbiological health protection. This relationship is depicted in Figure 2.2 below.

Some questions relevant to determining radiological parameters in drinking water are germane to radiation health protection policy generally and because of the high degree of cooperation and coordination among agencies in the policy sector, these questions are

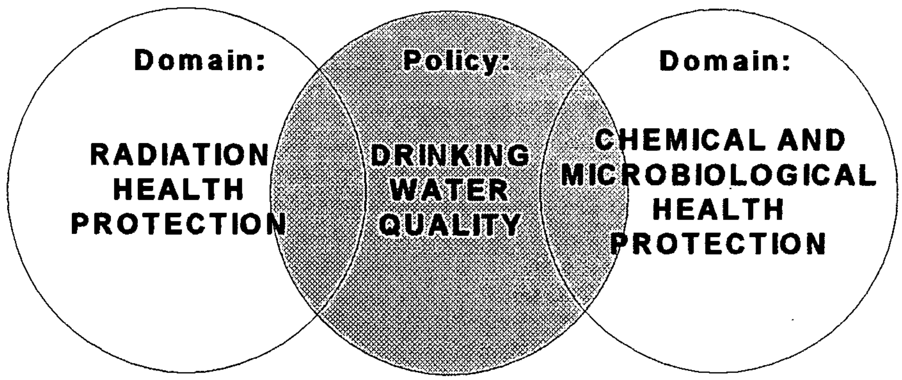


Figure 2.2: Political Context for Drinking Water Policy in Canada

answered consistently across policy issues. These include matters such as what constitutes an acceptable risk factor, and at what level the maximum dose limit of radiation should be set at. However, some questions are specifically relevant to drinking water policy such as what proportion of the maximum dose limit of radiation should be permitted from this pathway of exposure in order to keep the total dose from all pathways at or below the maximum limit. For the most part, nevertheless, answers to the core questions pertinent to this policy precipitate down from the assumptions and recommendations of other policies in the domain. Drinking water policy is an expression, therefore, of radiation policy generally and does not depart significantly from the core philosophy.

2.5 DRINKING WATER GUIDELINES IN THE RADIATION HEALTH POLICY FRAMEWORK

The cultural, political, and institutional variables which influence the development of radiation health protection policy, described in the previous sections, provide a useful conceptual model of the decision framework in this policy domain. The model, depicted in Figure 2.3 below, highlights the key characteristics discussed in the previous sections and emphasizes the importance of the whole political system in shaping policy decisions. The establishment of radiological parameters for drinking water policy is a function of technical debates which occur primarily among government official and scientists. The mood is cooperative and little opportunity exists for outside interests to challenge assumptions or methodologies (Health Canada Official (d) 1994). This framework has persisted throughout the history of radiation health protection policy making and has only recently been disrupted with the introduction of public involvement in Ontario's review of its tritium parameter.

POLITICAL CULTURE: CANADIAN ENVIRONMENTAL POLICY
• informal, confidential, consultative, cooperative processes
• centralized accountability
• internal debate of policy issues

POLICY DOMAIN: RADIATION HEALTH PROTECTION
• small policy sector
• concentrated and unambiguous jurisdiction
• expertise at the federal level
• exclusivity in policy development
• bipartite bargaining policy style

POLICY ISSUE: DRINKING WATER QUALITY
• adoption of federal recommendations

Figure 2.3: Socio-political Framework for Radiation Health Protection Policy

2.6 THE TREND OF INCREASING PARTICIPATION IN ENVIRONMENTAL DECISION MAKING

The decision framework for radiation health protection in Canada has remained remarkably consistent throughout the period of this study. Moreover, the approach to decision making, where science plays a central role in a closed, confidential process of policy development, remains dominant. However, this particular policy domain is not representative of what has been happening in environmental decision making more generally. In the decade following the "first wave" of environmentalism, economic issues usurped environment on the political agenda. Yet in the late 1980's, when environment and health protection re-surged as important political issues (Hoberg 1993; Paehlke 1992), decision makers were confronted not only with a renewed interest in the issues, but with intense public pressure to change the processes whereby environmental policies are formulated (Doern 1990).

Undertaken in the mid-1970s, the Berger Inquiry is often held up as the cornerstone for public involvement in environmental decision making in Canada (Doern 1990; Jasanoff 1986; Salter and Slaco 1981). During this inquiry into the potential effects of building a natural gas pipeline in the Arctic, input was solicited from the residents of potentially affected communities, and the project was ultimately blocked. Although subsequent inquiries into risk management concerns were not always as influential--given the weak advisory nature of these types of processes generally--they became a very popular means of addressing the concerns of a diverse range of interests on controversial policy issues. By the late 1980s, public involvement had also become apparent in other decision making styles. These include "multipartite bargaining" processes such as stakeholder consultations, round tables and task force committees which aim to develop policy on the basis of some form of consensus among the members. Another example is the policy style of "legalism" in which the Canadian judiciary is (uncharacteristically) brought into the policy debate by the public to interpret environmental legislation (Hoberg 1993). This style emerged in recent years as a potentially efficacious participatory approach for many environmentalists when such precedent setting court cases as those involving the Rafferty-Alameda Dam in Saskatchewan and the Oldman River Project in Alberta found the federal government negligent in following its own environmental assessment legislation (Doern 1990). In all of their different forms, decision making processes which involve the public are becoming increasingly utilized across North America and Europe (Jasanoff 1986).

The impetus for change appears to involve three significant changes, occurring over the period between the first and second waves of environmentalism, within the social context of political decision making on the environment. These changes have resulted in what Hoberg (1993) terms a "crisis of legitimacy" facing decision makers with respect to the traditional bipartite bargaining process of decision making which traditionally characterized environmental and risk policy making in Canada during the first wave of environmentalism. The first factor appears to be a waning in public confidence that the government will adequately defend its interests against the strong and well organized interests of industry. Most risk management problems involve complex issues of distributive equity and differing value frameworks. Tradeoffs among different interest groups in society are often necessary; and how the benefits and risks of a policy are allocated has traditionally been determined by political judgement informed by scientific advice. Jasanoff (1986, 55) suggests that the public is increasingly recognizing this dynamic. Moreover, she observes that "[i]ncreasingly, citizens in the industrialized nations are reluctant to commit the resolution of such issues to the exclusive jurisdiction of experts and the state." The bipartite bargaining style of decision making, which depends on a strong state to defend public interests and a widespread perception that scientific information can and will be objective and neutral, has been blamed for the inadequate levels of environmental protection perceived to have been provided by policies developed during the first wave of the environmental movement. As Hoberg (1993, 316) explains, "[a]fter a decade and a half of experience, the idea that the state could adequately represent environmental interests. . .appeared to be a cloak concealing a system dominated by business interests."

The second factor involves a shift in the broader social concept of democracy in decision making. In addition to an apparent dissatisfaction with government performance, significant changes in public attitudes are reflected in societal values about how democracy is achieved in decision making. Nelkin (1977, 12-13), who writes in the early stages of the movement toward participation, notes that the public's sense of obfuscation by the technical complexity of risk debates fuelled demands for a more direct and effective role in the decision process. Specifically, she states that,

> [t]he declining influence of the citizen in an expertise-based society has. . .become a pervasive public concern widely interpreted as a failure in the existing system of representation. It has called for a revitalization of democratic principles and their extension to areas of sectoral and national policy where they were not formerly applied.

She notes also that the technical nature of risk policies poses unique problems for decision makers in designing participatory processes, and that government agencies have responded in a variety of ways, with various experiments in process, in order to attempt to overcome these problems.

The concept of "sustainable development," introduced by the Brundtland Commission report in 1987, had a tremendous effect on public and government perceptions of environmental protection, and also on the potential for conflicts in values, in relation to risk policy problems, to be resolved. Its central message being that business and environmental issues need not be in conflict, this concept made the success of negotiations involving a broader range of interests in society seem more feasible (Doern 1990, Hoberg 1993). Doern (1990, 2) argues that the concept of sustainable development, along with a growing list of environmental success stories involving participatory mechanisms, have focused public attention on the need to reform Canadian decision making processes. He also suggests that "the basic democratic right of Canadian citizens to be involved in public decisionmaking, whatever the issue," has pushed process reforms in the direction of a more active role for non-traditional, or lay, participants.

The third significant change involves the public's perception of the appropriate role of science in political decision making. Society's overall perception that science can "arbitrate between competing views about social policy options," by lending an objective and politically neutral perspective on the issues to the debate, has traditionally underpinned the legitimating role of science in decision making (Brunk Haworth and Lee 1991, 2). However, this perception has been diluted in society, although not entirely overcome, by the introduction of social constructivist views which challenge the legitimacy of science-based decision making in some policy domains (Jasanoff 1990). This social change is discussed in greater detail in

As Parenteau (1988, 6) indicates, "[p]articipation performs two significantly different functions: it is at once a formal procedure for bringing the public into the decision making process and a political device for obtaining public support for decisions." Consequently, from the perspective of decision makers, it can also be a useful and adaptive approach to decision making when addressing problems of legitimacy in decision making. Public inquiries have a long tradition of use in social policy development in Canada. However, they are usually conducted to elicit public responses to issues of broad public concern rather than specific public policies (Salter and Slaco 1981). Participatory approaches to developing specific policies, "conducted through specific institutionalized mechanisms belonging to decision-making and administrative processes," are a relatively recent occurrence (Parenteau 1988, 1).

Today, many distinct mechanisms for involving the public in decision making exist. The various types of mechanisms include those for which participation is compulsory under general legislation, such as environmental assessments; and others for which public involvement is more discretionary, such as project planning or policy development (Parenteau 1988). However, regardless of decision makers' obligations to involve the public, the extent to which that involvement has a bearing on the outcome of the process depends largely on the design of the approach taken. Table 2.2 depicts five classes of participatory approaches representing, from left to right, an increasing transfer of decision making power from the government agency to the public. The first two classes, Information and Persuasion, involve little or no influence on the part of the public to affect decisions. Rather, these types of approaches would best characterize government actions in relation to decisions formulated under a closed, bipartite bargaining framework. The other three classes, Consultation, Cooperation, and Control, would encompass the range of participatory approaches utilized in Canadian environmental decision making.

Table 2.2: Classes of Participatory Approaches to Decision Making (Eidsvik 1978 in Parenteau 1988)

INFORMATION	*PERSUASION*	*CONSULTATION*	*COOPERATION*	*CONTROL*
The decision is made and the public is informed.	The decision is made and an effort is made to convince the public.	The problem is submitted, opinions are collected, the decision is made.	The limits are defined, the decision is shared with and made together with the public.	The decision is made by the public, which assumes a role of public responsibility.

2.6.1 Recognizing Legitimacy in Decision Making

One of the objectives of this research is to identify the social and political factors inducing decision makers in the radiation health and drinking water policy domain to incorporate a participatory approach into their traditionally closed decision making process. The analyses of the general trend observed in environmental policy toward greater use of participatory mechanisms is useful here. Environmental decision makers are both: voluntarily adopting participatory processes because there are political advantages associated with them; and being compelled to adopt such measures, either because legislation is making it compulsory, or because the traditional exclusionary approaches are suffering for want of legitimacy. The most difficult of these explanations to identify, for explaining the introduction of public involvement in the case of a specific policy, is the problem of legitimacy. The concept of legitimacy tends to be contextually relevant and has various aspects. Therefore, how the concept is being interpreted in this context must be clarified.

There are two ways of evaluating legitimacy in decision making: in terms of actions, or in terms of perceptions. A process may be legitimate in terms of actions in that "the behaviours of institutional actors. . .are in accord with some set of established rules or principles" which govern them (McEwen and Maiman 1986, 258). However, if the governed do not perceive such adherence, or if there is disagreement as to what the rules and principles of behaviour are, then legitimacy may be elusive (Tyler 1994).

The perception of legitimacy is difficult to evaluate using a fixed set of criteria. As Williams (1994, 5) argues, "our judgments about the goodness or legitimacy of environmental policies [or by extension, policy processes] are contingent and revisable in light of their experienced consequences." He suggests that establishing legitimacy is an iterative and ongoing process of learning. However, Tyler is helpful here in that he suggests that there are certain broad categories of judgments about the actions of decision makers which form the basis of public perceptions of legitimacy. He explains that,

> [s]everal types of judgments about the actions of authorities potentially underlie public judgments about their legitimacy, including (1) agreement with the policies and decisions and (2) judgments about the fairness of decisionmaking procedures (Tyler 1994, 810).

These parameters define how the concept of legitimacy with respect to public perceptions is being used in the context of this study.

Chapter Three

SCIENCE AND PUBLIC POLICY

3.1 DEFINING "SCIENCE"

"Science" is an extremely difficult term to define. It represents a range of meanings in varying social contexts. Consequently, establishing any agreed upon set of delineations between science and non-science would be elusive. In any case, defining science narrowly is less valuable, in terms of understanding its different roles within society, than is recognizing the full range of contextual meanings. For example, disciplinary, or academic science traditionally plays an important social role as a practical means of generating and disseminating knowledge within society. This branch focuses on trying to explain the range of phenomena observed as the processes and interrelationships in our natural and social systems. However, more contemporary roles include policy-oriented science, which serves to provide direction in the making of social decisions, and product-oriented science, where research is directed at fulfilling economic needs.

For the purposes of this study, science is understood to encompass the full range of social roles. More specifically, however, it is recognized as a concept with two main aspects: process and product (Pickering 1992). Consequently, the term refers to both the activities involved in generating knowledge, and the actual information which it provides. Both the processes and the products of science aim to follow a set of established and accepted norms. These norms can vary depending on the role that science plays in a particular context. Moreover, these norms need not be universal. Although the scientific peer community plays an important role in establishing standards within traditional disciplinary sciences, other groups in society may recognize non-traditional norms. Consequently, informal origins of knowledge, such as indigenous learnings and lay expertise, may also be recognized as forms of science.

3.2 POSITIVIST SCIENCE AND EARLY ENVIRONMENTALISM

Disciplinary science played an important role in the social-political dynamic of the "first wave" of environmentalism in the early 1970s. Environmentalists, in their attempts to draw public and governmental attention to environmental issues, relied heavily on scientific arguments to popularize these issues and relay a sense of urgency with respect to the need to take action. Similarly, in responding to the pressures of a rising social consciousness, government agencies relied equally resolutely on science to provide credible policy direction, and to support policy choices (Harrison and Hoberg 1994). Scientists were highly regarded in society as principled and disciplined professionals (Brunk et al. 1991). And although support for environmental concerns waned somewhat in the latter half of the 1970's, an integral role for both scientists and scientific information had been firmly established within the political framework for policy development on the environment (Benveniste 1977).

The dominant social perception of science during the early environment movement was essential in defining its ultimate role in the political framework. This perception is founded in the widely held belief that scientific methodologies seek to uncover "facts" about natural processes, and that their implications for society are rational, objective and detached from partisan motivations. This "positivist" (Edge 1995) perception separates technical elites from the rest of self-interested society and paints them as altruistic and neutral in a political context. Positivist science takes a deductive approach to inquiring about natural processes (Popper 1993). The process of doing science is experimental, methodological, and it is assumed that subjective elements may be controlled or eliminated through process structure and the rigorous tradition of peer review (Ravetz 1996). According to this view, the products of scientific inquiry provide objective truth and hence a neutral basis for resolving policy disputes.

The bipartite bargaining style of policy development, which historically characterizes radiation health protection policy in Canada, is congruent with the application of a positivist approach to studying environmental problems. With a bipartite style, public interests are assumed to be represented by the governing agency (Hoberg 1993). Further, any disputes arising out of conflicting interests are resolved by referring to the recommendations of scientific experts. During the early stages of environmentalism, scientists were widely thought capable of solving technology-induced problems with the same precision and leadership as they had demonstrated with the many technological achievements of this century. This perception was extremely important in shaping the social-political context in which risk management decision processes and policies would evolve.

Science was (and still is) an important basis of policy legitimacy, particularly under conditions involving high uncertainty and significant cost allocations in society. Citizens place an enormous amount of trust in the scientific community to adhere to a proper code of ethics in their work and to form balanced and objective judgements. This trust is not generally extended equally to political decision makers. Consequently, the risk management decision framework described earlier, in which decision makers relied almost exclusively on scientific experts for policy advice, was congruent with public expectations on the whole, especially at this early stage of the environmental movement.

3.2.1 Mandated Science

The positivist perception of science affected the evolution of both the practice and the application of science in political decision making. In general, science undertaken in a disciplinary or academic setting follows from a certain set of assumptions and procedures which have evolved through practice and have been deemed acceptable by the established peer community. Ideally, scientists in this framework study natural systems in order to further their own and society's understanding of how these systems function and how they are impacted by anthropogenic activities. They seek to fill voids in contemporary knowledge. Moreover, it is assumed that their work is undertaken independently of political or economic interests although it is recognized that any relevance the work may have in this regard plays an important role in the ultimate allocation of research funding.

In contrast, scientific work assumes a unique character when undertaken and applied in a political context. Because of the extent to which scientific information is relied on to both explain and lend credibility to risk policy decisions, science has in many cases become prescriptive. The time frame within which the public demands some form of regulatory action in relation to a potential risk often defies the normal schedule of disciplinary research (Harrison and Hoberg 1994). Moreover, scientists are often asked to answer questions which extend the results of their research well beyond what would normally be acceptable. These types of inferences, often called expert judgements, are in many cases comparably weighted with the actual study results in policy decision making. Salter (1988, 3) has termed this policy focused work "mandated science." She explains that "the term 'mandated' refers most particularly to the pressure being placed upon science and scientists to reach conclusions that can lead to public policy or government regulations." The objectives, methods, and framing of results for this type of scientific work are focused specifically on resolving issues of public policy. Both in-house government research, industry funded policy-oriented research and academic research which is then taken and applied to a policy issue assume the characteristics of mandated science.

Salter contends that this socio-political context tends to alter the conduct of scientific activity in four key ways. First, the prominent political role idealizes science such that the extent of uncertainty and conjecture are often de-emphasized. Second, science must conform not only to disciplinary norms of process and ratification but legal and political norms as well given the context in which it is applied. Third, any debate of scientific information must address issues of fairness and democracy. Consequently, scientists must be conscious of the diversity of social values respecting the issues in question. And fourth, scientific work must address economic, political and social questions in addition to scientific ones, recognizing that tradeoffs among these areas of public concern will likely ensue as a result of any policy recommendations made (Salter 1988). Mandated science bridges the realms of disciplinary science and political decision making. Consequently, technical and political questions tend to be blurred and are often inseparable.

Salter argues further that although mandated science relies on the perception that it adheres to the positivist norms and procedures of disciplinary or academic science, it very often defies this ideal. Political values can influence the interpretation of results, the process of peer review and consensus is often absent, and the facts and recommendations asserted often purport to be more conclusive than the level of uncertainty would otherwise warrant. These qualities tend to diminish the reliability of the results relative to science undertaken in accordance with disciplinary norms. However, during the "first wave" of environmentalism, mandated science in support of risk management was central to virtually all policy decisions. In fact, it had already assumed various formal and specialized structures.

3.2.2 Risk Assessment

Risk management is a unique area of environmental policy making. It involves what is often described as a two step process. The first step, risk assessment, is in very basic terms a process of deriving a probabilistic estimate of harm from some hazard. Human health risk assessment occurs in two key stages: hazard identification and dose-response assessment. Hazard identification is the stage at which a relationship is identified between exposure to a toxin and some adverse health effect. Dose-response assessment then seeks to establish the approximate nature of the relationship between exposure and effect (Cranor 1993, 13). In the case of radiation health effects, both human and laboratory animal exposure data are used (Health Canada Official 1994). The second step, risk management, involves evaluating the social and political issues surrounding that risk in order to assess what amount is acceptable, and designing policies which keep the level of risk in society below that amount.

According to Salter's definition, risk assessment is a form of mandated science. As the pressure on decision makers to develop policies to respond to technological risks has increased over the last few decades, formal models and partially standardized procedures for conducting risk assessments have evolved, creating a field of study which resembles a professional discipline (Golding 1992). As Hattis and Kennedy (1990, 157) explain, however, the discipline is relatively new, dating back only to the 1970s, and "there is no consensus on which basic rules and procedures to apply in solving particular problems." Therefore, it lacks the formal cultural framework of traditional disciplinary science which provides for community consensus and peer review.

Risk assessment has evolved as a tool for decision making on the presumption that matters of fact and matters of value can be distinguished from one another. Its usefulness as such, in lending legitimacy to risk management policies, stems from the broad conception that risk problems are primarily technical. Brunk et al. (1991, 3) explain that "[t]he more closely [risk assessment] methodologies can approach the ideal of 'science,' the more they are thought to provide that objective and impartial decision procedure which can serve as the neutral arbiter in the liberal, democratic society." Regardless of whether one ascribes to the positivist view of science, its dominant place in society during the early stages of environmentalism has defined how the current political approach to addressing risk problems has evolved. It is a philosophy which has guided the development of risk management decision processes and policies in Canada throughout the last twenty years, and is particularly evident in the policy development procedures affecting radiation health protection, as will be illustrated by the case study.

3.3 FROM POSITIVISM TO SOCIAL CONSTRUCTION: AN EVOLUTION

It is interesting to note that the time frame which links the first and second waves of environmentalism parallels an intellectual evolution in thinking about the extent to which social and cultural factors influence scientific activities and hence call into question some of the assumptions of detachment and objectivity which underlie the positivist view. Jasanoff (1990, 12) notes, of the advisory role that scientists perform in policy development, that,

> [t]he idealized picture of science from which the advisory process has traditionally drawn its authority has come under attack not only from political scientists and policy analysts but from a thriving area of scholarship that has abandoned the notion of science as a representation of objective reality in favour of a closer inquiry into the social processes by which scientific knowledge is produced or "constructed."

In the 1970's, the "sociology of scientific knowledge" (or SSK) emerged as an amalgam of academic disciplines focused on developing "an empirically informed view of the social nature of scientific knowledge" (Edge 1995, 7).

The SSK scholarship interprets the practice and the products of science very differently than does the positivist tenet. Social constructivist theories of science argue that social and cultural forces shape both how the practice of science is undertaken and how it is ultimately accepted as true and absorbed into the social knowledge base. In contrast to the positivist view which relies on presumptions of objectivity and rationality in scientific approaches, social constructivism acknowledges that social factors, and often political influences, necessarily affect how scientific assumptions and judgements are made, and how the actual results of scientific studies are interpreted. The relationship between science and society--especially politics--has been a key area of interest in the emerging fields of science studies. However, only a few key concepts will be reviewed here. These provide some theoretical guidance in understanding possible cultural forces underlying the observed trend in risk management decision making toward greater public involvement.

One very important axiom which underlies the social constructivist view of science is that facts do not become such simply by virtue of being born out of formal scientific methods. Rather, truth and knowledge are the products of extensive social discourse and ratification through known and accepted channels. As Jasanoff (1990, 12-13) explains:

> We regard a particular factual claim as true not because it accurately reflects what is out there in nature, but because it has been certified as true by those who are considered competent to pass upon the truth and falsity of that kind of claim. Social construction begins in the laboratory, where most scientific claims originate.

Recognizing this process, it is possible to comprehend how unofficial or unconventional sources of information may be rejected outright regardless of the approach taken to acquire that information. Members of the public generally have very little technical understanding of environmental and risk problems. Instead, they rely on the media which generally perpetuates the social process of fact ratification by referring to the known and accepted scientific community when verifying information (Nelkin 1987).

Another important and related axiom of social constructivism is that facts are dynamic, responding to forces both inside and outside the scientific community. A fact, defined as an item of accepted or verified knowledge (Oxford 1993), may become accepted through a complex social process, but can be easily displaced if a conflicting theory successfully undergoes the same social process. Moreover, as Callon (1995, 49) suggests, "[s]cientific knowledge. . .[is] organized and structured according to different and changing social configurations." Current events, funding considerations, or other exogenous political events can shift emphasis to or away from specific issues, affecting their perceived relevance, or even how research in that area is approached.

Some theorists have discussed how certain facts become "stabilized." That is, how scientific information is able to maintain its factual status in society. For example, Watson-Verran and Turnbull (1995) recount Star's suggestion that as theories in science "clot," or become widely accepted and used, what is implicit is an equal social commitment to the values which underlie those theories. They explain further that in cases of extreme "clotting," theories can become, in Latour's terms, "black boxes" such that the underlying values are not only widely accepted, but unquestioned and essentially invisible in the theory's application. These processes are particularly telling of the extent to which social dynamics are involved in creating and maintaining knowledge on certain issues.

Acceptance of a social constructivist view of science has significant implications for considering the role that science plays in political decision making. If not the providers of a neutral, objective point of reference on which to develop environmental and health protection policies, then scientists must also be actors with interests in the outcome of the policy process beyond simply expressing factual information. Consequently, the political, economic and value-based influences under which scientific information was generated and presented must be considered and reflected in policy.

3.4 THE LIMITATIONS OF TRADITIONAL SCIENCE-BASED POLICY MAKING

One theme which is recurring in social constructivists theories is the suggestion that a policy decision making framework designed around and dependent upon widespread acceptance of a positivist approach to environmental problems is not congruent with the realities of contemporary risk problems. The environmental and health risks associated with a modern industrial economy stem from complicated interactions between human and natural systems. Moreover, the aim of many risk policies is to manage, or achieve a "fair" level of risk in society rather than to eliminate the hazard. This objective requires that policies be guided by some social value framework. Risks may be disproportionably distributed among a population such that geography, demographics, economics, or temporal factors disadvantage certain groups. Moreover, there may be ethical issues underlying the acceptability of a risk which are irresolvable by formal risk assessment techniques. Consequently, a traditional science-based approach to problem solving has extreme limitations.

A predominantly technical approach to designing risk policies ignores the inherent complexity of the often overlapping social and technical dimensions of risk problems. One such complexity is the extent to which scientific information is uncertain, and hence fairly reflective of the true relationships among factors relevant for public policy. Wynne (1992, 114-115) provides useful insight into why different types of uncertainty in science must be acknowledged and cannot be treated equally. He defines four broad categories of uncertainties. The first type of uncertainty, which occurs when the parameters which define a problem, and the relationships among them, are fairly well known, is "risk." In this case, although information is incomplete, "the system behaviour is basically well known, and chances of different outcomes can be defined and quantified by structured analysis of mechanisms and probabilities." This is the type of uncertainty which is often assumed to characterize risk problems when the decision making framework is defined by a positivist approach. In the case of radiation health protection, it is assumed that the information on human health responses to exposure to radiation (dose-response relationships) obtained from the survivors of the Hiroshima and Nagasaki nuclear bombings, because it involves human data, is extremely reliable. Moreover, the issue of uncertainty was addressed by applying what are assumed to be conservative assumptions to the methods of estimating risk in order to compensate for any discrepancy between the estimated risk and the true value. One such assumption is the linear no-threshold hypothesis which assumes that dose-response relationships measured at high doses of radiation exposure can be extrapolated to apply similarly at low doses of exposure (Health Canada Official 1994).

However, as Wynne explains, the uncertainty associated with risk estimates cannot always be accurately explained in this way. The second type of uncertainty is one which he labels "uncertainty." This occurs when the parameters which define a risk are known, but the probability distributions are not. This type would characterizes health risk problems in which some relationship between a toxin and a health effect is suspected, however, not enough is known about the relationship to associate probabilities with exposure levels. Third, Wynne describes "ignorance," which occurs when the parameters of a risk are either not known at all, or are not acknowledged because scientists are committed to a known yet perhaps inappropriate approach to examining similar risks. As Wynne (1992, 114) suggests, "we don't know what we don't know." In relation to a health risk, this type of uncertainty would characterize a case in which a relationship between a toxin and a health effect is unknown, but because scientists can relate this case to a relationship for which the toxin and effect are known, the ignorance is not acknowledged and the wrong types of assumptions may be made.

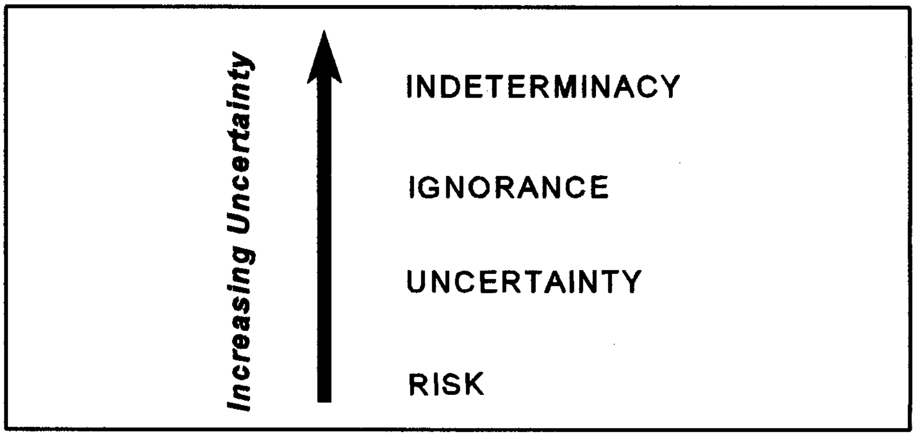


Figure 3.1: Wynne's Categorization of the Types of Uncertainty

Finally, Wynne's fourth category of uncertainty is "indeterminacy." This type of uncertainty would characterize a health risk problem for which not enough is known about the relationship between a toxin and a health effect to assess whether the scientific method used is even capable of discerning one. In this case, the social commitments to known methodologies make it unclear whether it is the approach which validates the knowledge gained, or rather if knowledge, by fitting an approach, serves to validate the approach. These categories can be thought to lie on a continuum of increasing uncertainty as Figure 3.1 depicts.

Given that the social significance of risk problems can also vary considerably by case, Funtowicz and Ravetz (1993, 744) contend that a positivist approach is not sufficient to address the full range of uncertainties. Instead, they propose a model of three alternative approaches to risk problems which call for science to undertake different roles in the social decision making process as would be appropriate given both the level and type of uncertainty, and the degree of social importance of the issue. The three approaches are represented on a two dimensional graph (Figure 3.2) in which one axis shows the "intensity" of "systems uncertainties" and the other shows the intensity of the "decision stakes." These variables are explained as follows:

> The term 'systems uncertainties' conveys the principle that the problem is concerned not with the discovery of a particular fact, but with the comprehension or management of an inherently complex reality. By 'decision stakes' we understand all the various costs, benefits, and value commitments that are involved in the issue through the various stakeholders.

The model makes explicit those variables which positivist science tends to downplay. The authors argue that acknowledgement of social factors, along with the limitations of traditional scientific approaches, improves the "quality" of scientific work in that the methodological approach to understanding the risk will be better suited to the nature of the problem including both its natural and social dimensions. This in turn improves the ability of decision makers to effectively manage particular risk problems.

A brief overview of the model is as follows. If both the uncertainties and the decision stakes are low, then a traditional disciplinary approach to analysing the risk is appropriate. Funtowicz and Ravetz term this approach "applied science." In these cases, the uncertainties fall into Wynne's "risk" category of uncertainty such that the risk "system" is fairly well known. Also, the probability of there being significant value conflicts in society is also low; therefore perspectives on the appropriate management strategies are not likely to vary considerably. If both the uncertainties and the decision stakes are moderately high, professional judgements must necessarily be invoked to supplement traditional scientific methods, which may be in question or are otherwise uncertain. Also, decision stakes may be higher because risk policies could potentially affect an individual or organization's interests.

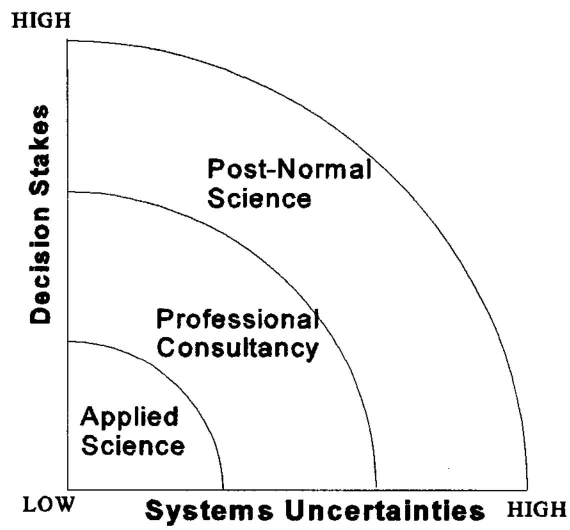


Figure 3.2: Alternative Approaches to Risk Management Problems (Funtowicz and Ravetz 1993, 745)

This approach is termed "professional consultancy." And finally, "post-normal science" is a term which applies to the approach to risk problem solving which would be most appropriate when either uncertainties, decision stakes or both are high. In these cases, uncertainties are in the realm of ignorance and indeterminacy (Wynne 1992). Moreover, the decision stakes may be characterized by a myriad of values interests and perspectives among different groups in society. This approach is described as "a type of science, and not merely politics or public participation" (Funtowicz and Ravetz 1993, 744). With these types of problems, policies cannot, by definition, rely on scientific certainty to provide the underpinnings of legitimacy and public acceptance. Instead, uncertainties and values dominate the issues of importance. Traditional disciplinary science is not capable of providing a neutral and objective basis for resolving either the uncertainties inherent in the risk problem or the complex social dynamics which surround it. Resolution of conflicts must be achieved through debate, conjecture, bargaining, and in many cases, concessions.

3.5 DIFFERING INTERPRETATIONS OF THE ORIGINS OF POLICY CONFLICT

Although the "crisis of legitimacy" which befell environmental policy development approaches in the late 1980s may be partly explained by a parallel slow breakdown in the positivist perception of science in society, social constructivist theories about the appropriate role of science in decision making are clearly not universally accepted. Controversy over risk management policies, and the apparent push for more public involvement in decision making, do not appear to be sending clear signals regarding what type of reforms to the traditional science-based decision making approach are needed. Decision makers, scientists, and individuals and groups in the public sphere apparently perceive the nature of these conflicts differently. This divergence has important implications for reforming decision making processes.

Robinson (1992, 241) suggests that the political changes of the late 1980s are interpreted differently by groups in society with different value frameworks. He identifies three classes of perspectives on the problem: the classical view, the neoclassical view, and the critical view. The classical view is held by those who continue to ascribe to the tenets which underlie the positivist perception of science, and believe that the traditional science-based approach to policy development is most appropriate. Risk problems are perceived as primarily technical. Consequently, risk assessment--formal and quantitative--is viewed as distinct from management. Moreover, conflicts over policy are believed to arise when "objective" measures of risk, rendered through formal quantitative methods by qualified experts, are not reflected in reactions of the public and decision makers who rely on "perceived" evaluations of risks. Robinson explains that those who hold this view, would prescribe "better education and communication" involving "a one-way flow of neutral scientific information, through which the public and politicians will become educated about what the risks really are," as the best means of resolving conflicts over policy.

The neoclassical view, although accepting of the same positivist tenets on the appropriate role of science in decision making, differs from the classical view in that it recognizes the inescapable political importance of perceived risks in the realm of decision making. Those who hold this view would agree that much of political conflict over policy is rooted in the failure of many risk perceptions to echo objective measures; however, the solution is thought to involve an education approach which utilizes a more interactive dialogue between technical experts and the lay public. As Robinson explains, "[t]his is done by increasing public involvement in the interpretation of risk assessment analysis which is still, however, assumed to provide information as to the true 'objective risks'." According to this view, the push for more public involvement in decision making is not an indication that the science-based approach is inappropriate, but rather that a more interactive approach is necessary if perceived risks, which play an important role in the political realm, are to become more reflective of reality.

Finally, the critical view questions the extent to which risk problems are technical in nature. Those who hold this view would suggest that although there is a technical and quantifiable dimension to risk problems, there is also a very important social dimension which involves "critical issues about control, legitimacy, trust, credibility, and appropriate decision making processes" (Robinson 1992, 242-44). These issues are perceived to be at the root of conflicts over risk. Moreover, this view suggests that the scientific community will resist recognizing the extent of the non-technical dimensions of risk problems because both their practical and social interests, in terms of their role and status in the decision process, is very much "tied up with the view of science as value-free and objective." The implication of this perspective is that science cannot be isolated in the policy process, and that to do so would perpetuate a bias toward the business interests predominantly upheld by a science-based approach. Robinson suggests that what is required is "a plurality of scientific analysis," and recognition that risk problems are not purely technical. This is best achieved through a process of "policy learning," such that science (usually mandated science) is used in a process of decision making not as a source of objective truth, but as a tool in a process of "mutual

Table 3.1: Robinson's Classification of Views on Conflicts Over Risk Policies

VIEW	*PERCEIVED PROBLEM UNDER-LYING CONFLICTS OVER POLICY*	*PERCEIVED BEST APPROACH TO RESOLVING CONFLICTS*
"Classical"	• inability to reconcile public perceptions of risk with "objective" measures	• public and decision maker education • better risk communication
"Neoclassical"	• inability to reconcile public perceptions of risk with "objective" measures • political process is "irrational"	• interactive education • public involvement in the interpretation of objective risk assessments
"Critical"	• control, legitimacy, trust, credibility, appropriate decision processes • practical and social interests of scientists	• "policy learning" among policy makers, scientists and the public • science is a tool for understanding policy issues, not a source of objective truth

learning among scientists, policy-makers and the public." This approach is thought to provide a decision making framework more accommodating to a broader range of interests in society, and more reflective of the politically complex and uncertain nature of contemporary risk problems.

3.5.1 The Relationship Between Knowledge and Political Power

Canadian political culture, and the decision framework for risk policy development discussed in the previous section, foster exclusivity in risk management areas such as radiation health protection. This, in addition to the tendency for our legal and political institutions to rely on quantitative assessments of risk in order to carry out their mandates according to their prescribed authority (Edge 1995, 19), has maintained an important place for the positivist view of science in decision making. Nelkin (1979, 15) explains that "access to knowledge and the resulting ability to question the data used to legitimize decisions is an essential basis of power and influence." Consequently, there is a systemic tendency for those who have knowledge of technical and scientific-based problems, and the credibility with which to put forth and defend that knowledge, to also have access to and influence over policy formulation in that area. In essence, knowledge is the basis of political power in this framework. There is also a reluctance, on the part of those who hold such power, to relinquish it by acknowledging their own inherent limitations as contributors to the political process.

An early study of scientific controversy by Dorothy Nelkin (1979, 11) "analyses the struggles between different perspectives: between those who see technological development as a rational and objective process and those who see this process as primarily political." She concludes that in cases where political decisions involving science and technology were controversial, forms of public protest, which had been attributed by scientists to a lack of understanding of science, were more likely measures taken to gain some control over this area of decision making. Nelkin explains that in the cases she reviewed,

> the protests described may [have been] less against science and technology than against the power relationships associated with them; less against specific technological decisions than against the declining capacity of citizens to shape policies that affect their interests; less against science than against the use of scientific rationality to mask political choices.

Scientific information may therefore be rejected by the public not for its lack of validity or adherence to accepted disciplinary principles, but because the structure of decision making allows that information to be manipulated and used as a political tool to advance certain interests. Understanding the substantive content of scientific information is peripheral to the issues which underlie the protests. Where a political bias favours the scientific community, economic interests, which often employ their own scientific experts, can often overshadow other social or community interests which lack the resources to argue on equal technical terms. Protests which shift the emphasis of arguments away from science are probably more accurately viewed as attempts to level the political playing field.

3.5.2 Models of Rationality

Risk perceptions among the lay public are often unsupported by quantitative measures of risk derived through formal methods. Technical experts, being unable to account for such discrepancies, often label these perceptions irrational, or presume that the public is disregarding the relevant "facts" in their evaluations. Several theories have speculated as to how and why technical and popular perspectives on risk diverge. Krimsky and Plough (1988, 302) propose that "there are two competing models for the interpretation of risk information--one technical and one cultural." Further, they suggest that "at the root of [the] divergence is the distinction between technical and cultural rationality of risk." Cultural rationality, rather than being misinformed, has a legitimate basis in that risk measurements are one of many variables factored into the public's evaluation of different hazards. Other variables may be social or value-based, and individuals will assign them different weights depending on circumstances or experiences.

Most models presume that risk is a linear function of probability times consequence. It would be a great oversimplification of public cognizance to expect perceptions to echo these models. The linear consequence model does not consider that public evaluations of risk are often intuitive such that the public "recognizes that society can absorb some kinds of harm more easily than others" (Fiorino 1989, 295) Moreover, the public's willingness to trust regulatory institutions can greatly influence the level of dread posed by a hazard (Wynne 1987, 10). Another possibility is that the public may "discount expert knowledge when it involves predictions of hypothetical events rather than analysis of patterns in past events" (Fiorino 1989, 295). This would account for the discrepancies very often evident for low probability, high consequence events--such as nuclear safety breaches--which measure very low in terms of relative risk but conjure considerable fear among the lay public.

Although the traditional view of science in society supports reliance on technical assessments of risk for policy legitimacy, decision makers often neglect to give parallel consideration to the factors underlying cultural rationality. What is not acknowledged is that the technical language of risk assessment poses a conceptual problem for most individuals. As the low probability, high consequence risk (often referred to as zero-infinity risk) issues indicate, perceptions of risk which deviate from technical evaluations are not a reflection of a misinformed or irrational public but rather an indication that other evaluative factors are also relevant. As Krimsky and Plough suggest, focusing too closely on numbers and technical jargon when communicating to the public about risks can ultimately have effects opposite to those intended:

> Quantitative risk analysis, rather than narrowing differences, may actually exacerbate antagonisms between the technosphere (the culture of experts) and the demosphere (popular culture). Casting the issues in a technical language reduces the possibility of a dialogue between the public and elites (303).

Public alienation can have the effect of breaking down policy legitimacy by eroding the elements of trust and comprehension that are important to public acceptance of government decisions. Therefore, more science is not necessarily better in terms of bringing the public on side with respect to controversial policy issues (Wynne 1987, 10).

The divergence between risk assessment and public perceptions, which is often evident with risk management policy issues, illustrates a dichotomy in the way the scientific community and the lay public understand science in the policy context. In general, scientists tend to focus on the cognitive or otherwise pragmatic role of science in decision making (Wynne 1995, 363), and often attribute any controversy surrounding this role to scientific illiteracy among the lay public (Howell 1992). The public may reject science, however, for moral reasons or otherwise as a means of resisting scientific determinism or control over decision making (Wynne 1995, 379; Nelkin 1979).

3.6 ADAPTING RISK POLICY MAKING TO NEW POLITICAL AND SOCIAL REALITIES

Throughout this and the previous chapter, a number of changes in public perceptions, observed over the approximate two decade period relevant to the case study, have been discussed. Some of these changes, apparent in diminished public confidence in government to act in defence of public interests, follow from the public's apparent dissatisfaction with the adequacy of past actions. However, other changes reflect a more significant shift in the perceptions which define the social context for risk policy making in Canada. Changing conceptions in society of how democracy is achieved in decision making, and changing perceptions of what constitutes an appropriate role for science in political decision making, have important implications for the design of decision making processes. All of the changes discussed alter the characteristics of the political environment by which risk policies and decision making processes have traditionally been legitimated, and suggest the need for some type of reform which would make these processes more reflective of contemporary political and social realities.

It appears that traditional science-based approaches to risk policy development, which involve closed and confidential negotiations among government, scientists and industry, are no longer universally perceived to be legitimate. The increasing level of comprehension, observed among members of the lay public, of the complex social and political nature of risk problems is placing greater demands on decision makers to justify their policy choices. Hence legitimacy problems are increasingly compelling government agencies to adopt alternative approaches to policy development including, in many cases, decision making processes which involve some degree of input from the general public.

However, despite the apparent recognition on the part of government that the legitimacy of the traditional approach to decision making is in some dispute, participatory processes do not always address specific legitimacy problems. As the theoretical arguments presented in this chapter indicate, a number of practical and philosophical constraints have, in the case of many risk policy domains, stalled any significant reformation of traditional science-based approaches to policy making. For one, there is no clear consensus among different groups in society that the traditional approach is inadequate. Moreover, different value, priorities, and experiences result in different interpretations of what is causing public controversy over risk problems. There is also the issue of how the traditional approach allocates authority and control over policy direction. Those groups whose interests are well served by excluding the public from the process of decision making will be generally disinclined to support radical reforms. Many of these problems and issues are illuminated and discussed in the context of the case study evaluation which follows in Chapters 4 and 5.

Chapter Four

A CASE STUDY OF DRINKING WATER GUIDELINE SETTING IN ONTARIO

4.1 BACKGROUND

In 1990, a new water treatment facility was proposed for construction in the regional municipality of Durham, located just east of Toronto, Ontario. The new plant was intended to replace an existing, inadequate plant at the same location, and will provide water supply services to the local population. Following this proposal, the Ontario Ministry of the Environment and Energy (the ministry), in accordance with Ontario's environmental assessment legislation, asked its Environmental Assessment Advisory Committee (EAAC) to recommend whether a full environmental assessment should be undertaken prior to the plant's approval. After a series of subsequent meetings, the EAAC issued its report to the minister, recommending that a number of steps be taken prior to construction, but that no environmental assessment was necessary. In September 1992, the facility was approved.

In and of itself, the new water treatment plant is not very controversial. However, the existing facility is located on the Lake Ontario waterfront in Pickering, approximately 5 km east of Ontario Hydro's Pickering Nuclear Generating Station (NGS). During the EAAC review, local area residents expressed concern about both current and future levels of contamination in drinking water from the radioactive emissions of the nuclear power station, and questioned whether the health risks had been adequately considered. Consequently, as one of its recommendations, the EAAC suggested that the minister ask its Advisory

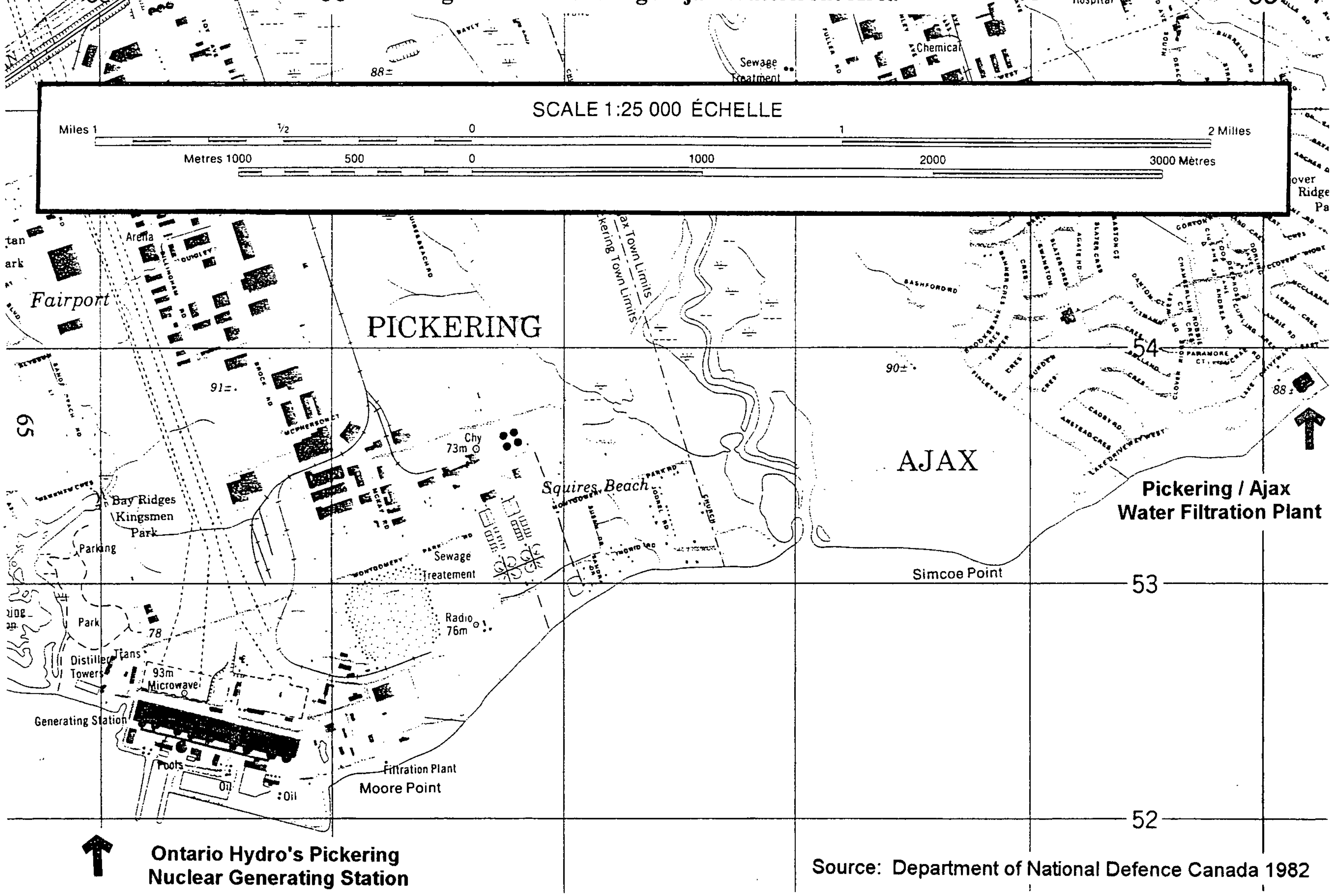
Committee on Environmental Standards (ACES) to "carry out a public review. . .on an appropriate standard for tritium in drinking water" (MoEE 1993).

4.1.1 Setting Limits for Radionuclide Concentrations in Drinking Water

At the time that discussions concerning the new water treatment facility were taking place, the Ontario Drinking Water Objective (ODWO) for tritium was 40,000 Becquerels per litre (Bq/l). This value had been in effect since 1979 when the radiological parameters of the GCDWQs were last revised and then adopted, unaltered, in Ontario. The following paragraphs provide a brief overview of the terminology and historical events surrounding radiation and health protection in Canada.

A *Becquerel* (Bq) is a standard unit of measurement of the activity level of a radionuclide "decaying at a rate, on average, of one spontaneous nuclear transition per second" (Weast et al. 1992, F-81). However, the health implications of radionuclide concentrations in drinking water are not directly correlated with levels of radioactivity. Each radionuclide, which has unique physical and chemical properties, will differ in terms of its ability to cause adverse biological effects. Some radionuclides are more easily absorbed and retained in the body, and may either concentrate in certain organs, or be disbursed evenly throughout different types of tissues (Galle and Masse 1982). The varying toxicity of radionuclides, therefore, led to the development of another standard unit of measurement, expressed in *sieverts* (Sv), of the dose equivalent or weighted absorbed dose to the body. This unit allows the potential biological effects of exposure to radiation from different radionuclides to be similarly compared. Accordingly, the number of sieverts

Figure 4.1: Pickering / Ajax Waterfront Area



Source: Department of National Defence Canada 1982 corresponding to one Becquerel will vary from one radionuclide to another. This number is known as the *dose conversion factor* and is usually expressed in terms of sieverts per Becquerel (Sv/Bq) (MoEE 1993).

The current legal limit for public exposure to anthropogenic sources of radiation in Canada, as stipulated in the *Atomic Energy Control Regulations* (1992), is 0.5 rem or 5 mSv per year (1 rem = 0.01 Sv). The radiological parameters of the GCDWQ are set according to the criterion that only 10% of an individual's total permissible exposure to radiation should come from drinking water (Health Canada official 1994b). Consequently, in principle, an individual should receive no more than 0.5 mSv per year from the consumption of radionuclides in drinking water. Tritium is generally considered to be a relatively weak emitter of beta radiation. This means that the energy level with which beta particles (electrons) are emitted from the tritium atom is low relative to other beta emitting radionuclides (UBC Radiation Safety Officer 1996). Consequently, the amount of tritium required to cause acute irradiation effects in humans is relatively high (Jeanmaire 1982). Consequently, the recommended maximum acceptable concentration of tritium, in terms of the

Table 4.1: 1979 Radiological Guidelines (GCDWQ Fifth Edition 1993)

RADIONUCLIDE	*MAC Bq/l*
Cesium-137	**50**
Iodine-131	**10**
Radium-226	**1**
Strontium-90	**10**
Tritium	**40,000**

number of Bq/l in drinking water, is significantly higher than those of the other four radionuclides regulated (Health Canada official 1994a and 1994c). The 1979 radiological guidelines, both GCDWQs and ODWOs, are listed in Table 4.1.

Radiological guidelines are applied in a manner unique to chemical and bacteriological guidelines. The MAC value for each chemical and bacterialogical substance stands alone, and is not affected by the presence of any other element in that water source. In contrast, the 0.5 mSv annual radiation exposure limit from drinking water applies to all radionuclides detected in a water source. Therefore, the 40,000 Bq/l value expressed in the GCDWQs and ODWOs only applies if tritium is the only radionuclide present. If other radionuclides are present, then the allowable limit for each will decrease such that the additive dose equivalent from that water source will not be greater than 0.5 mSv annually.

The actual values in the federal guidelines are based heavily on scientific information supplied, and recommendations made by international research organizations which specialize in radiation health issues. There are two main research organizations whose study results involving human exposure data are most widely cited. These are the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and the United States National Academy of Sciences' Committee on the Biological Effects of Ionizing Radiation (BEIR). These organizations draw on data from the survivors of the Nagasaki and Hiroshima nuclear bombings, and from other incidents involving significant releases of radiation to the human environment such as the Chernobyl nuclear accident. The information generated by these agencies is then used by the International Commission on Radiological Protection (ICRP) and other research organizations including the U.S. National Council on Radiation Protection and

Measurements (NCRP) as a basis for their recommendations to national and international regulators for radiation protection (MoEE 1993). Canada's radiation protection limits are based heavily on the recommendations of the ICRP (Health Canada official 1994a).

The 1979 revision to the radiological parameters of the GCDWQ followed the release of *ICRP Publication #26* (1977) titled "Recommendations of the International Commission on Radiological Protection." This publication is the original source of the 5 mSv dose equivalent limit for public exposure to radiation. The ICRP recommends here that the occupational dose equivalent limit for exposure to radiation should be 50 mSv per annum. This level of risk is assumed to be comparable to that of other occupations "having high standards of safety." The public dose-equivalent limit for exposure is "an order of magnitude lower than for occupational risks" or 5 mSv per annum. The ICRP evaluated the acceptability of radiation risks in terms of how they compared to other types of hazards which the public encounters as a matter of everyday life. The dose-equivalent limit of 5 mSv was assumed to correspond to a risk of cancer fatality of approximately 50 per million per year. However, it was also assumed that the average person would only be exposed to approximately 0.5 mSv per year, corresponding to "a risk [of fatality] in the range of 10^{-6} to 10^{-5}," and that this risk "would be likely to be acceptable to any individual member of the general public" (ICRP 1977, 21-23). This assumed average risk translates to between 1 and 10 excess cancer fatalities per million people per annum.

In the late 1980s, both UNSCEAR, and the U.S. National Academy of Sciences' BEIR V Committee, reported on new research findings on the potential biological effects of ionizing radiation on humans (MoEE 1994). An additional eleven years of data on the atomic bomb survivors lead researchers to conclude that earlier estimates of the probability of carcinogenic effects from exposure to ionizing radiation had underestimated the risk. These findings "increase[d] the probability values by between 1 and 2 times" for cancer death. Consequently, the ICRP revised its recommendations concerning both occupational and public dose equivalent limits for exposure, and released *ICRP Publication #60*, titled "1990 Recommendations of the International Commission on Radiological Protection" to supersede its 1977 recommendations (ICRP 1990, 114-115).

In the ICRP's 1990 recommendations, the difference between occupational and public equivalent dose limits for exposure is still one order of magnitude. The public exposure limit was reduced from 5 mSv to 1 mSv, corresponding again to a risk of excess cancer fatalities from exposure of 5×10^{-5} or 50 per million per annum (ICRP 1990, 70-72; Health Canada Official 1994). The same general assumptions about the risk corresponding to the average exposed member of the public were also considered to be relevant here (Health Canada Official 1994). This recommendation, and the assumptions of risk acceptability which underlie it, were important issues raised during the public consultation which was ultimately carried out by ACES for the Ontario Ministry of Environment and Energy.

4.1.2 The Public Consultation on Tritium

Both the EAAC and ACES are government agencies which operate at arms length to the Ministry of Environment and Energy in an advisory capacity. ACES was established in May, 1990 by an Order in Council. Its mandate is:

> to advise the Minister of the Environment and Energy. . .on sound, practical

environmental standards that have been developed through the consideration of pertinent scientific, legal, economic and socio-cultural issues and through the open process of public consultation (ACES Annual Report 1992-93).

On December 16, 1993, the minister asked ACES to undertake an internal review and public consultation regarding a new proposed "interim" drinking water objective for tritium of 7,000 Bq/l. This value was derived, to a large extent, by applying the new recommended dose equivalent limit from the ICRP (1990) to a derivation formula similar to that used in 1979. It was determined that the new guideline, if implemented, would be an interim guideline since the federal guidelines (GCDWQs) were simultaneously under review and also expected to be similarly revised.

The derivation of the proposed interim guideline followed from a few key assumptions. First, it was assumed that the dose equivalent limit for exposure from drinking water should continue to be 10% of the ICRPs recommended public dose limit, or 0.1 mSv per annum. This limit corresponds to an assumed risk of excess cancer fatalities of 5×10^{-6}, or 5 deaths for every 1,000,000 people. Second, it was assumed that the average individual consumes 730 litres of water per year or an average of 2 litres per day. And third, because there is some inconsistency among members of the scientific community as to the appropriate value of the dose conversion factor for tritium, an approximate average among dose conversion factors was used. The World Health Organization (WHO), in setting its own recommendations for limits of radionuclides in drinking water, adopted a dose conversion factor for tritium used by the United Kingdom's National Radiological Protection Board (NRPB), and arrived at a recommended limit of 7,600 Bq/l. The ICRP, however, in *ICRP Publication #61*, recommends an alternative dose conversion factor which if applied using the same formula, results in a possible limit of 6,850 Bq/l. The ministry determined that the value of 7,000 Bq/l was an appropriate compromise between these two values (MoEE 1993, 10-12).

The proposed interim guideline for tritium was presented to ACES by the minister in the form of a document which explained the rationale for choosing the specified value. This document, titled "Rationale Document for the Development of an Interim Ontario Drinking Water Objective for Tritium" (Rationale Document), was prepared by staff members at the MoEE to aid the process of public consultation which followed. The document included some information on the sources and chemical properties of tritium, and on the sources and health effects of ionizing radiation. It also described the international framework for radiation health research, risk assessment and regulatory recommendations. This document was prepared as the primary source of technical and policy related information for the participants in the consultation process.

In early January, ACES placed advertisements in local and national newspapers and magazines, and mailed information packages to over six thousand targeted and random individuals and groups in the province. The targeted audience included environmental and citizens groups generally known to have an interest in these types of issues, and individuals who had been in contact with ACES in the past in relation to other matters (ACES official 1994). Those who expressed an interest in participating in the consultation were sent a copy of the Rationale Document and asked to submit a written reply to the following three open-ended questions:

1. Is the proposed standard acceptable?

2. If not, what is the basis for finding the proposed level unacceptable? and,

3. Do you have an alternative level to propose? (ACES 1994)

Additional comments were also encouraged. Some of the more technical references supporting the proposed guideline were made available to the public for review at the ACES office in Toronto, and at the Town Clerk's office in Ajax, Ontario. In addition to the written material, an information session was held in Ajax on January 27, 1994. Moreover, oral submissions were accepted during a deputation session in Pickering on February 16, and via teleconference on February 28, 1994 in order to accommodate interested individuals in other parts of the province. Written submissions were accepted until March 10, 1994 (ACES 1994).

ACES received a total of 84 submissions. The respondents commented on a range of issues both specifically in response to the questions posed and generally on matters of related concern. Some of the issues raised correspond directly to those which were identified as relevant in the MoEE's Rationale Document. However, it is interesting to note that by far, the majority of issues raised ventured outside the scope of this document. In its report to the minister, issued in May 1994, ACES analyzed the written and oral submissions according to a set of broad issue categories, including: exposure, risk, feasibility, implementation, need for additional studies, and other comments and recommendations. Under these broad categories were listed the more specific issues raised by respondents. For each issue, ACES summarized the public response and followed with their own recommendation as to how that issue should be addressed. In summary, ACES made its recommendation to the minister on the proposed interim drinking water objective for tritium of 7,000 Bq/l. This recommendation, as summarized in the report, is as follows:

> ACES recommends that the Ontario Drinking Water Objective for Tritium be set immediately at 100 Bq/L. ACES further recommends that, due to the fact that tritium is a human carcinogen and because of the many uncertainties in the risk assessment, the tolerable level of tritium in drinking water be reduced to 20 Bq/l in 5 years with the goal of further reduction as human contributions to tritium background levels decline. The five year schedule for the reduction acknowledges the need for technical and financial feasibility studies on the ODWO of 20 Bq/l. In addition, ACES recommends that this standard be applied as a health-based Maximum Acceptable Concentration, that when this drinking water standard is exceeded, an alternative water supply should be made available (ACES 1994).

This advice was a significant departure from the 7,000 Bq/l proposed by MoEE.

The MoEE was apparently unprepared to receive a recommendation which differed so profoundly from its proposed policy. Consequently, during the next several months, the minister sought further advice from radiation specialists, nuclear industry representatives, and environmental groups by uncharacteristically releasing the ACES recommendation to the public prior to the minister's decision (MoEE official). On December 22, 1994, in a news release, the minister announced that the Interim ODWO for tritium would be lowered from 40,000 Bq/l to 7,000 Bq/l, and not to 100 Bq/l as recommended by ACES. No explanation for the ministry's decision not to accept the ACES recommendation was offered in the news release.

4.2 EXAMINING THE INSTITUTIONAL PROCESS IN 1979 AND IN 1994

In 1968, the *Canadian Drinking Water Standards and Objectives* were first published. In 1979, these were revised in what we now refer to as the Guidelines for Canadian Drinking Water Quality (Health and Welfare Canada 1993). At the time of this study, Health Canada is preparing to release the sixth edition of the GCDWQs. Among the changes which distinguish this edition from the last is the second significant revision of the radiological parameters for drinking water. The other significant revision of these parameters occurred in 1979, soon after the ICRP released its *Publication #26.* As was mentioned earlier, the Ontario Ministry of Environment and Energy's initiative to contemplate an interim ODWO for tritium pending the changes anticipated in the *Sixth Edition* of the GCDWQ, was an unusual step on its own. However, commissioning its Advisory Committee on Environmental Standards to undertake a public consultation on this interim level was unprecedented.

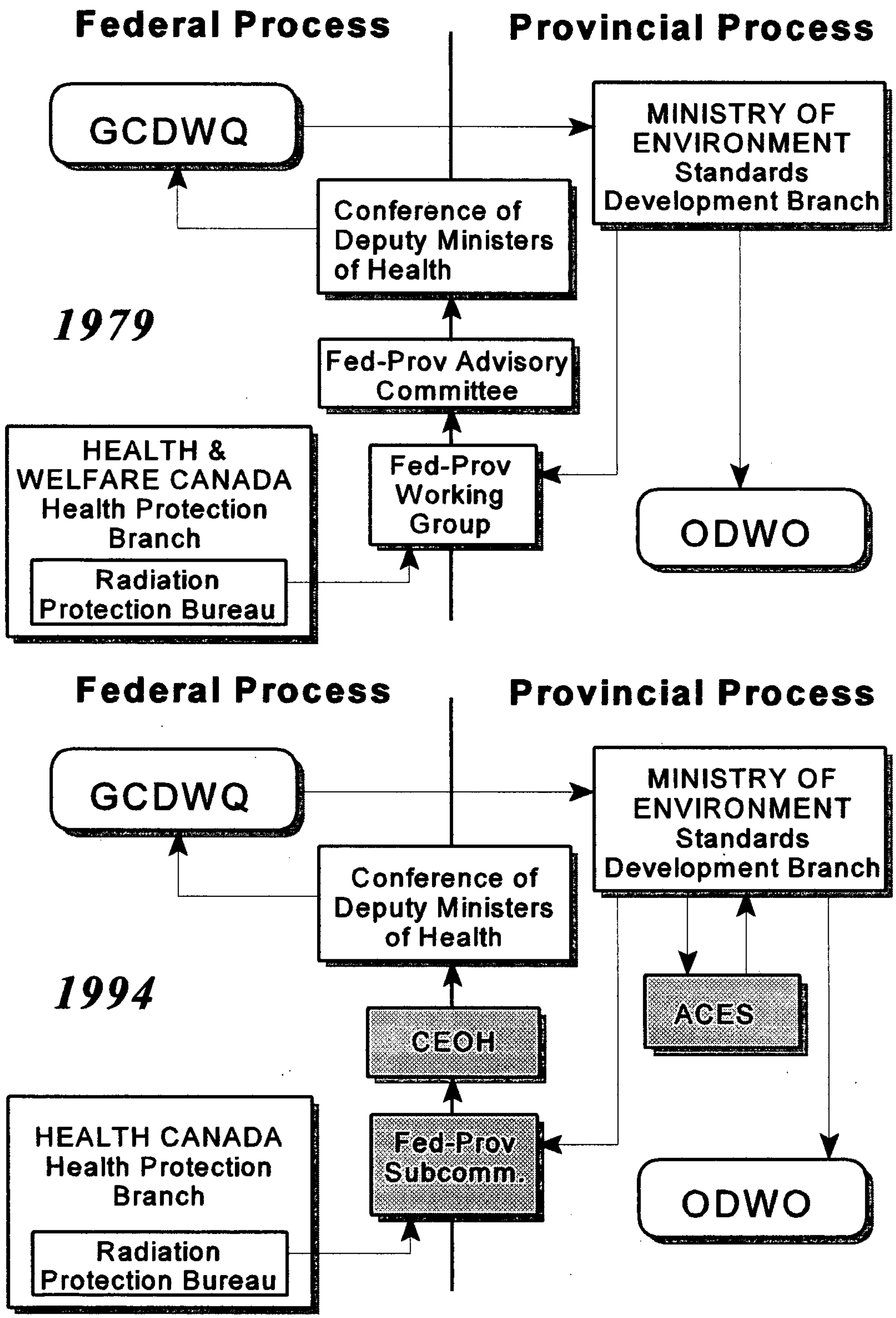
The institutional process of developing radiological parameters for both the GCDWQs and the ODWOs has remained remarkably consistent during the period from 1979 to present. This institutional consistency facilitates the analysis of how the ACES consultation has affected the overall process of decision making in this policy domain. From discussions with staff members of Health Canada, and from contemporary documents and correspondence, a conceptual map was generated of the institutional process of decision making in 1979, with respect to establishing the radiological parameters for both the GCDWQs and the ODWOs. A complementary map was also generated to represent the same process in 1994, also from discussions with Health Canada staff. Both maps are graphically represented in Figure 4.2. Any changes or additions which occurred between 1979 and 1994 are shaded in the latter.

Radiation health protection experts in Canada are few in number, and are concentrated within the Radiation Protection Bureau (the Bureau) of Health Canada. This is true historically and in 1979, the specific values which appeared in the GCDWQ were derived by Bureau staff and recommended by the Expert Committee on Radioactivity in Drinking Water to what was then called the Federal-Provincial Working Group on Drinking Water (Prantl and Meyerhof 1979). The official role of the Radiation Protection Bureau in the overall process was risk assessment, while the Working Group was charged with the more policy focused role of risk management (Health Canada Official 1996). In reality, however, it is difficult to distinguish the risk assessment and management functions. The Bureau relied heavily on the findings and recommendations of the international scientific community in its derivation, including UNSCEAR and, particularly, the ICRP. The recommendations of the ICRP involve not only estimating risk, but fixing the biological and behavioural parameters for measuring that risk, and then suggesting what level is acceptable to society. Therefore, they encompass both types of decisions. Consequently, most of the key risk management decisions had been addressed and resolved prior to the Working Group's review of the proposed radiological guidelines.

The Federal-Provincial Working Group would then report to its parent committee, the Federal-Provincial Advisory Committee on Environmental and Occupational Health. Both of these committees were comprised of representatives of federal and provincial government departments. Again, the main role of the Advisory Committee was to address policy issues related to the guidelines; and although the specific recommendations for guidelines would pass through one further level of administration--the Conference of Deputy Ministers of Health--before being published in the GCDWQ, any debate over specific values, their derivation and rationale, had essentially been resolved by this point in the process (Health Canada Official 1996).

Because the provinces were involved in the development of the GCDWQs through

Figure 4.2: Temporal Change in Institutional Process for Developing Radiological Parameters in Drinking Water (1979 and 1994)



both their participation in the Working Group and their affiliation with the Advisory Committee, it was generally expected that each province would adopt the recommendations of the federal guidelines into their own provincial drinking water policies (Health Canada Official 1994d). In 1979, the Ontario Ministry of Environment did adopt the radiological parameters verbatim as Ontario Drinking Water Objectives.

In 1994, the chain of departments and committees through which proposed changes to the radiological parameters must pass looked remarkably similar. In the mid-1980s, the Federal Provincial Advisory Committee on Environmental and Occupational Health was dissolved by the Conference of Deputy Ministers of Health, and subsequently replaced by simply the Committee on Environmental and Occupational Health (CEOH). Similarly, the Federal-Provincial Working Group on Drinking Water was replaced by the Federal-Provincial Subcommittee on Drinking Water. However, despite the formal name changes, very little had changed in terms of each group's function. The loosely termed risk assessment function still resided with the Bureau, while questions of policy were deferred to the Subcommittee and CEOH (Health Canada Official 1996).

Also in 1994, while Ontario's ACES' consultation process was taking place, the Radiation Protection Bureau of Health Canada was in the process of developing its recommendation to the Subcommittee for a revised set of radiological parameters based on the latest international scientific studies and ICRP *Publication #60*. Although the specific recommendations of the Bureau were not yet public, it was expected, at this time, that all radiological parameters would be revised downward to reflect the ICRP recommendations, and that the new GCDWQ for tritium would be 7,800 Bq/l (Health Canada Official 1994a).

As Figure 4.2 shows, the ACES process was undertaken in a context independent of the traditional formal process of drinking water guideline setting. Not only did the consultation preempt a decision forthcoming via the traditional decision making channel, it also, whether intentionally or not, opened for debate issues of risk assessment and risk management historically resolved by the radiation health experts at Health Canada, who received their guidance from the recommendations of the ICRP. As was discussed in Chapter 2, the highly esoteric nature of radiation health issues and language, along with a small and unified policy sector for radiation health protection, had effectively insulated this policy domain during its entire history from intense public scrutiny and had allowed many of the more controversial aspects of this policy to pass potential sceptics undetected. One of the effects of the ACES consultation, as the issue analysis reveals shortly, was to expose these controversial aspects to the public and provide an opportunity for those thus inclined to question the rationale for choosing specific limits for radionuclides in drinking water, as well as to ponder the credibility of the traditional process of decision making itself.

4.3 EXAMINING THE ISSUES

The specifics of how the nature of the debate surrounding radiological parameters in drinking water was affected by the ACES consultation can be gleaned from a comparison of the issues raised and perspectives expressed in both temporal contexts. Interviews with several staff scientists at Health Canada were conducted in December 1994. These interview were recorded and transcribed and, along with the rationale and derivation documentation for the 1979 radiological guidelines, provide insight into the pivotal issues underpinning the specific values published in the 1979 GCDWQs. Because of the prominent role played by Health Canada scientists in the development of radiological parameters, the information obtained from staff interviews and Bureau documentation is assumed to be sufficient in explaining how the radiological guidelines were arrived at, specifically, what the key issues were that needed to be resolved. For the issues raised and perspectives expressed in 1994, the MoEE's Rationale Document, and a sample of 76 of the 84 submissions received by ACES were analyzed. The remaining eight submissions were missing from ACES' files and were therefore not available for review. The arguments of the Radiation Protection Bureau, the MoEE, and the submission of each respondent in the sample, are organized in a series of tables, each of which will be explained in turn. In order to facilitate the organization of the many issues and perspectives expressed during the public consultation, a graphic analytical framework was utilized. This framework was chosen for its simplicity and for its usefulness in allowing the various issues and perspectives to be identified and expressed in a consistent and comprehensible manner. Before the key issues for both periods are discussed, the format and approach of the framework, and the rationale for choosing it, will be reviewed.

4.3.1 Analytical Framework

Copies of 76 of the total of 84 written submissions were obtained for this study and will form the basis of the analysis of 1994 issues. The sample size is assumed to be a large enough proportion of the total number of responses to be sufficiently representative of the views expressed during the consultation.

The analytical framework is a graphic one, which displays the main elements of each party's response to the questions posed by ACES. The graphic framework is inspired by the work of Limoges et al. (1995) in their study of a spruce budworm epidemic which occurred in Quebec in the 1980s. The authors examined a controversy which arose over the government's proposal to combat the spruce budworm problem by aerially spraying the affected forests, and was played out in a set of public hearings overseen by the government's advisory agency on environmental controversies. The authors' objective was to analyze the dynamics of public controversies about risk. Consequently their framework is an attempt to graphically represent how each party perceived the problem at hand, and how that party proposed to approach finding a solution to that perceived problem.

Limoges et al. also discuss their framework in the context of various alternative frameworks for analyzing risk controversies. They suggest that Renn's (1992) "social arena concept of risk debates" and Douglas and Wildavsky's (1982) "grid/group analysis" are also useful frameworks for doing qualitative study on social risk conflicts. These frameworks were also reviewed for this study and it was found that the Limoges et al. framework would be the most suitable to adopt given the specific objectives and the nature of the data being analyzed here.

From the briefs presented and transcripts of exchanges which took place at the hearings, Limoges et al. identified the key elements of each party's argument. They then arranged those elements, individually boxed and linked by lines where elements related to one another, in a figure which separated with a vertical line the elements of that party's perception of the problem from those of their proposed solution. This format is depicted in Figure 4.3 (a). Although the same basic principles apply here, the framework is modified for the tritium consultation because of a difference in the focus of the consultation's objective.

The questions posed to the participants by ACES were framed to draw out their support for, or opposition to, an already proposed policy. This framework contrasts with the objective of the public hearings in Limoges et al. analysis which was to "draft a broader, more integrated approach to forest management." ACES' objective was to evaluate the appropriateness of an interim drinking water objective for tritium of 7,000 Bq/l; therefore, a problem-solution framework would not provide a fair representation of each party's argument. Consequently, the elements of each party's argument are displayed according to how they correspond to "support" for or "opposition" to the proposed policy. Moreover, given that a number of matters were raised by the participants as relevant to the debate but not necessarily raised in support of their position on the questions posed by ACES, a third category of "other issues" is included in the framework. This format is depicted in Figure 4.3 (b).

In Limoges et al. framework, the elements of each party's argument are termed "entities," also depicted in Figure 4.3 (a). An entity is meant to be any subject, object, or effect of an action identified by that party as relevant to the controversy. For the purposes of this study, a sharper distinction will be made among the types of entities identified. As Figure 4.3 (b) illustrates, an element marked with a shaded box is a specific issue identified by the party. If that issue is raised specifically by a party in support for or opposition to MoEE's proposed interim ODWO for tritium, then the box is located in the appropriate space. However, if the issue was raised by the respondent as relevant to the discussion at hand, but he or she is not directing that aspect of the argument at either their support for, or opposition to, the proposed guideline, then the issue is located in the space labelled "Other Issues."

These include, as will be discussed later, such issues as regulatory control of nuclear plant emissions and the priorities and responsibilities of society and government. In short, they are issues which the respondent perceives to be relevant to the consultation--and therefore elected to include in their submission as part of their argument--but do not lend support to a position on the MoEE proposal, which is the subject of the consultation.

Figure 4.3 (a): Limoges et al. (1995) Analytical Framework

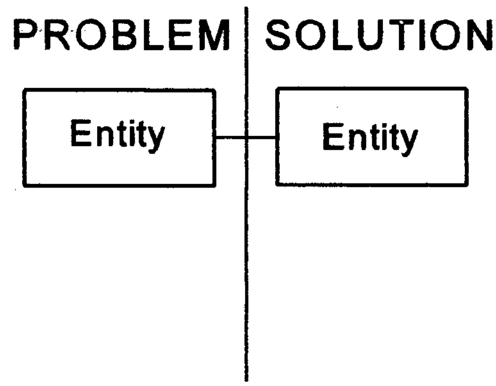
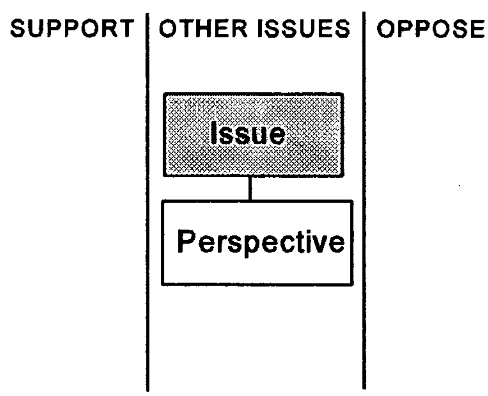


Figure 4.3 (b): Argument Profile



The other type of entity distinguished in this framework is marked with a white box, and denotes a point, generally in relation to an issue raised, which defines that respondent's perspective on that issue. This distinction is important because different parties can have very different perspectives on the same issue; consequently, simply identifying the issue is insufficient in representing that party's argument as expressed in their written response. Each white box is connected, with a line, to the corresponding issue. Further, any of the two types of elements which the party identifies as having some interconnected relevance are connected with a line. Modifying Limoges et al. terminology, the resulting map of issues, perspectives and their interconnectedness in the context of the party's response to ACES' questions on the proposed policy is termed an "argument profile." Each party will have its own argument profile according to which issues it raised, and how those issues related to the consultation's questions in its written submission to ACES. The interpretation of each party's argument is admittedly and necessarily somewhat subjective in that each written submission must be interpreted in order for the elements of the argument to conform to the restrictions of the analytical framework. However, the intent is to simply extract and reiterate the key elements from the written documents. It is assumed that the potential for some error or misrepresentation in interpreting the submissions using this analytical framework is minimal, however, and does not undermine the objective of the exercise, which is to provide a means of facilitating comparisons among the key elements of the argument profiles and making general statements about public perceptions of what is relevant and important in risk management decision making.

Each party's argument profile, including that which is expressed by the MoEE's Rationale Document, is graphically represented in Appendix A. The issues and perspectives are summarized in a series of tables which group related and similar issues and then list the range of perspectives expressed. Highlights from these tables are described in the following sections.

4.3.2 1979 Issue Summary

In both 1979 and presently, the values of the radiological parameters of the GCDWQs were and are recommended by the Radiation Protection Bureau of Health and Welfare Canada, now Health Canada (Health Canada Official 1994c). Consequently, in attempting to reconstruct the list of relevant issues and associated perspectives that formed the foundation of the 1979 values, current Bureau staff were interviewed, and a discussion paper, prepared by Bureau staff in February 1979 for the then Expert Committee on Radioactivity in Drinking Water (Prantl and Meyerhof 1979), was reviewed. From what was learned from these sources, there were four pivotal issues underpinning the specific values chosen for the guidelines. These issues, and the associated perspectives on the issues as interpreted from the interviews and documentation, are listed in sections A through D of Table 4.2. Although there are numerous ways in which the information summarized here could have been arranged, the method chosen is believed to represent the essential elements of the argument in a reasonably fair manner consistent with the methodology used for representing the 1994 issue summary.

The first issue (although the order is arbitrary) described in Table 4.2, section A, relates to the nature of the criteria used to develop drinking water guidelines generally. Given that the department's mandate is to protect human health, the Bureau asserts that all criteria must be health based and independent of the concerns of other government departments such as the environment.

Table 4.2: Issues Addressed by the Radiation Protection Bureau in Support of 1979 Recommended Limits for Radionuclides in Drinking Water	
ISSUE	*PERSPECTIVE*
A: Criteria For Developing Guidelines	• health based • mandate to protect human health • independent of economic or environmental concerns
B: Regulatory Consistency	• based on findings and recommendations of UNSCEAR, NAS, and ICRP • consistent with legal limit for public exposure as established in the *Atomic Energy Control Regulations*
C: Biological Effects of Low Doses	• linear no-threshold hypothesis • low dose effects are not known and cannot be studied adequately • assumes risk of getting cancer is proportional to amount of substance present • is a conservative, pessimistic scenario under conditions of uncertainty • no "safe" level means must establish limits based on concept of acceptable risk
D: Dose Equivalent Limit for Drinking Water	• taken from *ICRP Publication #26*: 5 mSv per annum • derived on two different criteria 1. risk involved, and 2. natural variations in background radiation • 5 mSv translates to a risk of 10^{-6} to 10^{-5} which is acceptable • magnitude of radiation risks considered in light of public acceptance of other risks in everyday life • not reasonable to drop allowable limit of exposure below natural variations in background levels • 5 mSv is natural variation between different places • limit of exposure from drinking water 10% of total exposure limit or 0.5 mSv • limit applies to sum of all radionuclides present in a water source • is meant as a cap so average dose among public is less

Section B describes the issue of regulatory consistency, both nationally and internationally, with respect to the quantitative derivation of radiation guidelines. Bureau staff suggest that this issue is very important in the field of radiation health protection because of the respect commanded internationally by ICRP recommendations, and the scientific studies of UNSCEAR and the NAS on which they are primarily based. In 1979, the AECB legal limit of

5 mSv for public exposure to radioactivity, on which the limit of exposure from drinking water of 0.5 mSv is based, was taken directly from ICRP Publication #26.

The third issue in Table 4.2, explained in section C, is important in terms of how the scientific data on the biological effects of radiation, collected primarily in relation to humans exposed to very high doses, is extrapolated to apply to cases of exposure at low doses. As was mentioned earlier in this chapter, both UNSCEAR and the U.S. NAS BEIR Committees based their findings to a very large extent on studies of the survivors of the Nagasaki and Hiroshima nuclear bombings; these incidents involved exposures orders of magnitude greater than those which the GCDWQs seek to control. Consequently, the ICRP, and subsequently the Radiation Protection Bureau, adopted the linear no-threshold hypothesis of extrapolation from high to low doses. This hypothesis, which assumes that effects are proportional to the size of dose received, is considered to be a conservative assumption, since it was (and still is among most technical elites) generally believed that the actual relationship between dose and effects at low doses is relatively less acute (Health Canada Official 1994c). However, accepting the linear no-threshold hypothesis as a basis for setting radiation exposure limits is consistent with the recommendations of the ICRP and an important presumption to the fourth key issue, establishing the dose-equivalent limit for drinking water.

ICRP Publication #26 recommends explicitly that the dose equivalent limit of exposure to radiation for the general public should be 5 mSv per annum (ICRP 1977, 23). It is Health and Welfare Canada's policy that since drinking water is only one of many potential pathways of exposure to radioactivity, the radiological guidelines are based on a dose equivalent limit which is 10% of ICRP's recommended total annual dose (Health Canada

Official 1994b). Considering the emphasis placed by Bureau staff on maintaining consistency with the ICRP, this recommendation alone is probably the most important basis for determining the dose equivalent limit for exposure from drinking water. However, the main assumptions underlying this value are equally relevant to a full understanding of the government's perspective on the issue.

The 5 mSv value was derived on two different criteria (Health Canada Official 1994b). The first criterion involves establishing a level of risk that is acceptable to the public and modifying the occupational dose equivalent limit to fit that criterion. Specifically, how the ICRP determines what level of risk from radiation is acceptable to the public is best explained in the text of *Publication #26* itself:

> Radiation risks are a very minor fraction of the total number of environmental hazards to which members of the public are exposed. It seems reasonable therefore to consider the magnitude of radiation risks in the light of the public acceptance of other risks of everyday life. From a review of available information related to risks regularly accepted in everyday life, it can be concluded that the level of acceptability for fatal risks to the general public is an order of magnitude lower than for occupational risks. On this basis, a risk in the range of 10^{-6} to 10^{-5} per year would be likely to be acceptable to any individual member of the public (ICRP 1977).

A risk in the range of 10^{-6} to 10^{-5} translates to somewhere between 1 in a million and 1 in a hundred thousand fatal cancers per year.

The second criterion involves placing the risk in the context of variations which occur naturally in the level of background radiation. The rationale for this criterion is that it is unreasonable to drop the radiation dose equivalent limit to a level which is below that which the public is exposed to naturally. The value of 5 mSv is estimated to be approximately equal to variations in background radiation experienced in different places in the world. The other point is that because the dose equivalent limit is meant to be a cap on public exposure, the average exposure will be much lower. This characteristic is believed to provide an additional measure of conservatism to the value (Health Canada Official 1994b).

There is one final point of relevance to the issue of a dose equivalent limit for drinking water which is that the value--0.5 mSv--applies to the sum of all radionuclides which are present in a water source. As was discussed earlier in this chapter, the specific maximum acceptable concentrations for each of the radionuclides listed in Table 4.1 apply only if each is the only radionuclide present. If there are two or more present, then the concentration of each must be a proportion of the MAC such that the total dose of radioactivity is not greater than 0.5 mSv. The dose conversion factors for each radionuclide do not appear to have been significant issues in setting the values for the guidelines. These also presumably emanate from studies undertaken by the international scientific community although they are not specifically mentioned in the documentation.

As the issues and perspectives in Table 4.2 illustrate, there is a dubious distinction between tasks of risk assessment and risk management in traditional radiation health protection policy making. In establishing a recommended dose equivalent limit for public exposure to radiation, the ICRP's estimation of an acceptable risk to the public was far from a technical exercise. Moreover, the values and conjectures of technical experts play a pivotal role in all four issues identified as central to the Radiation Protection Bureau's recommendations. The recommendations of the ICRP, therefore, appear to be a classic example of mandated science in the context of radiation health protection policy making. Despite the policy-oriented focus of the organizations' research, the credibility of its recommendations rests on the technical expertise of its membership, and the technical approach taken in arriving at its recommended radiation protection limits. This credibility, in turn, lends an important element of legitimacy to national health protection policies such as the GCDWQs.

4.3.3 1994 Issue Summary

The ACES consultation process in 1994 provided a forum, not only for government, industry, interest groups and the general public to comment on a proposed health policy, but also for these groups to air their views on a range of issues perceived to be relevant in the context of the policy question at hand. The "argument profile," depicted in Appendix A, revealed a great deal about the extent to which different perspectives on the same issue can diverge, and also about the variety and range of issues that are deemed relevant when the number and interests of participants are increased.

Some parties responded to ACES' request for submissions with arguments either in support of or in opposition to the ministry's proposed interim ODWO for tritium of 7,000 Bq/l; some of these parties also raised other issues which did not directly relate to the policy proposed; and still other parties took no concrete position on the ministry's proposal, but chose to comment only on other issues perceived to be relevant. Of those who opposed the ministry's proposal, some respondents argued that the proposed value was too lenient, while others argued that it was too strict. Figure 4.4 shows the distribution of the 76 respondents studied among these four categories of responses. The figure also shows a breakdown of the general categories of respondents. Any individual who made a submission to ACES on her or his own behalf was classified as an "individual," while the "environmental or citizens' groups" category applied to groups which organized around non-business related interests. The distinction between industry and government was difficult to make. However, for the purposes of this study, given the economic significance of the policy in question, "industry" was deemed to include all unions, utilities, industry organizations and crown corporations, as well as any private sector firms, while the "government" category applied to municipalities or government departments.

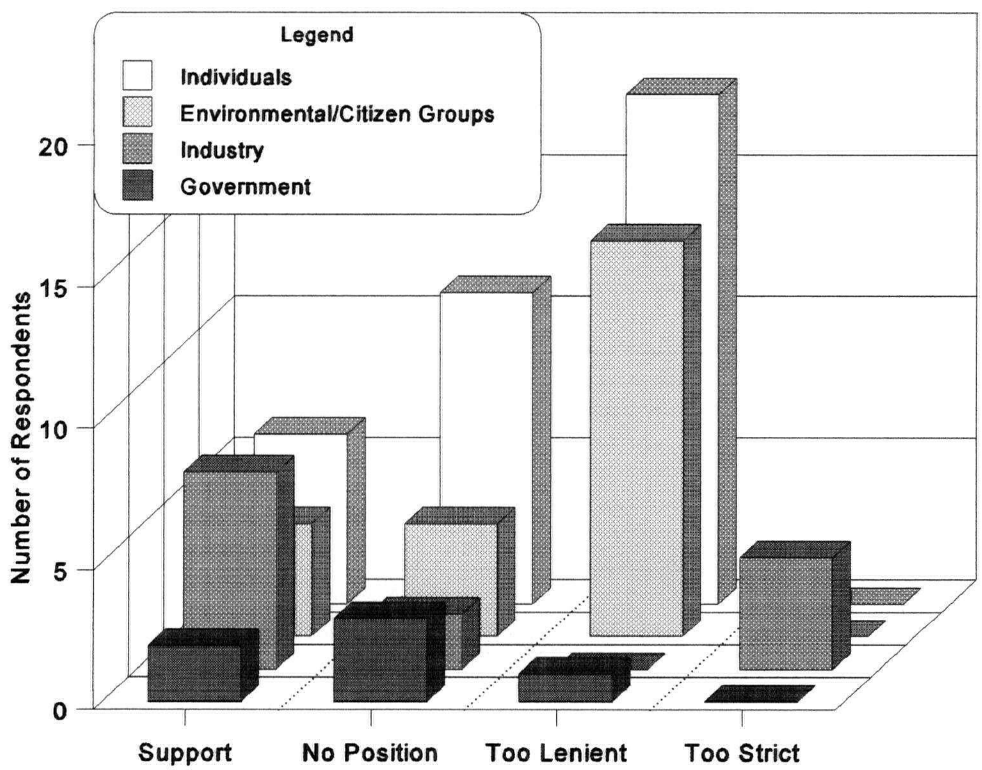


Figure 4.4: Classification of Consultation Respondents Studied

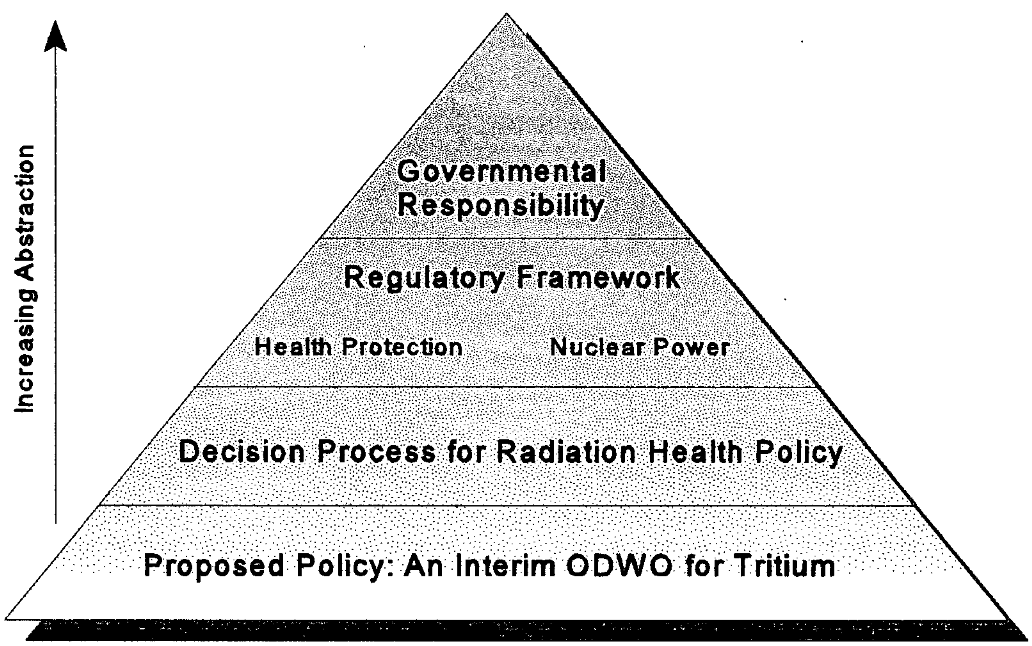
There are two points of interest in Figure 4.4 worthy of note here. The first is that a significant proportion of the total number of respondents, 20 of 76, did not take a position on the proposed policy. The argument profiles for these respondents were therefore concentrated in the "Other Issues" section of the framework. The other interesting point is that while four of the 37 respondents who opposed the proposed policy were industry related, all four, and only these respondents, felt that the new guideline was actually too lenient and should either remain at the current level of 40,000 Bq/l or be increased. Consequently, no industry related respondent argued that the proposed interim guideline was too lenient.

Of the 76 respondents studied, the 37 opponents outnumber the 18 supporters by approximately two to one. However, this ratio is not considered to be an important factor in this study, except to the extent that it is acknowledged that the opponents' arguments are perhaps more comprehensively represented in the analysis. There are several possible reasons why a greater number of individuals or groups who oppose a government action would participate in a process such as this over those who support it. The possibility of a vocal or well organized minority is acknowledged. No significance is therefore given to whether the allocation of responses is representative of society more generally. However, this study is concerned with what the specific arguments expressed during this consultation may indicate about public perceptions and opinions of the risk management process. The 76 sample responses to the ACES consultation display a wide range of views as to what issues are relevant to the debate, and which perspectives on those issues ought to be given serious consideration in policy formation. Not only did the participants respond to the questions posed with respect to the proposed policy, but many imparted unsolicited comments on a range of additional issues. It is assumed, therefore, that this sample is reasonably representative of the range of views held in society, yet is not necessarily representative of the distribution of those views.

Indicative of the range of views held by the respondents, in relation to establishing a health based guideline for tritium in drinking water, are a host of issues which were raised as relevant to the debate but not directly in support of a respondent's position, or in many cases any position, on the proposed interim ODWO for tritium of 7,000 Bq/l. These issues are represented in the centre space of the graphic framework titled "Other Issues." In addition to addressing the three open-ended questions, ACES also encouraged potential respondents to make additional comments. Either this suggestion was widely acted upon or the three-question format provided an inadequate framework for participants to air their views, but 59 of the 76 respondents studied expressed views which did not specifically address the proposed policy, reasons for agreeing or disagreeing with it, or an alternative to it.

Instead, many of their arguments or suggestions touched on issues relating to the appropriateness or acceptability of activities occurring at various levels of the socio-political framework in which risk management decisions are made. Figure 4.5 depicts the various levels of this framework as a hierarchy in which the higher levels represent increasing abstraction from the policy issue in question. The first level in the hierarchy is that with respect to the specific policy in question. Issues raised here involve arguments on the proposed ODWO for tritium. These issues are taken primarily from the "Support" and "Oppose" areas of each respondent's argument profile (Appendix A). The next level involves the processes of decision making in this policy domain. On this matter, respondents commented both on the traditional process of decision making for radiation health policy, and on the consultative process carried out by ACES in which they had chosen to participate. The next level in the hierarchy involves various regulatory frameworks of which the respondents focused their comments on two in particular: that with respect to health protection, and that concerning nuclear power technology. Issues discussed here abstract further from those of the decision process to include some of the more general concerns, goals and principles of regulation. Finally, the highest level in the hierarchy is that with respect to governmental responsibilities. These issues are the most abstract from the policy question and include social and philosophical matters raised independently of concerns relating to the other three levels.

Figure 4.5: Hierarchy Of Levels Within The Socio-political Framework For Risk Management



This hierarchy is representative of the scope and dimensions of the policy debate played out during the tritium consultation. Moreover, each level forms the basis for how the issues and perspectives raised by respondents are organized in the following section. The main points of the respondents' arguments, as expressed in their submissions to ACES and represented in Appendix A, are summarized in Tables 4.3 through 4.7.

4.3.3.1 The Proposed Policy of An Interim ODWO For Tritium

In Table 4.3, the arguments advanced in relation to each party's position on the proposed ODWO for tritium are organized by issue, and according to whether the position represents support for or opposition to the government's proposal. Although many of the respondents commented on issues raised by the ministry in its Rationale Document, the scope of discussions regarding the policy was definitely not limited in this regard. On the issue of the guideline value (section A), a range of alternative values were suggested by those who opposed the policy, presumably in response to the third of ACES' three questions. The majority of these were offered by respondents who argued that the proposed value was too lenient, although the suggestion also was made to maintain the current value or actually increase it.

The issue of acceptable risk (section B) is one which roused, not surprisingly, a fervent response from participants who opposed the proposed guideline, including those who argued to maintain or increase it. Those who supported the government's proposal deferred this issue to the technical experts, and looked to consistency with other jurisdictions for reassurance that the risk imposed was reasonable. Opponents who argued for a stricter guideline, however, appeared to rigorously question not only the value itself--as to whether 5×10^{-6} is indeed an acceptable level--but also the legitimacy of the underlying assumptions which guide the derivation of the risk value. This is a significant observation, as will be discussed later in the chapter, in that it demonstrates a reluctance among some members of the public to accept

Table 4.3: The Proposed Policy Of An Interim ODWO For Tritium

	SUPPORTING ARGUMENTS		*OPPOSING ARGUMENTS*	
ISSUE	*MoEE RATIONALE*	*AGREE*	*TOO LENIENT*	*TOO STRICT*
A: Proposed Tritium Guideline	• 7,000 Bq/l interim guideline pending release of GCDWQ 6th Edition	• 7,000 Bq/l is acceptable	• should be zero • should not exceed background levels • should be 5-10 Bq/l • should be 10-30 Bq/l • should be two standards: 8.7 Bq/l near nuclear plants or else 300 Bq/l • should be 100 Bq/l • should be 800 Bq/l • should be 2300 Bq/l or lower	• should remain 40,000 Bq/l • should be higher than 40,000 Bq/l
B: Acceptable Risk of 5×10^{-6} fatal cancers	• based on ICRP recommendations for public exposure limits	• recommended by reputed scientists internationally • basis of standard setting in other jurisdictions • comparable to other common accepted risks	• ignores wildlife and sensitive populations • is an annual rather than lifetime risk • less stringent than for other carcinogens • ignores non fatal effects • accepts too many deaths • immoral to argue this • figure is uncertain • non-cancer effects are also important	• risk comparable to that of other normal activities • low level radiation may be beneficial
C: Regulatory Consistency	• GCDWQ for tritium is to be similarly revised • AECB will soon adopt 1 mSv legal exposure limit • consistent with WHO drinking water guidelines	• guideline is effectively same as EPA limit	• IJC recommends virtual elimination of radionuclides with a half-life > 6 mo • standard should be at least as low as U.S. limit • standards for other hazardous materials more stringent	

	SUPPORTING ARGUMENTS		OPPOSING ARGUMENTS	
ISSUE	***MoEE RATIONALE***	***AGREE***	***TOO LENIENT***	***TOO STRICT***
D: Natural Sources of Human Radiation Exposure	• greatest exposure is from background radiation		• no treatment technology exists	
E: Anthropogenic Sources of Human Radiation Exposure	• CANDU emissions are a small percentage of total exposure	• NGS discharge should be as low as possible • tritium is measured regularly and is always below 7,000 Bq/l • 7,000 Bq/l is 19 times > highest measured in 1991 • levels rarely exceed 100 Bq/l	• non-natural tritium should not be allowed in drinking water • only source of elevated tritium is CANDU reactors and is preventable • levels decline as move away from Ajax • Canada has highest tritium levels in world	• tritium spills are expensive therefore rarely occur • NGS emission are only a small percentage of background levels
F: Tritium in Drinking Water		• should be as low as possible • highest measured values of tritium are only 370 Bq/l	• tritium spills are often not publicized • measuring techniques may underestimate amount present • public should be notified if levels rise to above background • should work toward zero tolerance	
G: Health Effects of Radiation	• low doses may cause adverse effects • linear no-threshold hypothesis is assumed		• not enough is known so guideline should be prudent • present and future generations are at risk • sensitive populations and other life forms are important	• longer life expectancy at high altitudes in India suggests radiation beneficial • low level radiation may be beneficial

	SUPPORTING ARGUMENTS		OPPOSING ARGUMENTS	
ISSUE	***MoEE RATIONALE***	***AGREE***	***TOO LENIENT***	***TOO STRICT***
H: Health Effects of Tritium		• intergenerational effects not proven • studies near nuclear facilities not conclusive • birth defects studies not conclusive	• alternate information suggests guideline should be more conservative • don't know combined effects with other hazardous substances • gov't resources should be directed at more studies • even small quantities harmful • risks include cancer / immune deficiency / birth defects • tritium has unusually high cell binding and mobility	
I: International Scientific Community Recommendations	• important basis of radiation health policy internationally	• experts are respected / current / impartial / qualified • apply conservatism in methods • differing scientific views are considered • non-fatal effects are considered • linear no threshold hypothesis is conservative	• recommendations are not reliable • confidence in results not justified • history of underestimating risks • framework committed to nuclear power • not conservative enough • dose limit is for average person and does not consider children and fetus • risk calculations for low doses guided by high dose studies • assumes homogenous population • linear dose-response model is arguable	

	SUPPORTING ARGUMENTS		*OPPOSING ARGUMENTS*	
ISSUE	***MoEE RATIONALE***	***AGREE***	***TOO LENIENT***	***TOO STRICT***
International Scientific Community Recommendations (continued)			• studies not based on "hard data" • risk assessment is too narrow • combined effects of contaminants not considered	
J: Uncertainty in Scientific Information			• research cannot keep up with number and combinations of contaminants • effects probably more severe than estimated • tritium dispersion not known • standard should reflect possible inaccuracies • long term effects not known • conflicting estimates of dose from exposure	
K: Economic Effects of Changing Guideline from Current Value		• none since levels are below proposed guideline and no treatment technology exists	• none at a any guideline > 500 Bq/l • limit is impossible to exceed	• potential costs to industry should be reasonable • should not be changed to appease special interests • any reductions should balance costs and benefits
L: Environmental Effects of Changing Guideline from Current Value				• environmental benefits are unclear

	SUPPORTING ARGUMENTS		OPPOSING ARGUMENTS	
ISSUE	*MoEE RATIONALE*	*AGREE*	*TOO LENIENT*	*TOO STRICT*
M: Potential for Guideline To Be Exceeded		• government agencies will act responsibly • unplanned tritium releases addressed by emergency planning procedures • guideline allows for sufficient margin of safety • short term deviations are safe • measures planned in case of nuclear emergencies		
N: Proper Allocation of Health Protection Funds		• to control costs, need to resist eco-media terrorism and exercise common sense	• clean up of toxic emissions is paid for by taxpayers	• tritium should be low priority relative to other health problems • insufficient evidence to justify costs of lowering guideline
O: Application of Tritium Guideline		• community safety should be main priority		
P: Past Debates on Tritium Guideline			• Porter Commission [1980] had recommended 4,000 Bq/l	
Q: Toxic Contaminants as a Health Risk			• accumulate in food chain • increased cancer rates are observed on Great Lakes	

(without question) the recommendations of scientific experts on issues related to public policy, especially where there is a high perceived level of uncertainty associated with the recommended values.

The perspectives expressed regarding the issue of regulatory consistency (section C) provide an excellent example of how, by placing emphasis on different aspects of the same issue, one can argue for very different outcomes. Both supporters and opponents of the proposed guideline agree that regulatory consistency is an important issue in setting health based standards. However, what divides the two sides are the policies and agencies with which it is argued the guideline should be consistent. The ministry and its supporters argued that the proposed guideline: is consistent with the (anticipated) EPA guideline, the expected revised GCDWQ, and the WHO drinking water guidelines for tritium; and is consistent with the 1 mSv dose equivalent limit which the AECB is expected to adopt shortly, therefore should be supported. A few opponents, however, argued that tritium, as a radionuclide with a half-life of greater than six months, falls under the IJC's category of persistent toxins which it recommends, in its "Strategy for Virtual Elimination of Persistent Toxic Substances" (IJC 1993), should be eliminated. They also refer to the U.S. EPA guideline for tritium, and cite the risk factor used to establish standards for other hazardous substances, for example chemical contaminants in drinking water, which involve usually a 10^{-6} lifetime, rather than annual, risk of cancer fatality.

Both natural and anthropogenic sources of human exposure to radiation (sections D and E), especially the relative contribution of each to total exposure, were also important issues raised with respect to the proposal. Those who supported the proposed policy appeared to focus on the significance of the low measured levels of tritium relative to recommended exposure limits, whereas the opponents who argued for a stricter guideline presented more philosophical arguments regarding the preventability of those measured levels. The opponents who argued against lowering the guideline expressed confidence in the nuclear industry to prevent high levels of tritium from contaminating drinking water, or again emphasized the relative contribution of natural radiation to total human exposure. With respect to the issue of tritium in drinking water specifically (section F), supporters again iterated the importance of low levels and referred to those which have been measured. Opponents arguing for a more strict guideline, however, appear to be less concerned with the actual measured levels than with the failure of authorities to properly measure, and adequately inform the public when levels of tritium in the water system are higher than usual.

An interesting dynamic occurred in the debate with respect to the issues of health effects from radiation and, specifically, tritium (sections G and H). Uncertainty in scientific information was an argument used both to support and to oppose the ministry's proposal. What distinguishes these arguments is the emphasis on prudence in light of that uncertainty suggested by those who argued for a more strict guideline. Another interesting aspect is the contentious suggestion made by a couple of respondents who argued against changing the guideline because human radiation exposure may in fact be beneficial.

The recommendations of the international scientific community (section I), particularly those of the ICRP, were raised as an issue both by the ministry and by many respondents to the consultation. Arguments in support of the proposed guideline stressed the importance of these recommendations to radiation health policy internationally, the credibility and impartiality of the associated scientists, and emphasized the conservatism of the approach taken on arriving at these recommendations. In stark contrast, the policy's opponent arguing for more stringency stressed the limitations of the community's studies, the poor credibility of the agencies, and several perceived problems with the assumptions underlying the policy recommendations. This divergence of views is significant in the context of this study since these recommendations have historically formed the basis of the scientific aspect of legitimacy for all policies in the radiation health protection policy domain in Canada. The extent of public skepticism on this issue, as well as on the following issue in the table involving the extent and relevance of uncertainty in available scientific information (section J), should be an important indication to decision makers of potential problems of legitimacy regarding the traditional, closed, science-based approach to decision making which characterizes this domain.

Issues regarding the economic and environmental effects of changing the guideline from its current level (sections K and L) were also raised. Supporters suggested that the absence of any economic implications is an argument in favour of the proposed guideline. Opponents, however, at least those who would like to see the guideline lowered further, question the rationale for choosing the proposed level since the new guideline will have no real effect on economic activity and will therefore have no measurable effect on tritium levels in drinking water. Moreover, the opponents who argued against lowering the guideline argued in terms of which principles should be applied in circumstances involving cost-benefit tradeoffs.

The next issue in the table listing policy related issues involves the potential for unplanned releases of tritium from nuclear facilities to bring levels in drinking water above the guideline (section M). This issue was raised by supporters of the proposed guideline, and is an important reflection of the extent of confidence expressed by some respondents as to the ability of government agencies and procedures to protect the public's interests in the event of an emergency situation. The views expressed on this issue reflect public confidence in both the conservatism of the guideline and the effectiveness of emergency planning procedures. And finally, the next three issues in the table (sections N to P) reflect the distribution of certain priorities and specific concerns with respect to the costs and application of health protection policies expressed by respondents, while the last issue (section Q) is a comment on the general health risks of consuming toxic contaminants.

4.3.3.2 The Decision Making Process For Radiation Health Protection

The next in the series of tables summarizing the issues raised during the public consultation corresponds to the second level in the hierarchy representing the socio-political framework for risk management. In Table 4.4, arguments advanced on the subject of the processes of decision making are distinguished between those relating to the traditional process of decision making for radiation health protection policies, and those relating to the public consultation, coordinated by ACES, on the proposed tritium guideline. These arguments are organized according to whether the respondent expressed support for or opposition to the particular process, or whether an unaligned statement of principle was simply offered on a particular issue.

The first item in Part A of the table relates to the MoEE's decision to proceed with the

Table 4.4: The Decision Making Process For Radiation Health Protection Policy

	A: TRADITIONAL PROCESS		
ISSUES	***SUPPORTING ARGUMENTS***	***OPPOSING ARGUMENTS***	***STATEMENTS OF PRINCIPLE***
A: Decision to Proceed with Pickering / Ajax Water Supply Plant		• should be located farther away from Pickering NGS • too close to sewage and nuclear outflows • existing water plant predates the Pickering NGS • poor and unhealthy location • disturbs the beauty and serenity of the waterfront • approval is appalling, not logical	
B: Justification of Health Standards		• reasons for different rationales for drinking water guidelines in U.S. and Canada are unclear	• published sources should be consulted before any advice taken • should be based on cost-risk/benefit analysis
C: International Scientific Community Recommendations	• standards have gradually been tightened	• has consistently underestimated carcinogenic effects of radiation • alternative scientific views not given enough weight • constitutes a "house of cards" for standard setting • interests not congruent with public concerns • confidence expressed in findings not justified	
D: Credibility of Policy Advisors	• respondents are not experts		

	A: TRADITIONAL PROCESS		
ISSUES	***SUPPORTING ARGUMENTS***	***OPPOSING ARGUMENTS***	***STATEMENTS OF PRINCIPLE***
E: Derivation of Dose Equivalent Limit		• should also consider skin and air pathways • should address water ingestion and dose conversion factor for children • internal doses are underestimated	
F: Background or Natural Radiation as a Basis for Setting Guidelines		• reference to natural radiation obfuscates the issues / ignores sensitive populations • humans have a physiological response to tritium exposure which is unique to other forms of radiation • should consider pre-1945 background levels • have limited understanding of atmospheric effects • background levels are higher than before industry	
G: Risk Assessment as a Basis for Guideline Value		• risk estimate assumes cancer only ill health effect • processes depersonalize health impacts • do not consider cumulative effects • is a means of rationalizing decision • not sound basis for standard setting • risks imposed without choice	• should justify why acceptable risk diverges from that of other ODWOs
H: Accounting for Uncertainty in Health Risk Estimates	• humans may be able to adapt to greater exposure to radioactivity • intergenerational effects are debatable	• combined effects of pollutants unknown • chronic exposure less certain	
I: Public Concerns Regarding Radiation Health Risks	• medical treatment of overexposure is simple and effective		

	A: TRADITIONAL PROCESS		
ISSUES	***SUPPORTING ARGUMENTS***	***OPPOSING ARGUMENTS***	***STATEMENTS OF PRINCIPLE***
J: Community Consultations		• previous recommendations regarding drinking water have not yet been implemented	
	B: ACES' CONSULTATION PROCESS		
K: Adequacy of Public Information Provided by MoEE Rationale Document		• Rationale Document is misleading; minimizes concerns • not clear on sources of tritium • health effects are downplayed • disjointed presentation • inconsistent use of units • should follow a specified format • too technical to comprehend • tritium data for water treatment plants near Darlington is absent	
L: Practical Effect of Consultative Process	• effort is laudable / commendable • good opportunity to investigate health problems near nuclear facilities • good opportunity to investigate chemical contamination	• government is not serious about incorporating public views • time frame too short • participant funding is needed • process protects the "status quo" • not effective; parties allowed to "let off steam" • issues raised here duplicate other processes • not necessary if lowering standard is possible without consultation	• public should have access to the committee's report

	B: ACES' CONSULTATION PROCESS		
ISSUES	***SUPPORTING ARGUMENTS***	***OPPOSING ARGUMENTS***	***STATEMENTS OF PRINCIPLE***
M: Jurisdiction of ACES			• should compensate for regulatory "vacuum" for radioactive emissions • agency should recommend a new location for the water treatment facility • report should include a recommendation to eliminate all sources of tritium including nuclear reactors
N: Qualification of the Public to Comment	• many citizens have useful knowledge to contribute	• lack of technical knowledge limits ability to comment on alternative levels • no expertise to contribute to consultation • few have knowledge to give credible comments	• credentials should be checked before advice given

new water treatment facility in Ajax (section A). The appearance of this issue in the debate is indicative of the apparent relevance of matters which historically underpin the ministry's decision to proceed with the tritium consultation. The respondents who commented on this issue appear to be displeased with both the process used to make the decision, and the rationale given to proceed with the facility. Although siting of water treatment facilities was an issue effectively outside the scope of issues relevant to setting drinking water guidelines, to these respondents, given the history of this consultation process, it seemed relevant and apparently worthy of consideration by those who are charged with establishing the tritium guideline. However, it is also possible that these respondents, while recognizing that the siting issue is outside the scope of the review, viewed the consultative process on tritium as the most effective forum for making their views on this issue heard.

Questions related to how health standards generally, and radiation health standards specifically, are developed and justified (sections B to D) were also raised as issues of process. With respect to the issue of justification (section B), two respondents suggested particular principles of decision making including the need to consult credible information sources and to apply cost- or risk-benefit analysis. More specifically critical of the traditional process, one respondent criticized the apparent divergence in rationale between U.S. and Canadian guidelines. On the issue of the international scientific community recommendations (section C), some respondents provided an indication of how they perceive this sector of the policy community. Although one respondent supports the gradual tightening of recommended radiation exposure limits, the views expressed in the next column represent varying degrees of scepticism. Some respondents criticize this group of technical elites for consistently underestimating the cancer risk of exposure to radiation. Other criticisms include a failure to give adequate consideration to alternative views and research, and an overconfidence in their own results. Systemic problems with relying so heavily on the recommendations of this group are also stressed. One respondent views this reliance as analogous to a "house of cards," while another is concerned with an apparent inconsistency of their interests with those of the public interest generally. Collectively, the perspectives expressed here seem to relay a sense that historical reliance on the legitimating ability of the international scientific community in radiation health protection policy making may no longer be adequate. Another argument with respect to the credibility of policy advisors (section D), in support of the traditional process, concerned the limited expertise provided by lay citizens.

The next three issues in the table deal specifically with some of the assumptions underlying radiation health policies (sections E to G). For the most part, those who expressed opinions here were critical of this aspect of the traditional decision making process. Those assumptions which were specifically targeted were: the derivation of the dose equivalent limit (section E), using background radiation exposure as a basis for setting guidelines (section F), and using risk assessment as a basis for establishing the guideline value (section G). It is interesting to note that as well as suggest various weaknesses and omissions with respect to these assumptions, a few respondents questioned the appropriateness of even using risk assessment to set guidelines. These arguments suggest that risk assessment depersonalizes the health impacts, that it is a means of rationalizing the imposition of risks, and that it does not differentiate voluntary from involuntary risks.

The last three issues in this section of the table were relatively narrowly discussed. On the next issue in the table, accounting for uncertainty in health risk estimates (section H), supporters and opponents of the traditional process are again divided by the question of whether policies should reflect prudence when information on health risks is lacking. Then, on the next issue regarding cause for public concern over radiation health risks (section I), a respondent argues in support of the traditional process on the basis that medical treatment of overexposure is both simple and effective. And finally, one respondent, who raised the issue of community consultations as part of the traditional process (section J), expressed scepticism at the government's sincerity in seeking public input given its failure to adopt previous recommendations borne out of other community discussions with decision makers.

Part B of Table 4.4 is concerned with issues raised and arguments made on the specific matter of the ACES consultation process. On the issue of the information which was provided for the consultation (section K), particularly the MoEE's Rationale Document, the submissions were overwhelmingly critical. Several respondents criticized the format, clarity, and completeness of the document; one was displeased with the emphasis given potential health effects; and another felt that the requirement to comprehend technical information was too great. Yet on the issue of the practical effect of the ACES process (section L), the opinions were mixed. Several respondents supported the process in principle and were pleased at the government's initiative in this regard, while others were more critical of the government's motivation and sincerity. For the most part, however, respondents referred to the perceived weaknesses in the process' design.

With respect to the issue of the scope of ACES' jurisdiction (section M), the arguments neither support or criticize the process; however, they are indicative of the reasons why some respondent's chose to participate in this process. More than one respondent suggested that the functional role of ACES should extend beyond its terms of reference on the interim ODWO for tritium. There were three such suggestions. One respondent argued that ACES, in its recommendation regarding the drinking water objective, should consider the need to compensate for the apparent regulatory "vacuum" which exists in the control of radioactive emissions. Another respondent appealed to ACES to recommend a new location for the water treatment facility proposed in Ajax. And yet another respondent suggested that ACES should recommend the elimination of all sources of tritium including nuclear reactors. Again, it is possible that these respondents perceived these matters to be relevant in the context of the consultative process to review the tritium guideline because of a necessary link between their suggestions and the policy question at hand. However, it is also possible that this participatory process provided a reasonably germane forum in which to raise, and express strongly held convictions on, these other policy questions at a time when no alternative forum was apparent.

Finally, the last issue in this table involves the perceived qualification of various individuals and groups in the public sphere to comment on a highly technical policy question (section N). While some respondents felt that their own technical knowledge, and that of others lay citizens, was not adequate enough to have any affect on the direction of policy, one respondent stressed that some citizens have acquired useful knowledge in this regard, and hence are qualified to comment on certain issues.

4.3.3.3 *The Regulatory Framework For Health Protection*

Corresponding to the third level in the hierarchy of socio-political considerations for risk management, Tables 4.5 and 4.6 profile the issues relating to two aspects of the regulatory framework for this policy domain: health protection and nuclear power. Again, the arguments advanced here are organized according to whether the respondent expressed support for or opposition to the particular framework, or whether an unaligned statement of principle was offered.

Table 4.5 lists a number of issues related to health protection policy making which are relevant at a more general level than the operative process of decision making that was profiled in Table 4.4. It is interesting to note that while arguments advanced on the matter of process tended to be highly critical, the arguments advanced on the matter of the health protection policy framework reflect, to a much greater extent, statements of principle. This is certainly the case with respect to the issue of drinking water guidelines as a policy tool (section A). While one respondent criticized the guidelines for their failure to seriously consider public health and safety, other arguments were framed around priorities and programs which should, in the views of these respondents, guide their application.

On the issue of the principles which guide risk management generally (section B), the arguments involved were again, overwhelmingly, statements of principle. One respondent argued in support of the traditional framework which purports to allow for a sufficient margin of safety in setting guidelines. However many other respondents suggested a range of principles including: balancing risks and benefits, establishing priorities, factoring a mix of

Table 4.5: The Regulatory Framework For Health Protection

	TRADITIONAL FRAMEWORK		
ISSUES	*SUPPORTING ARGUMENTS*	*OPPOSING ARGUMENTS*	*STATEMENTS OF PRINCIPLE*
A: Drinking Water Guidelines as a Policy Tool		• health and safety of the public are not taken seriously	• should be for the protection of the entire population • human and animal life should be priority over business • should consider future generations • effects on developing fetus should be considered
B: Principles for Guiding Risk Management	• benefit of reactor shutdown when tritium standard approached does not justify costs		• should be realistic / credible / rational / meaningful / measurable • should maximize the net benefit to society • costs of reducing small risks should be justified • one cell harmed by one molecule of substance should mean zero tolerance • no priority should be given to business interests • gov't should adopt a balance of different views and not adopt one side • principles should be the same for all hazardous materials • should be "as low as reasonably achievable"
C: Environmental and Health Policy Goals			• should plan to eliminate all anthropogenic tritium

	TRADITIONAL FRAMEWORK		
ISSUES	***SUPPORTING ARGUMENTS***	***OPPOSING ARGUMENTS***	***STATEMENTS OF PRINCIPLE***
D: Focus of Regulatory Concern			• need to focus on controlling discharges • need to document natural variations in contaminants • need phase out, rehabilitation and clean up programs • need a timetable for phase out of contaminants • drinking water supplies should be protected • need to clean up the Great Lakes
E: Regulatory Consistency / Contrast		• should follow IJC recommendation of virtual elimination of radionuclides with a half-life of more than 6 months • U.S. and Canada should harmonize their standards • should follow U.S. model: no construction 5 mi of an NGS • should follow IJC "precautionary principle" and "principle of reverse onus" • rationale for lower U.S. standard unclear	
F: Implications of Overregulation	• overregulation can cause public to lose respect • real environmental problems can be overshadowed by trivial ones		
G: Health Effects Near Nuclear Facilities	• studies not conclusive	• more studies needed to explain childhood leukaemia excesses near Pickering and Bruce NGS'	

	TRADITIONAL FRAMEWORK		
ISSUES	***SUPPORTING ARGUMENTS***	***OPPOSING ARGUMENTS***	***STATEMENTS OF PRINCIPLE***
H: Siting of Water Treatment Plants		• should await results of long term exposure testing • U.S. law prevents construction within 5 mi of an NGS	• siting should consider health threats
I: Emergency Water Plant Closure	• other mechanisms (than drinking water objectives) should trigger		
J: Measurement of Tritium Levels for Drinking Water		• tritium not measured at point of water treatment intake	• should have continuous monitoring
K: Availability of Information		• sufficient data exists regarding the health risks of tritium to warrant action	
L: Radiation Health Effects Research	• work of scientist challenging linear no threshold hypothesis is not relevant to humans	• indicates higher incidence of childhood leukaemia near nuclear plants • is accommodating to the interests of the nuclear industry	• long term testing of low level exposure and cumulative effects is needed • important to remain current • need information on build up in the food chain • more research needed into low level radiation effects • health benefits of radiation should be explored
M: Other Health Effects Research			• more investigation into natural contaminants is needed • experts suggest that many chemical contaminants are still unknown
N: Controversy Over Risk		• special interests affect one's perception of risk	

	TRADITIONAL FRAMEWORK		
ISSUES	***SUPPORTING ARGUMENTS***	***OPPOSING ARGUMENTS***	***STATEMENTS OF PRINCIPLE***
O: Food Irradiation		• products should be labelled	
P: Alternative Drinking Water Sources			• prefer spring to municipal water

views into decisions, and applying consistent regulatory principles across hazardous materials. Statements of principle were also the focus of comments made regarding policy goals and regulatory focus (sections C and D). Most of these arguments involve suggestions as to how to improve the existing regulatory framework without specifically criticizing the existing one.

Arguments relating to the next issue in the table regarding regulatory consistency (section E), however, are primarily criticisms of the traditional framework. These arguments focus on some principles of regulation espoused by the International Joint Commission such as the "precautionary principle" and "reverse onus," as well as on its strategy for "virtual elimination of persistent toxic substances" which recommends that all radionuclides with a half-life of greater than six months be eliminated (IJC 1993). They also focus on regulatory principles applied in the U.S. and question the divergence observed between the two countries in terms of policy rationales.

The next six issues listed in this table reflect some specific concerns or opinions of respondents. Reviewing these briefly, arguments advanced on the issue of overregulation and its implications for society (section F) are supportive of the traditional framework as they caution decision makers against acquiescing too much to demands for tighter standards. Arguments regarding the issue of health effects near nuclear facilities (section G) were again divided on the appropriateness of prudence; and similarly, on the issue of siting water treatment facilities (section H), respondents argued for prudence and conservatism. The next issue of water plant closure in case of emergencies (section I), in support of the traditional process, argues against using drinking water guidelines as the regulatory mechanism for this type of action. On the issue of how tritium levels are measured for drinking water (section J), a respondent questions why measurements are not taken at the point of water treatment intake. And finally, also critical of the existing framework, a respondent raises the issue of availability of information (section K) and argues that enough is in fact known about the risks of tritium to human health to warrant stricter regulatory action.

With respect to the next two issues in the table, radiation and other health effects research (sections L and M), there is a dominant theme among the statements of principle offered which stresses the importance of current and comprehensive research. However, on the issue of radiation health research specifically, some debate as to the traditional framework was evident. One respondent defends the linear no-threshold hypothesis on which radiation risk estimates are based against the work of one scientist discussed during the consultation whose research challenges this assumption. Yet another respondent, however, challenges the traditional assumption that the added risk from exposure to tritium in drinking water is small by referencing another study which indicates a higher incidence of leukemia near nuclear plants.

The remaining three issues in the table reflect very specific concerns. On the issue of risk controversy (section N), one respondent stresses that one's perception of risk is influenced by whether one is subject to or benefits from that risk. On the issue of food irradiation (section O), a respondent expresses concern as to the public's awareness of the nature of consumer products. And finally, on the issue of alternative drinking water sources (section P), a respondent stated her or his decision to choose an alternative to municipal water supplies.

4.3.3.4 The Regulatory Framework for Nuclear Power Technology

Also corresponding to the third level in the hierarchy of socio-political considerations for risk management are a significant number of issues and arguments made during the consultation which relate to the regulatory framework for nuclear power technology. These issues are organized in Table 4.6 in the same format as that which characterized Table 4.5. It is both interesting and informative to note that these issues, which involve an entirely different jurisdictional framework from that of health protection and drinking water, figured so prominently in the debate played out during the consultation. Moreover, with the exception of a few philosophical statements or suggestions, the overarching theme of arguments advanced on this subject is overwhelmingly critical of the traditional regulatory framework.

The sentiment expressed in relation to the issue of governmental commitment to nuclear power (section A) is echoed in the arguments advanced on many other issues in this table. On this issue, some respondents expressed their objection to, and concerns regarding, the government's historical economic and political commitment to the technology, and are dubious of the implications of this commitment for adequate and effective protection of public safety. For example, on the issue of regulatory principles applied to emissions control (section B), respondents are critical of the "dilution solution" principle, which allows radioactive emission levels to be measured after they have been diluted and which is not permitted in relation to other non-radioactive types of toxic emissions, and of the failure of the industry to utilize the best available abatement technologies.

Again, on the issue of the regulatory framework itself (section C), respondents were critical of the exemption which radioactive substances enjoy from the provincial emissions

Table 4.6: The Regulatory Framework For Nuclear Power Technology

	TRADITIONAL FRAMEWORK		
ISSUES	***SUPPORTING ARGUMENTS***	***OPPOSING ARGUMENTS***	***STATEMENTS OF PRINCIPLE***
A: Governmental Commitment to Nuclear Power		• AECB, AECL, and MoEE are historically strong advocates • government concerned with promotion / protection • public resources are being used for private gain	
B: Principles for Regulating Radioactive Emissions		• is guided by "dilution solution" principle • best available technology for emission control not being used	• costs of nuclear power should reflect costs of regulation • should not be licence to pollute
C: Framework for Regulating Radioactive Emissions		• tritium emissions not subject to MISA policy • dominated by nuclear industry • a regulatory "vacuum" exists for control of tritium emissions • levels rarely exceed 100 Bq/l therefore plants have no incentive to improve operations	• best way to reduce toxins in drinking water is at source • every effort should be made to contain spills • emissions should be reduced • gov't should focus on controlling Ontario Hydro emissions
D: Monitoring of Nuclear Plant Emissions		• accidental spills not monitored adequately	
E: Risks from Nuclear Plant Emissions		• U.S. nuclear plants are also on Great Lakes contributing to tritium levels • 12.5 year half-life for tritium allows for environmental loading • birth defects are proven	• levels which approach standard for tritium suggests problem with safety of reactors • emissions from NGS in Kincardine is source of concern

	TRADITIONAL FRAMEWORK		
ISSUES	*SUPPORTING ARGUMENTS*	*OPPOSING ARGUMENTS*	*STATEMENTS OF PRINCIPLE*
F: Merits of Nuclear Power Technology		• millions of dollars have been wasted • costs of clean up will be borne by future generations • has led to higher electricity prices	
G: Trust in Industry		• industry disregards unfavourable information and twists other available information to their advantage	
H: AECL Chalk River Laboratories		• monitoring of waste stream is inadequate • a tighter tritium guideline would expose its inadequacies • ongoing cover-up of magnitude of releases and health consequences • a radiation plume is moving toward the Ottawa River	
I: Power Surplus Situation in Ontario			• opportunity exists for regulators to anticipate plant weaknesses

control policy MISA (Municipal Industrial Strategy for Abatement), and perceive a "regulatory vacuum" in place of this exemption. Other respondents perceive that the industry has a dominant influence over the design of policies in this framework, and that the approach to setting emission limits is ineffectual. Several principles were also suggested on this issue. These include the arguments that tritium levels are more effectively controlled at their source than by drinking water guidelines, and that emphasis on the need to reduce current emission levels is needed. Moreover, on the issue of nuclear emission monitoring (section D), one respondent is critical of authority's efforts to adequately account for accidental tritium spills.

With respect to the risk posed to human health by nuclear plant emissions (section E), a few respondents stressed the inadequacy of the traditional framework to account for the contribution of U.S. plants to tritium levels in the Great Lakes, and to reflect the potential for tritium levels to accumulate given the 12.5 year half-life of the contaminant. Another respondent stressed the extent to which health effects are known but not acknowledged. A couple of statements of principle were also advanced. One respondent suggests that if tritium levels approach the level of the standard, the implications for reactor safety are much greater than for human health. Another respondent simply expressed concern regarding emissions from the Bruce Nuclear Generating Station in Kincardine, Ontario.

Arguments advanced in relation to the next two issues in the table, those of the merits of nuclear technology and of public trust in the industry (sections F and G), reflect highly critical views of the traditional regulatory framework. On the merits of nuclear technology, the respondents expressed disapproval with both the level and distribution of its costs. Moreover, on the issue of trust, one respondent expressed distrust in the industry to provide an honest and fair assessment of the risks. On the issue of the AECL Chalk River Laboratory (section H) raised by a few respondents, concern was expressed with respect to a number of perceived inadequacies including waste stream monitoring and the provision of honest information to the public regarding its exposure to health risks. And finally, on an issue raised by one respondent regarding the power surplus situation in Ontario, it is argued that regulators should be using this opportunity to anticipate plant weaknesses and prevent potential emergencies.

4.3.3.5 Governmental Responsibilities

The last in the series of tables summarizing the issues raised during the public consultation corresponds to the fourth level in the hierarchy of socio-political considerations for risk management. Table 4.7 lists those issues which are most abstract from the policy question and focus on the broader responsibilities of government as they relate to this policy domain. The arguments advanced on these issues are organized similarly to the approach used for the second and third levels in the hierarchy with the exception that the supporting and opposing arguments correspond to the perceived adequacy of the government's performance in meeting its responsibilities. Most of the arguments presented here are, again, primarily statements of principle. However, a few respondents made comments which directly criticized the government's effectiveness in fulfilling its responsibilities.

The views expressed on the issue of the regulatory role of government (section A), suggest a degree of expectation on the part of respondents that government will act as guardian to the interests of public health and safety. More specifically, on the issue of social

Table 4.7: Governmental Responsibilities

	RESPONSIBILITIES ADEQUATELY FULFILLED		
ISSUE	*SUPPORTING ARGUMENTS*	*OPPOSING ARGUMENTS*	*STATEMENT OF PRINCIPLE*
A: Role of the Regulator			• should serve the public interest • should be preventing environmental disasters
B: Social Priorities		• presence of toxins violates principles of clean water • economic considerations are not more important than ecological concerns • public's willingness to tolerate risks is declining	• drinking water should be a priority now and in future • air and water should be suitable for human use • public safety should be a priority over Ontario Hydro's interests • health of children is primary importance • concerned with human health and the protection of the planet
C: Public Dependence On Government To Defend Its Interests			• depend on politicians to protect public safety • millions rely on water from the Great Lakes • both humans and animals are affected
D: Trust in Authorities to Defend Public Interests		• past incidents have diminished public trust • cannot be trusted to decide what is "safe"	

priorities (section B), many respondents commented on certain priority setting principles for the development of health policies. These comments include the suggestions that drinking water should be always be a priority, that air and water should be suitable for human use, that public safety should take priority over business interests, that the health of children should be a high priority, and that human health and ecosystem protection should be important concerns. There were also a few criticisms of the government's performance on this issue. One respondent argues that the presence of toxins in drinking water violates the principle of maintaining clean water. Moreover, other arguments include the suggestion that prioritizing economic concerns over those of the environment has been inappropriate, and that the public's willingness to tolerate risks is declining relative to those which are currently reflected in policy.

The expectation that government should defend public interests is also reflected in the views expressed on the issue of public dependence on government (section C). These comments reflect a sense of vulnerability on the part of some respondents to the risks to public safety often broadly imposed by industry. However, the arguments advanced specifically on the issue of public trust in government to defend those interests (section D) reflect criticisms arising out of some respondents' past experiences in this regard.

As Tables 4.3 to 4.7 demonstrate, the range and diversity of both the issues raised and the perspectives expressed by respondents during the public consultation are considerable. Each argument profile is a unique map of the logic of a respondent's argument as it was conveyed in their written submission to ACES. There are two pronounced general observations arising from the issue analysis. The first observation involves the extent of diversity among perspectives held by participants on the same or similar issues, and the range of issues perceived to be relevant both to the debate over the proposed policy question specifically and, in the wider context of the more abstract levels of socio-political framework for decision making, in the radiation health protection policy domain. Even when the scope of arguments was limited to those aspects which specifically related to the interim ODWO for tritium, the scope of the debate including arguments in support of and opposition to guidelines was widened from that which characterized the 1979 derivation of radiological parameters. The second observation is the extent to which respondents advanced statements of principle in their arguments regarding, especially, the three higher levels of the socio-political framework for risk management. The prevalence of these statements suggests that some members of the public perceive, to varying degrees, a need to reform the traditional approach to decision making not only at the level of process, but at the higher levels of the framework as well. Moreover, the principles advanced at the higher levels indicate a dominant theme among perceptions that risk management decisions should be reflective of the values and priorities of society as a whole.

4.3.4 Incorporating The Consultation Into Decision Making

As was mentioned earlier in this chapter, the MoEE did not accept the recommendation of ACES which followed from the public consultation process. That recommendation was to lower the tritium guideline immediately to 100 Bq/l, and further to 20 Bq/l over the following five years to allow for any necessary economic adjustments (ACES 1994). Moreover, no formal explanation was provided by the ministry for its decision to reject ACES' proposal.

There are, however, a few interesting observations regarding this decision which follow from the process and issues analyses undertaken here. Many respondents to the consultation challenged the assumptions which underlie the traditional approach to decision making in this policy domain. One such challenge was to the use of an acceptable risk factor of five per million (5×10^{-6}) excess cancer fatalities per annum. This assumption was disputed because acceptable risk factors for exposure to chemical contaminants are usually in the range of one per million excess cancer fatalities per average human lifetime or seventy year period. The discrepancy was perceived to allow for a significantly greater risk to the public from exposure to radiological contaminants than from exposure to other types of contaminants. This argument led ACES to adjust the 7,000 Bq/l value proposed by the MoEE to reflect a five per million per lifetime risk. The 100 Bq/l value was derived by dividing 7,000 by 70 years. The further reduction to 20 Bq/l suggested to follow in five years was similarly adjusted to reflect lowering the risk from five per million excess cancer fatalities per lifetime to one per million.

As Figure 4.2 illustrates, the consultation process was peripheral to the traditional institutional process of decision making for the policy domain. For the most part, it did not involve the actors from the traditional policy community, but reflects the perceptions and opinions of individuals and groups in the public sphere. Consequently, the recommendation for policy which followed from it illustrates how decision makers have failed to comprehend the extent to which public perceptions of this policy, and the process of decision making whereby it is developed, have diverged from those which were prevalent in 1979 and earlier.

The recommendation of ACES was likely rejected because it challenged many of the fundamental assumptions which underlie all radiation health protection policy in Canada. Moreover, the add-on nature of this process to the traditional approach, and the weak terms of reference provided by the ministry, minimized the extent to which it was obliged to justify its decision.

4.4 EXAMINING THE ROLE OF SCIENCE IN THE DECISION MAKING PROCESS

As was discussed earlier in this chapter, science has historically played an important role in the process of policy development for the radiation health protection policy domain. From the discussion of the formal institutional process of setting the radiological parameters for drinking water guidelines in Canada, it was apparent that on two levels, both international and national, scientists were, and still are, important policy advisors to the decision makers in this domain. Moreover, despite attempts to allocate the risk assessment and risk management functions of policy development among different government departments and committees, the more critical risk management decisions to radiation health protection policy--such as acceptable risk and the relevance of background radiation levels--are inherent in the recommendations of the scientific experts at the ICRP and the Radiation Protection Bureau.

The policy sector for radiation health protection, including Health Canada, AECB, and the provincial environment ministries, has relied heavily on the legitimating abilities of the international scientific community to ground their policies. Consequently, in keeping with this expectation, the work of these agencies exhibits some of the prescriptive qualities of mandated or policy-oriented science. The ICRP derives its recommendations for limiting occupational and public exposure by applying an assumed degree of acceptability to quantitative estimates of risk taken from the results of scientific studies undertaken by other international scientific organizations. Clearly, the role of the ICRP in the decision making framework in Canada is less technical than it is policy-oriented given the nature of the judgements needed to arrive at specific values, especially the recommended dose equivalent limit for occupational and public exposure.

In the context of the institutional framework which characterized the development of radiological guidelines for drinking water in 1979, depicted in Figure 4.2, the vast majority of the most potentially contentious policy issues had been resolved before the recommendations of the Radiation Protection Bureau were advanced to the Federal Provincial Working Group on Drinking Water. Moreover, the same conflict resolution arrangement exists presently in the context of the framework under which the radiological parameters of the sixth edition of the GCDWQs are being developed. For the political decision makers, there is a considerable advantage to attributing the most difficult social decisions to the advice of technical experts. Moreover, the advantage is even greater when those decisions are embedded in scientific recommendations which have the appearance of being derived through complex analytical methods.

The influence which both national and international technical elites have exercised in this and other radiation health decision processes has undoubtedly been a determining force in steering the direction of public policy in this domain. The combined traits of exclusivity in decision making and consensus among scientists have effectively allowed the science-based decision making framework to endure the many changes which have occurred in public perceptions of science and in environmental policy making generally. Although it is difficult to say definitively why the MoEE did not adopt the ACES' recommendation regarding the tritium guideline, it appears that the political actors, whose interests were supported by the recommendations of the scientific community, exhibited a degree of political leverage greater than that held by the participants in this particular process. In short, it appears that introducing an element of public involvement to this highly esoteric and traditionally science based policy domain effectively did little to diminish the influence of the scientific community over the process of policy development. The role of science was, and apparently still is, that of key policy advice and legitimation both for the process of decision making, and for the policy itself.

Chapter Five

EVALUATING THE PARTICIPATORY APPROACH

5.1 OVERVIEW

The goal of this thesis is to study how decision makers are responding to public pressure for risk management decision making processes which are more transparent, and more representative of the diversity of interests in society. Specifically, the study is concerned with how well participatory processes have been designed to address the issues of legitimacy which have plagued the traditional, science-based approach to decision making common to many risk policy domains in Canada.

The first of three specific objectives identified in Chapter 1 was to describe and contrast the traditional approach to decision making for radiation health protection policy (using the process for developing the 1979 drinking water guidelines as representative of the traditional approach) and the participatory approach utilized by the Ontario government in 1994 to introduce an interim drinking water objective for tritium. This objective was met through the process and issue examinations, and the examination of the role of science in decision making undertaken in Chapter 4. The two remaining specific objectives of the study are addressed in this chapter. They are: to identify the problems of legitimacy which characterize the traditional approach to decision making in the radiation health protection policy domain, and to evaluate the design of the participatory approach utilized by the ministry for its interim tritium guideline in terms of how well it addresses the problems of legitimacy identified.

5.2 IDENTIFYING PROBLEMS OF LEGITIMACY IN RADIATION HEALTH POLICY MAKING

In identifying which types of issues raised by respondents to the consultation were indicative of potential problems with the legitimacy of the traditional decision making approach, several arguments presented in the literature were used. These arguments were discussed in Chapter 2. In summary, they suggest that public demands for a more direct and effective role in policy development have flowed from a few key changes in public perceptions and expectations observed during the first and second "waves" of environmentalism. First, it is argued that public confidence in government to defend its interests against those of industry has been diminished by perceptions that many risk management regulatory frameworks are controlled by industry, and that past attempts to introduce protective measures have been inadequate. Second, it is suggested that public conceptions of how democracy is achieved in decision making no longer reflect a strict representative model. And third, it appears that public perceptions of the appropriate role of science in decision making no longer support a positivist, science-based approach, and that the legitimacy of difficult social decisions cannot be attained by deferring social and political questions to scientific experts.

By entering into a participatory process on an interim tritium guideline, the Ministry of Environment and Energy pre-empted the traditional federal process of setting radiological parameters in drinking water. However, the decision to adopt this particular approach followed from the ministry's earlier decision to approve the construction of a water treatment facility in Ajax, Ontario. The historical context of the public consultation on tritium helps to explain why many of the participants commented on matters not covered by the terms of reference of the consultation. However, observations from the case study analysis suggest that the wide range of issues perceived to be relevant to drinking water policy may also be significant more generally for understanding how issues of legitimacy affect the incentives of individuals and groups to participate.

As was discussed in Chapter 4 and illustrated in Figure 4.5, the socio-political framework for decision making on radiation health protection in Canada can be considered to comprise four main levels of a hierarchy where each level represents a further degree of abstraction from the policy question. The first level involves the policy itself. The second level relates to the process of decision making. The next level relates to the regulatory framework for decision making and two such frameworks were perceived to be relevant: health protection and nuclear power. And finally, the highest level involves issues related to the responsibilities of government.

The case study revealed that when the question of a particular policy was presented to the public for comment, a range of issues corresponding to all levels within the socio-political framework for decision making on that policy were perceived to be relevant to the debate. Moreover, it appears that the types of legitimacy problems discussed in the literature in relation to risk decision making generally, arise at all levels in the hierarchy of socio-political considerations for radiation health policy making. For example, some arguments advanced by respondents on the matter of governmental responsibilities in Table 4.7 suggest that a lack of public confidence in government to defend public interests contributed to a compromise in the legitimacy of the traditional approach. Also, other arguments advanced on the matter of the ACES consultation process in Table 4.4 suggest that public support of the concept of participation in decision making challenges governmental commitments to the closed bipartite bargaining process.

Consequently, the case study lends support to the argument that public perceptions of the legitimacy of a particular approach to decision making are affected by perceptions of legitimacy at any one or all levels of the hierarchy which characterizes the socio-political framework for decision making in that policy domain. This observation poses a challenge to decision makers in designing participatory processes which remedy problems of legitimacy. Not all of these types of problems can be addressed through process design. However, it is argued here that an acknowledgement on the part of decision makers that these types of problems are prevalent among public perceptions is necessary. This acknowledgement may involve some means of registering public views on these problems or a long term strategy for dealing with them.

Table 5.1 summarizes the perceived problems of legitimacy identified through the issue analysis undertaken in Chapter 4. The perceived problems of legitimacy are grouped according to how they relate to the general types of problems identified in the literature. Each component of the table is explained in the following sections.

5.2.1 Public Confidence in Government

In reviewing of the views expressed during the tritium consultation, it is evident that not all of the participants lacked confidence in governmental decision makers to safeguard and defend the interests of the public. Some respondents who supported the government's proposed tritium guideline expressed confidence that in the event of a potential health

Table 5.1: Support for and Challenges to the Legitimacy of the Traditional Science-Based Approach to Decision Making		
ISSUE OF LEGITIMACY	*SUPPORTIVE PERCEPTIONS*	*CHALLENGING PERCEPTIONS*
A: Public Confidence in Government to Defend Public Interests	• confidence in government to act responsibly in the event of an emergency health situation • confidence in the adequacy of measures in place to respond to a nuclear emergency	• concern with correlation of government and nuclear industry interests • concern with inadequacy and industry bias of the regulatory framework for nuclear emissions • concern with government's past record of failing to protect public interests over those of industry • mistrust of government to determine acceptable levels of safety
B: Conceptions of Democracy in Decision Making	• scepticism regarding the usefulness of citizen input	• support for the concept of participation in decision making • endorsement of the value of lay expertise
C: Perceptions of the Role of Science in Decision Making	• emphasis on science as an important basis of policy legitimacy • endorsement of notion that information and recommendations of international scientific community provide sufficient basis for policy • stress the importance of qualified and recognized expertise	• concern with extent to which uncertainties and information gaps are recognized and reflected in policy • concern with credibility of the international scientific community due to perceived ties to nuclear industry • concern with reliability of the international scientific community due to past inaccuracies • concern with balance of alternative scientific views considered for policy • concern with balance of science and non-science principles for establishing policy

concern, the appropriate government agencies would act responsibly, and existing emergency mechanisms would be adequately responsive. These perceptions are listed in the second column of Table 5.1, section A and indicate a degree of support for the legitimacy of the traditional approach.

Many respondents, however, did express concern that the government was either disinclined on unable to defend public interests against those of industry. Distrust and disillusionment with governmental priorities in relation to health concerns was a dominant theme in discussions related to the regulatory framework for nuclear power and nuclear plant emissions. Essentially all respondents who raised nuclear power technology as an issue relevant to the consultation debate expressed some degree of concern or disapproval regarding the safety or cost of the technology, or the adequacy of its regulation. Amid these types of statements were concerns regarding government's apparent connection, at and across various levels, to the nuclear industry, and hence the strong convergence of both parties' interests.

In addition to public concerns over nuclear power regulation, a number of principles and arguments were advanced by respondents generally on the matter of the government's perceived record of fulfilling its public interest responsibilities. With respect to the regulatory role of government, a few respondents made statements which underscore the conviction that it is the responsibility of government to protect public safety. Other respondents, however, indicated that public trust in government to defend its interests has been diminished by past experiences, especially with regard to determinations of what constitutes an acceptable level of safety. These perceptions are listed in the third column of Table 5.1, section A and indicate that the legitimacy of the traditional approach is in some dispute.

In summary, the broad public conception that it is the charge of government to defend the public's interests against those of industry does not appear to be in dispute among the participants. However, public confidence in government to defend its interests in this regard is a matter of some debate among respondents. Those who expressed confidence focused specifically on the adequacy of programs and actions aimed at guarding public interests in the event of a nuclear emergency. In contrast, and more generally, those who expressed concern were overwhelmingly critical of the government's ability to fulfill its public interest responsibilities in relation to the nuclear industry.

5.2.2 Social Values and Conceptions of Democracy

The extent to which public conceptions of how democracy is achieved in decision making influenced the level and nature of participation in this process was less clear from the views expressed during the consultation than was the extent of public confidence in government. However, the arguments advanced on the matter of the ACES consultation process do provide some insight into public views in this regard. In support of the traditional approach, some respondents were critical of the ability of lay citizens to provide useful input to the process. Others were particularly critical of the participatory approach taken by ACES and the ministry in the tritium case.

However, some respondents commended the government's effort to involve the public in the policy development process, citing the value of the extensive practical knowledge held by some members of the public. With the exception of those who opposed the approach in concept, it seems that those who expressed criticism did so in a way which suggested that the process could be improved. Moreover, public participation, to these respondents as well as to those who lauded the effort, appears to fulfill an important function in the decision making process. These perceptions are listed in section B of Table 5.1.

5.2.3 Perceptions of the Role of Science in Decision Making

It has been argued throughout this study that the positivist perception of science is at the root of the traditional decision making framework for radiation health protection policies. From the submissions made during the public consultation on tritium, it appears that a significant segment of the general public still subscribes to that view. For example, of those respondents who supported the government's proposal for an interim ODWO for tritium, those who endorsed the acceptable risk factor of 5×10^{-6} did so almost entirely because of its acceptance elsewhere and the credibility of the international scientific community from which it originated. Moreover, on the issue of the scientific community itself, supporters of the proposal defended the impartiality and qualifications of its members, and referred to the scientific rigour and focus on conservatism which are perceived to underpin their recommendations. Some respondents cautioned decision makers not to heed unqualified advice, and to check the credentials of anyone who claims to have expertise on these types of issues. Moreover, in a similar vein, others questioned their own qualification to comment on the policy questions posed given their lack of technical training, and limited comprehension of the subject matter of the debate. These perceptions lend support to the legitimacy of the traditional approach and are listed in the second column of Table 5.1, section C.

Focusing less on the actual role of science and scientists in the decision making process, several respondents made general comments regarding the importance of scientific information for policy. One respondent emphasized the importance of remaining current in terms of radiation health effects research. Moreover many other respondents also stressed the need for more studies on a range of issues including health effects near nuclear plants, low level radiation exposure effects, potential health benefits from radiation exposure, and naturally occurring contaminants in drinking water. This resounding call for more research suggests that science is still widely viewed as an important basis for developing health protection policies. However, other arguments made suggest that the importance of reliable and current scientific information does not necessarily infer that science should form the pivotal basis of risk policies.

Not all participants expressed equal confidence in the information and recommendations of the scientific community. A number of participants stressed the need to be realistic about the level of inherent uncertainty in these types of statements. Moreover, further arguments related to several perceived limitations in scientific methods reflect an apparent acknowledgement on the part of some respondents of the inherent complexity of natural and biological systems, and the need to reflect uncertainties in health based standards.

In addition to uncertainty, many respondents also questioned the credibility of the international scientific community, and hence the reliability of their assessments, given extent to which the framework for radiation health research accommodates the interests of the nuclear industry. Reliability is also raised as an issue with respect to the community's history of consistently underestimating the carcinogenicity of radiation exposure. Moreover, it is apparent that many respondents perceive that not enough conservatism is being reflected in policy by accepting these recommendations. In several cases, respondents question, or specifically oppose, the underlying assumptions of the community's policy recommendations, often with reference to other sources of information and research. The public perceptions of uncertainty, credibility and reliability with respect to science in decision making are listed in the third column of Table 5.1, section C.

Hence a dichotomy in public views as to the nature and role of both scientific information, and the acknowledged scientific community is observed. While some of the respondents studied appear to view the tasks of risk assessment and policy advice to be rightly and necessarily the exclusive domain of technical experts, others, to varying degrees, expressed confidence in both their own right and their qualification to comment on several aspects of this domain. Although some of these respondents limited their comments to very general statements of concern or recommended actions, there were many which expressed their views in technical terms, and argued as if their suggestions should be weighed equally against those of the international scientific community. This observation is significant in that it demonstrates that the perception of scientists as an elite and revered group in society is not universal. Moreover, it demonstrates an eagerness, on the part of at least some lay citizens and social interest groups, to become involved in an esoteric debate which has traditionally been carried out among a small and select group of experts.

Further, comments made which question the credibility of these experts suggests that a portion of the public recognizes the inherent characteristics of mandated science in the recommendations of the ICRP and other scientific agencies, and is conscious of its limitations in terms of providing objective and politically neutral information for policy. Given the extent to which respondents' comments specifically questioned the assumptions and research underlying policy recommendations, it may be inferred that a portion of the population is reluctant to allow these experts, in closed negotiations with decision makers, to continue to decide the direction of radiation health protection policy. Moreover, it is also reasonable to conclude that public concerns regarding the reliability of scientific information, and to an extent, regarding the objectivity and neutrality of scientists, is likely a significant contributing factor to the change observed in this policy domain toward public involvement in decision making.

From the submissions analysed in this study, it would be impossible to deduce the proportion of the population which holds each of these types of views. However, it is significant to note that while no one appears to be questioning the importance of or need for science in decision making, disagreement is prevalent on the matter of the extent to which we should be relying on that information in developing risk management policy. This observed dichotomy is an important indication of the source of controversy over radiation health policy which arose during the ACES consultation. From many of the views expressed on these issues, the legitimating capacity of risk assessment and risk management recommendations is not clearly sufficient on its own to underpin radiation health policy for all respondents. This is true not only for those participants who argued for a more conservative approach to health protection, but also for those who cautioned decision makers against imposing too strict a guideline. Indeed, many respondents argued for the need no only to weigh alternative scientific arguments against each other, but also to weigh scientific information generally among a host of other important social and political considerations. These perspectives are also listed in the third column of Table 5.1, section C.

In summary, of those respondents studied, there is an apparent divergence in perceptions as to the reliability, objectivity and neutrality of science and hence its appropriate role in the decision making process for radiation health protection policy. However, most respondents agree that science should be one of a number of social considerations to be weighed in policy development. Although opinions tend to differ as to what these considerations should be, and how much weight should be afforded each, the need to widen the scope of the policy debate to include more significant, non-science arguments is echoed across respondents' arguments. Consequently, public perceptions that the traditional science-based approach to decision making is too narrow to consider the range of relevant issues is also likely an important contributing to the introduction of public involvement to this domain.

It is difficult to say whether and how the perceptions of public confidence, democracy and the role of science in decision making have changed over the course of period between 1979 and 1994 without any parallel process with which to evaluate differences. The radiation health protection policy sector has enjoyed prolonged insulation from intense public scrutiny throughout this period and has provided few opportunities for the public to comment on processes for decision making. However, the submissions analysed here indicate that the legitimacy of the traditional process is, in the opinions of many of the respondents, in some degree of doubt. In keeping with arguments put forth in the literature, this analysis suggests that the impetus for the observed change in process in the radiation health protection policy domain is due, at least in part, to perceptions which challenge the legitimacy of the traditional approach to decision making.

5.3 ANALYSING THE GOVERNMENTAL RESPONSE

Each of the problems of legitimacy identified in Table 5.1 have implications for the design of a participatory process. However, it is how they are interpreted in the social and political contexts for decision making which determines what those implications are. From the theoretical concepts discussed in Chapters 2 and 3, it was apparent that the different perspectives, values and priorities held by different groups in society profoundly affects how social issue controversies are perceived. Not all of the respondents in the tritium consultation presented arguments which challenged the legitimacy of the traditional science-based approach to decision making. Citizens determine their own point of reference against which to judge the rationality of their own and others' concerns. Therefore, addressing a diversity of concerns, underscored by an even greater diversity of rationality references, requires a decision making approach which is sensitive to this diversity, and adaptive to changing public perceptions of legitimacy over time.

The governmental response to, in part, public pressure to become involved in policy decision making on radiation health issues is documented in Chapter 4. In general, this response appears to fall short of adequately and appropriately addressing the legitimacy concerns identified from the submissions. More specifically, as Table 5.2 illustrates, the ministry appears to have approached the concept of participation in decision making without a clear acknowledgement or understanding of the concerns which prompted many citizens and groups to become involved.

Section A of Table 5.2 lists the first two legitimacy-relevant concerns identified in Table 5.1, section A. These concerns relate specifically to the government's relationship with the nuclear industry in Canada. As presumably most of the respondents who advanced these arguments were aware, nuclear industry regulation was effectively outside the terms of reference for the consultation and, even more significantly, entirely outside of the MoEE's legislative jurisdiction. Consequently, it is not surprising that no provision was made in the participatory process to address these specific concerns.

Table 5.2: Summary of the Evaluation

	PUBLIC PERCEPTION	*GOVERNMENTAL RESPONSE*	*CONGRUITY OF RESPONSE TO PERCEIVED PROB.*	*THEORETICAL ISSUES*
A	• concern with correlation of government and nuclear industry interests • concern with inadequacy and industry bias of the regulatory framework for nuclear emissions	Emphasis placed on regulatory consistency among the government agencies in the radiation health policy sector in Canada.	NONE	The legitimacy of decision making for the radiation health protection policy domain is linked to the legitimacy of the regulatory framework for nuclear power technology.
B	• concern with government's past record of failing to protect public interests over those of industry • mistrust of government to determine acceptable levels of safety	Public fears are addressed with written and sessional information on technical basis for policy.	INADEQUATE ATTEMPT	Alternative models of rationality from those which characterize the framework for decision making exist in the public sphere. Other social and political factors are of varying importance to the rationality requirements of different groups in society.
C	• support for the concept of participation in decision making • endorsement of the value of lay expertise	A process which best resembles "persuasion" is advanced as a "consultation." No change in the policy or decision making process was intended to follow from it.	INADEQUATE ATTEMPT	Incorporating public views in the process of decision making is perceived by the public to have potential benefits. Some redistribution of authority and influence over policy is necessary.
D	• concern with extent to which uncertainties and information gaps are recognized and reflected in policy	The matter is deferred to the information and recommendations of the international scientific community.	INADEQUATE	The public acknowledges the complex and varying nature of uncertainty and its implications for policy making. "Risk," "uncertainty," "ignorance" and "indeterminacy" in science each call for different approaches to developing protective policies.
E	• concern with credibility of the international scientific community due to perceived ties to nuclear industry	No recognition of a problem was apparent.	NONE	The public recognizes political and economic influences over science. The public is frustrated with the present power relationships which are inherent in the traditional decision making process.

	PUBLIC PERCEPTION	*GOVERNMENTAL RESPONSE*	*CONGRUITY OF RESPONSE TO PERCEIVED PROB.*	*THEORETICAL ISSUES*
F	• concern with reliability of the international scientific community due to past inaccuracies	No recognition of a problem was apparent.	NONE	The public is confident and sufficiently literate to deconstruct traditionally stabilized facts and notions. The public is demanding a more explicit and comprehensive justification of risk management policies.
G	• concern with balance of alternative scientific views considered for policy • concern with balance of science and non-science principles for establishing policy	No recognition of a problem was apparent.	NONE	Social constructivist views challenge the assumptions which underpin the legitimacy of mandated science.

However, the history of events leading up to the consultation should have alerted decision makers to the potential for these types of issues to surface. Although the ministry lacks the legislative capacity to effect change in the nuclear regulatory policy domain, omitting these issues from the scope of relevant issues covered in the Rationale Document ignores a significant point of public contention in the policy debate. The issue analysis undertaken in Chapter 4 indicates that issues relating to the regulatory framework for nuclear power are perceived to be relevant to a number of respondents in the context of the policy issue. Moreover, the matter of designing health protection policy for radiation contamination is conceptually linked to, and in many cases indistinguishable from, the matter of controlling potential sources of that contamination. Consequently, the perceived legitimacy of radiation health policy for drinking water is integrally connected to the perceived legitimacy of the regulatory framework for nuclear power technology.

It does not appear, given the emphasis on regulatory consistency which characterized the ministry's arguments, that this conceptual connection was fully appreciated. The Rationale Document stressed the high degree of consistency prevalent among the radiation health protection policies of the AECB, Health Canada and the ministry. However, this emphasis probably did more to diminish public perceptions of the legitimacy of the drinking water guidelines setting process than it did to support it.

In section B of Table 5.2, the next 2 legitimacy-related concerns identified in Table 5.1, section A are discussed. These concerns relate to perceptions of the extent of governmental protection provided for public interests. These involve both public perceptions of the adequacy of protection provided in the past, and mistrust in government to determine what constitutes an appropriate level of safety for the public. It is very likely that in entering into this particular process, the ministry was acknowledging, at a fundamental level, its poor public image in regard to these issues. The participatory process was initiated around a proposal to tighten a standard for a widely perceived health risk. Moreover, a public process would possibly have been perceived by the ministry as an effective means of profiling the introduction of a new health policy which, in lowering a contaminant limit from 40,000 to 7,000 units, appears to offer a more substantive level of public protection. However, judging from the range of alternative guideline values suggested by respondents who perceived the proposal to be too lenient, the ministry not only misjudged the extent of the public's risk aversity to radiation related contaminants, but significantly miscalculated the guideline value at which its efforts would be widely applauded.

With respect to the issue of the government's past record of defending public interests, the process does appear to have been designed to address some specific concerns. The Rationale Document--despite its perceived inadequacies--and the public information sessions held during the consultation were undoubtedly attempts to inform the public of the technical process whereby radiation protection policies are formulated, and of the assumptions and priorities on which they are based. Presumably, the ministry assumed that a more comprehensive understanding of the process and assumptions would allay many of the public fears perceived to be borne out of irrationality as a result of incomplete information. Therefore, regardless of whether the approach was able to adequately address this issue, the initiative on the part of government to respond to the concern through public involvement was apparent.

However, the assumption that more information could adequately address public concerns did not consider the possibility that risk perceptions are not necessarily correlated to technically based estimates of harm. Members of the public tend to evaluate their acceptance of certain risks according to their own sense of rationality (Krimsky and Plough 1988). Moreover, technical methods for measuring risk comprise only one aspect of that rationality along with many personal and social considerations. Consequently, a participatory approach which focuses solely on informing the public of technical methods of risk assessment will undoubtedly prove to be inadequate for addressing these types of legitimacy issues.

With respect to the issue of public mistrust in government to establish appropriate levels of safety for the public, the same types of problems with the participatory approach are evident. The ministry defers the issue of determining levels of safety to the recommendations of recognized experts in the field internationally, and reiterates their arguments in its Rationale Document. Although the process does appear to involve at least an attempt to address issues of public trust through written and sessional information, the assumption which underlies this approach is not reflective of any alternative models of rationality prevalent among members of the public. For example, there were a few respondents who argued that to base a health guideline value on a quantitative estimate of an acceptable risk to the public is immoral, or otherwise inappropriate in terms of providing protection to the public. Because the values and priorities of the public are heterogeneous, consensus as to any one particular determination of a universally accepted level of safety would be impossible. Therefore, the actual choice of that level, in terms of its legitimacy, is probably less important than the process whereby it is determined.

The next perceptions discussed, in section C of Table 5.2, involve public conceptions of democracy. Although the consultation on tritium did not provide a clear indication of how conceptions of democracy and participation in decision making are reflective of problems of legitimacy in this policy domain, some arguments advanced did indicate that many respondents supported the concept and felt that certain measures could be taken to improve it. However, the approach to public involvement taken by the ministry did not reflect an attempt to incorporate public views into its traditional decision making process.

Upon commissioning ACES to undertake a public consultation for an interim tritium guideline, and in taking steps to prepare a policy proposal for public review, it is apparent that the MoEE was not prepared for the debate which ensued. It is possible that the minister viewed the consultative process as an important measure for legitimating the decision to proceed with construction of the water treatment plant. It is also possible that the government hoped to capitalize on an opportunity to introduce a more strict guideline at a time when the policy issue was most visible, and the decision could be profiled to the electoral constituency most prominently. However, it appears unlikely that the government intended for public input to alter the current direction of radiation health policy for drinking water in Ontario. The ACES consultation on tritium, both in its design and implementation, and in its placement within the broader context of setting guidelines for radionuclides in drinking water in Canada, was, in terms of Eidsvik's (1978 in Parenteau 1988) classification, an attempt at "persuasion" disguised as "consultation."

There are several observations which support this argument. First, there is no practical explanation for isolating tritium from the other four radionuclides listed in the GCDWQ other than the obvious public concern over nuclear plant emissions affecting drinking water. The traditional approach to setting radiological parameters is to limit the sum of all radionuclides present in a water source to within a maximum dose equivalent limit. The key assumptions which underlie a specific radiological guideline value are common to all radionuclides with the exception of the dose conversion factor applied to each element. These technical assumptions, spelled out for the most part in the MoEE's Rationale Document, could not have been intended for public debate with respect to tritium alone. Any change in these assumptions would necessarily apply to all radionuclides, and would therefore have significant implications outside the scope of the proposed interim guideline. Not only would the policy sector's emphasis on consistency undermine the legitimacy of the other radiological parameters for drinking water, but the policies of the AECB, which involve nuclear plant emissions regulation, would also be affected. It seems extremely likely that the government's intention, in providing this rationale, was, as was discussed in relation to the issues of public confidence, to inform the public of the basis used to establish the proposed value, and not to open these issues up for public debate.

Second, even if the government had intended to launch a public debate on the assumptions underlying radiation health protection policy, the technical presentation of arguments and focus of discussions on the information and recommendations of internationally recognized scientific organizations limits the scope of issues on which the public can provide qualified comments. Although many of the recommendations of the ICRP on which radiation health policy in Canada is based--such as acceptable risk--are essentially policy related questions with broad social significance, they are framed here as scientific issues which have traditionally been resolved through technical methods. Non-technical or even technical arguments presented by lay citizens would be hard pressed to subvert those of the recognized technical elite.

A third observation in support of the argument that the ACES consultation did not display the characteristics of a "consultation" as such, involves the stage of the traditional decision making process at which the participatory process was introduced. From Figure 4.2, it was apparent that the majority of issues relevant to establishing radiological parameters for drinking water have been historically, and are still currently, resolved by the Radiation Protection Bureau of Health Canada, and then the Federal-Provincial Subcommittee (or Working Group) on Drinking Water. The Ontario Ministry of Environment and Energy participates in this process through its involvement in the latter, and again through the Conference of Deputy Ministers of Health. However, the policy debate is generally resolved, and positions are fortified through intergovernmental agreement before the parameters are published in the GCDWQ. It is not apparent that by introducing the participatory process for the tritium guideline that the MoEE was proposing to abandon its involvement in the traditional process. The proposed guideline had been deemed an "interim" value pending the release of the sixth edition of the GCDWQs. Moreover, the consultation had not been an attempt to reform the traditional framework within which the policy debate generally takes place. Consequently, it appears that public views regarding the desirability of public involvement, and regarding the benefits to the overall process of incorporating the expertise of lay citizens, were entirely missed in designing this particular participatory process.

The remainder of Table 5.2--sections D through G--relate to public perceptions of the appropriate role of science in the decision making process. In relation to the other two categories of legitimacy problems, these are the most illuminating of the issues which divide the supporters from the opponents of the traditional approach to decision making. These issues are arguably the critical impediments to the political and social transformation from traditional bipartite science-based decision making for risk management to approaches which involve the public directly and effectively in the decision process. The discussion in section D of Table 5.2, regarding the recognition and treatment of uncertainty in science, provides a useful overview.

As was discussed in earlier chapters, the legitimacy of science-based decision making depends to a great extent on a widely held perception of science in society which is consistent with the positivist view. Risk assessment is a form of mandated science; therefore, public acceptance of social trade-offs made on the basis of recommendations which flow from these methods depends on the perception that the work is objective, systematic, and politically neutral. At the time the decision making framework for this policy domain was established in the late 1960's, it is very likely that the science-based approach was not only widely perceived to be legitimate, but perceived to be the only acceptable approach to this type of policy making. Therefore, during the radiation health protection policy sector's long and stable period of insulation from intense public scrutiny, changes in public perceptions regarding the perceived appropriate role of science in decision making would have been of little practical significance.

In addition to the historical basis of legitimacy, the case study indicates that at least a portion of the population is still comfortable with the science-based approach. These citizens not only perceive an important role for science in risk decision making, but are also reluctant to accept any information or recommendations which do not emanate from the traditionally accepted scientific community of experts. Therefore, although some citizens do recognize the inherent limitations of mandated science in terms of addressing the complex social and political issues which accompany risk problems, it is not surprising that the ministry would be reluctant to raise scientific uncertainty and information gaps as issues in this participatory process and risk compromising its present acceptance by having to justify the decision making framework for radiation health policy in Canada.

For those who consider science to be an objective, politically neutral and systematic enterprise, uncertainty is often perceived as a simple error factor--which can be reasonably estimated and compensated for by some amount of conservatism--for an otherwise accurate assessment of risk. This perception sees the uncertainty associated with radiation health risk in the "risk" category of Wynne's (1992) categories of uncertainty which assumes that the critical chemical and biological parameters which define the risk, and the relationships among them, are well known. For these respondents, the traditional approach to decision making in this policy domain provides a sufficient margin of safety to the public.

The ministry appears to have addressed the issue of uncertainty in science by not acknowledging its relevance in the context of the policy question. It seems that pronouncement of the credibility and authority of the international scientific community was perceived to provide a sufficient response to questions of potential inaccuracies or omissions. However, for those who are sceptical of the positivist character of science, the uncertainty inherent in radiation health risk estimates reflects more than just a margin of error. Many respondents suggest that the confidence with which estimates of risk are advanced in support of health policies is unjustified, and cite several perceived inaccuracies and omissions in the underlying assumptions. They also question the capability of science to answer all of the relevant questions in the policy debate. This perception sees the uncertainty associated with radiation health risk encroaching on the other three categories--which represent increasing degrees of uncertainty--of Wynne's risk categories. "Uncertainty," "ignorance," and "indeterminacy" are all types of uncertainty perceived to characterize radiation health risk. Consequently, the same science-based approach to risk management, which is sufficient for those who believe that technical methods can compensate for scientific uncertainty, will not be adequate for this group.

From a process design perspective, addressing this particular problem of legitimacy presents an obstacle for decision makers different from the other categories of problems. Addressing public concerns with respect to uncertainty and information gaps in policy would require a radically different approach to decision making, with very different assumptions about the limitations of science than that which has traditionally characterized this policy domain. This could involve accepting alternative scientific information or recommendations, or even relying to a much lesser extent on technical approaches to estimating risk and determining acceptable levels. These types of approaches challenge what has been the most fundamental basis of legitimacy for radiation health policy making in Canada, and adopting them could risk, in the short term at least, losing the support of those who are committed to the positivist perception of risk problems.

However, it is argued here that the dichotomy of public views observed from this case study reflects a dynamic transformation in public views from positivist to social constructivist perceptions of the role of science in risk management. In time, decision makers will have to adapt policy making processes to reflect a growing comprehension among citizens of the complex social and political nature of risk problems, and of the inherent limitations of science-based approaches for designing protective policies.

The next concern identified in Table 5.2, section D, involves the credibility of the international scientific community. This concern is reflective of the extent to which some respondents recognize and are sensitive to the inherent limitations of mandated science for providing objective and politically neutral policy recommendations. Challenges to the credibility of the international scientific community are based on the perception that the framework for radiation health effects research is biased towards the interests of the nuclear industry. Therefore even if the participatory process had been designed in such a was as to allow decision makers to defend the credentials, expertise and objectivity of these agencies, the most important issue underlying this problem of legitimacy would still have been ignored.

As Nelkin (1979) argued in relation to a number of controversial risk management problems of the 1970's, public concerns which are directed at science and scientists are often more accurately interpreted as indications that the public is displeased with the power relationship which exists among different social actors. In this case, it may be interpreted that arguments concerning scientific agency credibility reflect public concerns over the extent to which the nuclear industry, whose interests are not necessarily consistent with those of the general public, controls the direction of radiation health protection policy. Therefore, an appropriate response to this particular concern would necessarily involve some redistribution of power among actors in the decision making framework. However, as the evaluation of the ministry's response to changing conceptions of democracy in decision making indicates, no real redistribution of decision making authority was intended or occurred as a result of the tritium consultation.

In a similar vein, the discussion in section F of Table 5.2 involves concerns with respect to the reliability of the recommendations provided by the international scientific community. On this matter, many of the respondents questioned the specific assumptions underlying these recommendations. In doing so, these respondents demonstrated not only a degree of comprehension of this esoteric risk problem, but an inclination to deconstruct many of the facts and notions which had become "stabilized" within the traditional science-based framework. For example, there are a number of quantitative assumptions on which the recommendations for radiation health protection are heavily dependent. Two of these include the linear no-threshold hypothesis, which assumes that dose-effect relationships observed at high levels of radiation exposure can be extrapolated linearly to low doses, and the acceptable risk factor of 5×10^{-6} which assumes that five in a million cancer fatalities is an acceptable risk to the general public. Both of these assumptions are specifically challenged by respondents during the tritium consultation. Although it is difficult, in designing a process, to anticipate which assumptions will be contentious and which will not, the potential for some controversy must be acknowledged, and some conflict resolution mechanism defined. As this case study illustrates, some members of the public are demanding a more explicit and comprehensive justification of the assumptions underlying radiation health policy. Many of these were taken for granted in the closed, science-based framework, and it is not apparent that the ministry had made provisions to open them up for public comment or discussion during the tritium consultation.

Finally, the last two concerns identified in Table 5.1 are discussed in section G of Table 5.2. These relate to the need to attain a balance among sources of scientific information and between science and non-science. These views indicate that social constructivist views are held by some groups in society. This in turn has implications for the extent to which mandated science can be used to legitimize social policies which involve significant cost and risk allocations in society. The arguments of respondents suggest further that some members of the public acknowledge that social and political factors can influence scientific policy recommendations, hence the necessary presumption of objectivity and neutrality is not universally accepted. Some citizens perceive scientists as actors in the political process with interests and objectives which often reflect economic affiliations. Moreover, the case study indicates that at least a portion of the population is reluctant to commit the resolution of difficult social questions to a decision making framework characterized by negotiations among government, scientists and industry. Again, it does not appear that the ministry recognized the potential for these issues to be discussed during the consultation.

5.4 INTERPRETING THE RESULTS

As Table 5.2 shows, there appears to have been little or no recognition on the part of the MoEE that the types of concerns expressed by respondents in relation to the traditional science-based decision making approach might have compromised its legitimacy. Even where some acknowledgment of public concern is apparent, the government's response in terms of its accommodation of such concerns in the participatory approach does not appear to reflect a full appreciation of the issues which underlie them.

The traditional approach to decision making in the radiation health policy domain reflects a perception of policy conflict consistent with Robinson's (1992) "classical" view. It assumes that health risk problems from exposure to radiation are essentially technical and are best resolved by deferring to the judgements of the international scientific community's technical elites. The participatory approach to decision making, characterized by the ACES consultation, appears to reflect a neo-classical perception of the nature of the policy conflict over radiation health protection. This perception is characterized by the same classical assumptions of the nature of risk problems, with the exception that the importance of public perceptions of risk for policy legitimacy are acknowledged. The public consultation was a modest attempt to improve the communication of risk problems and solutions between technical experts and the general public. The impetus for entering into this consultation process, at least that aspect which can be attributed to the ministry, seems to have been less a factor of strong public pressures to reform the traditional process than it was a factor of the political advantages which were likely perceived to follow from it.

It appears that the long and consistent insulation of this policy domain from intense public scrutiny has prevented decision makers from gaining an awareness of a number of changes which have occurred in perceptions held by some citizens. These changes have had significant implications for the perceived legitimacy of traditional processes of decision making which rely on positivist perceptions of science to validate a science-based approach.

Presently, public pressure is compelling decision makers to reform policy processes in order that they be more reflective of the realities both of changing public perceptions and of the true social and political nature of risk problems. This pressure is apparently encroaching on a number of policy domains which are now forced to confront, with minimal warning and preparation, a new political and social reality.

The public consultation on an interim drinking water objective for tritium revealed that many of these social and political changes are affecting the policy domain of radiation health protection in Canada. Moreover, it has revealed that the issues which characterize the public debate on radiation and health are extensive. Matters ranging from the nature of the policy itself, to all levels in the socio-political framework for decision making are perceived to be relevant in the context of the policy question presented. The range and nature of arguments advanced during the consultation is illustrative of the heterogeneity of public values and priorities. However, an even more significant observation arising out of an analysis of the public controversy suggests that this policy domain is in the early stages of a crisis of legitimacy. Not all respondents agreed that the present approach and direction lacked legitimacy. Yet if recent trends are indicative of what can be expected in the future, increasing social constructivist views in society threaten to undermine the legitimacy of not only the closed science-based approach to decision making, but also the overall framework within which policy decisions are made.

The framework presented by Funtowicz and Ravetz (1993), summarized in Chapter 3, provides a useful overall framework for considering the problems of addressing issues of legitimacy through public participation discussed in this study. They suggest that a "post-normal" approach to decision making is necessary in circumstances where either value and interest conflicts are significant, or the uncertainties inherent in science for a policy correspond to Wynne's "ignorance" and "indeterminacy" categories. Both of these conditions are apparent in the context of radiation health protection policy making. The approach involves an open acknowledgement of the inherent limitations of science for answering social and political questions, and of the importance of value and interest conflicts to the public debate. From this, an alternative process of negotiation and debate can be developed which is more appropriately designed to respond to problems of legitimacy such as those identified in relation to the case study policy domain. However, before this type of approach can be successful, it is necessary that the decision making framework be responsive to alternative conceptions of rationality to those which characterize the traditional approach.

Chapter Six

SUMMARY AND RECOMMENDATIONS

6.1 SUMMARY OF THE STUDY AND RESULTS

The objectives of this study focused on deriving an assessment of how well risk management decision makers in Canada have interpreted public demands for more involvement. This assessment concerns the design of participatory processes used to develop policies for which no public involvement has occurred previously. The research approach involved a case study and a theoretical examination of social and political trends observed over the last few decades. Arguments presented in the literature suggest that recent trends in decision making processes toward greater use of participatory mechanisms are due to changing public perceptions of the factors which traditionally lend legitimacy to risk policies and decision processes. Policy domains which have long relied on bipartite bargaining, science-based approaches to policy development, are experiencing reduced public support and increasing public pressure to introduce reforms which are more reflective of contemporary political and social realities with respect to achieving legitimacy. The case study analysis undertaken here supports these arguments, and suggests that decision makers do not sufficiently comprehend the issues and perceptions which underlie public demands for more involvement. Consequently, they are failing to adequately address these concerns in the design of participatory processes.

Within Canadian political culture, formal avenues for the public to intervene and comment on proposed policies are not generally provided. Moreover, the public is not necessarily privy to the assumptions and methodologies which underpin many public policies. Therefore, participatory processes for decision making provide an important forum in which the public can express their views and support or oppose government actions. The implications for decision makers of misinterpreting the impetus for change in risk decision making are considerable. Not only are participatory processes costly in terms of the time and resources required to implement them, but their failure can be politically costly as well. If problems of legitimacy are not addressed, neither the public nor government will have achieved the recognition and acceptance sought from the other. Moreover, because certain groups in society--usually industry--are well served by traditional science-based processes, ineffective and inappropriate modes of participation may fuel arguments to abandon such approaches, thus augmenting the extent of political control over policy exercised by this group.

The analysis of issues raised by the respondents to the consultation on tritium suggested that diminished public confidence in government stems, in part, from public concerns involving the regulatory framework for nuclear power regulation in Canada. However, the ministry's emphasis on regulatory consistency within the radiation health protection policy sector seems to indicate that the ministry did not recognize the interrelated nature of the legitimacy of all policies developed within this domain. The analysis also suggested that public perceptions of past inadequacies in government action to protect the public was another contributing factor to the legitimacy crises facing decision makers. However, it again appears that the complex and varying nature of public rationality with respect to risk problems had been missed as technical and scientific arguments continued to be offered in response to questions of social and political concern.

Broad public support for the concept of democracy through participation is reflected in the specific comments and arguments advanced on the subject of the ACES' consultation, and can be inferred by the extent to which statements of principle were advanced in relation to the higher levels of the socio-political framework for decision making on radiation health protection in Canada. It appears that a sector of the public perceives practical value in the views and expertise of lay citizens, even on issues involving highly technical and esoteric information. However, the particular participatory approach utilized to review the tritium guideline had no impact on the ultimate policy and did little to reform the traditional approach to setting radiological parameters for drinking water. In effect, the "consultation" process appears to reflect a minimal understanding on the part of the ministry of public concerns regarding fair decision making procedures and the principles of democracy.

On the matter determining an appropriate role for science in risk management decision making, the results of the study are equally critical of the government's response to public concerns. It appears that the ministry approached the issue of public involvement in decision making from a "neo-classical" perspective of the nature of public controversy. This view reflects an understanding of risk problems that is primarily technical, but includes some recognition that public concerns influence the political process. However, public concerns are interpreted as irrational and reflective of an insufficient understanding of the "true" (or technical) nature of risk problems. The tritium consultation focused on providing the public with a comprehensive explanation of the scientific basis for radiation health policies. This scientific basis was derived primarily from risk assessment methods. What this approach does not acknowledge is the possibility that public concerns are rational despite their apparent inconsistency with technical assessments of risk, and that the public is cognizant of the limitations of using mandated science such as risk assessment as the basis of social policies.

The study indicates that the public recognizes the extent to which political and economic influences affect science, and is frustrated with the power relationships which flow from traditional science-based decision making approaches. It also indicates that the public is confident and sufficiently literate to deconstruct the traditionally stabilized facts and arguments which have underpinned radiation health policy in Canada historically. The public is demanding more explicit and comprehensive justification for the scientific assumptions which underlie policy choices. Moreover, many citizens are rejecting the traditional assumptions of objectivity and neutrality in science, and demanding a more balanced approach to using science in decision making.

This study confirms that traditional science-based approaches to risk policy making which exclude the public and develop policies through closed negotiations among government, industry and scientists no longer exhibit the required elements for legitimacy for society as a whole. However, it appears that addressing issues of legitimacy through public participation is complex. Problems of legitimacy are perceived to involve issues at all levels of the socio-political framework for decision making. Not all of these issues can be addressed through process design. For the policy domain of radiation health protection, members of the policy community have enjoyed a long and consistent period of insulation from public scrutiny, and have received a minimal amount of political pressure in the past to justify the methods and assumptions used in the determination of specific guideline values. Therefore, many of the problems of legitimacy identified from the consultation submissions have likely built up over a number of years, escaping recognition from decision makers because of the protection provided by the traditional decision making framework.

It is argued here, however, that the social and political context for risk decision making in Canada is undergoing a dynamic transformation, defined by significant changes in the public perceptions which have traditionally lent legitimacy to the bipartite, science-based approach to policy development. Consequently, decision makers in many risk policy domains will be increasingly confronted with the need to legitimize policy decisions to a public which recognizes the complex social and political nature of risk problems as well as the inherent limitations of science for addressing all aspects of these problems. The design of participatory processes will be an important factor in providing that legitimacy. However, first the problems must be recognized and the need to reform existing processes acknowledged. Only then will decision makers be prepared to make the adaptations to all levels of the socio-political framework necessary to adequately and appropriately respond to the new political and social realities of risk management in Canada.

6.2 RECOMMENDATIONS FOR REFORMING THE PARTICIPATORY APPROACH

Problems of legitimacy in risk policy making are complex in that they reflect public concerns not only with respect to process, but with respect to the general frameworks for decision making and role of government generally in that policy domain. Moreover, political processes are guided by the elaborate and powerful interactions which occur among social actors. Recognizing the complexity of the decision making framework for policy making, the recommendations made here are general in nature in order to maintain their applicability to other risk policy domains.

One important consideration for the design of participatory processes is the requirement for some acknowledgement that public input is both useful and necessary given changing conceptions in society of what constitutes a democratic process of decision making. Another equally important consideration is the prevalence and validity of social constructivist views of science among some groups in society. Moreover, there must be an appreciation for the possibility of an increasing prevalence of these types of views in the future. Decision makers need to be aware of how changing perceptions of democracy and science in society are affecting the legitimacy of traditional decision making processes. They must also recognize that reinforcing technical arguments will not adequately address the types of concerns which flow from these changing views.

Involving the public in the identification of legitimacy issues and in the design of participatory processes are two ways of ensuring that problems of legitimacy are addressed. However, it may also determine that legitimacy concerns cannot be addressed through process but must involve fundamental changes to the frameworks or philosophies which guide policy making for a given domain. This discovery can be extremely beneficial for decision makers. It may result in the avoidance of expensive and ineffective participatory processes, and will not necessarily preclude the option of participation in other instances where it might be appropriate.

It is also important to recognize that the design of appropriate and effective participatory processes is iterative, and requires, as Robinson (1992) suggests, a comprehensive process of "policy learning," where decision makers, scientists, industry and the public use science as one type of tool for understanding risk problems rather than as a source of objective truth. Moreover, the range of different approaches to resolving risk policy issues, which are applied according to the degrees of uncertainty and social significance reflected in the policy, should be utilized. According to this framework, heavy reliance on traditional risk assessment methods is only appropriate under conditions of relatively low uncertainty and few political and economic ramifications. All other conditions require a greater mix of social and technical considerations.

What is especially useful about participatory decision making for risk policy development is the opportunity which this type of approach provides for interactive dialogue among divergent interests in society (Leiss and Chociolko 1994). Value and interest conflicts are inevitable in risk policy making; and as Wynne (1987) suggests, attempts to educate the public on the matter of what constitutes "rational" behaviour can cause resentment and can actually exacerbate conflicts between technical elites and lay citizens. In order to address issues of legitimacy in risk policy development, all parties need to understand the nature of the debate as well as the issues which cause divergence among views in society. Whether the most appropriate mode of participation is consultation or consensus building, there must be a mutual acknowledgement among parties of the rationality of the often varying degrees of risk aversity exhibited. Moreover, regardless of the extent of public involvement in decision making, the distribution of political influence among parties will be--if not the most important factor--a considerably important matter in determining the extent of give and take which will ultimately occur in a negotiation setting.

The policy making processes which characterize many risk policy domains in Canada, including radiation health protection, require radical reforms in order to more accurately reflect contemporary political and social realities. These reforms are complex, and will likely require gradual and iterative modifications to all aspects of the socio-political framework for decision making. The bipartite, science-based approach to decision making, which served the legitimacy requirements of the public during the first wave of environmentalism are no longer sufficient to accommodate a changing social context for risk management. Perceptions of risk problems reflect a dynamic and heterogeneous public. Therefore, in order to maintain the relevance and legitimacy of protective health policies, decision makers must become more attuned to the public's expectations of its role as protector and defender of public interests. They must also recognize that their decisions are being judged more vehemently than ever before, and that if current trends continue, it will become increasingly more difficult to legitimize decisions which do not reflect fair decision making procedures.

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Appendix A

ARGUMENT PROFILES - CONSULTATION SUBMISSIONS

Sub.# = Submission number assigned by ACES

Sub #	Party Name	Diagram #
	GOVERNMENT	
--	MoEE Rationale Document	A1
1	Regional Municipality of Durham	A2
10	Town of Whitchurch-Stouffville	A10
13	Town of Ajax in Regional Municipality of Durham	A13
29	York Region, Public Health Department	A29
34	Etobicoke Health Department	A34
59	Elgin St. Thomas Health Unit	A56
	INDUSTRY	
5	Ontario Hydro	A5
8	AECL Research	A8
16	American Water Works Association	A16
19	Black Hackle Engineering	A18
20	Ridgetown Public Utilities Commission	A19
22	Royal Society of Canada, Canadian Academy of Engineering	A22
24	C. Bruce Bigham Consulting	A24
25	International Geochemical Mapping	A25
26	Windsor Utilities Commission	A26
27	Town of Dryden Public Works	A27
31	Walter Brown Associates	A31
32	The Entry Group	A32
38	C.U.P.E. Local 1000, Power Workers Union	A38
	ENVIRONMENTAL / CITIZENS' GROUPS	
2	Guelph Field Naturalists	A3
3	Conserver Society of Hamilton and District	A4
6	Energy Probe	A6
7	Pickering Ajax Citizens Together for the Environment	A7
9	Durham Wetlands and Watersheds	A9
11	Ajax Citizens for the Environment	A11
12	Citizens Network on Waste Management	A12
14	Unitarian Congregation of South Peel	A14
15	Consumers' Association of Canada (Windsor)	A15

Sub #	Party Name	Diagram #
	***ENVIRONMENTAL / CITIZENS' GROUPS** (continued)*	
18	Durham Nuclear Awareness	A17
21	Ajax Save the Waterfront Commitee (I)	A20
21i	Ajax Save the Waterfront Commitee (II)	A21
23	Community Liason Group - Siting Task Force	A23
28	The Brereton Field Naturalists Club	A28
30	The Beaver Valley Heritage Society	A30
33	Pickering Beach Residents Association	A33
35	Concerned Citizens of Renfrew County	A35
36	Sault Area Nuclear Awareness	A36
37	Bruce Penninsula Environmental Group	A37
43	Atikokan Citizens for Nuclear Responsibility	A42
45	The Little Cataraqui Environment Association	A44
79	Northumberland Environmental Protection	A75
	INDIVIDUALS	
39	Individual Citizen	A39
40	Individual Citizen	A40
41	Individual Citizen	A41
44	Individual Citizen	A43
46	Individual Citizen	A45
47	Individual Citizen	A46
48	Individual Citizen	A47
49	Individual Citizen	A48
50	Individual Citizen	A49
51	Individual Citizen	A50
52	Individual Citizen	A51
53	Individual Citizen	A52
55	Individual Citizen	A53
56	Individual Citizen	A54
57	Individual Citizen	A55
60	Individual Citizen	A57
61	Individual Citizen	A58
62	Individual Citizen	A59
63	Individual Citizen	A60
64	Individual Citizen	A61
65	Individual Citizen	A62
66	Individual Citizen	A63
67	Individual Citizen	A64
68	Individual Citizen	A65

Sub #	Party Name	Diagram #
	INDIVIDUALS (continued)	
69	Individual Citizen	A66
70	Individual Citizen	A67
72	Individual Citizen	A68
73	Individual Citizen	A69
74	Individual Citizen	A70
75	Individual Citizen	A71
76	Individual Citizen	A72
77	Individual Citizen	A73
78	Individual Citizen	A74
80	Individual Citizen	A76
84	Individual Citizen	A77

Diagram #A1: Ontario Ministry of Environment and Energy (Rationale Document)

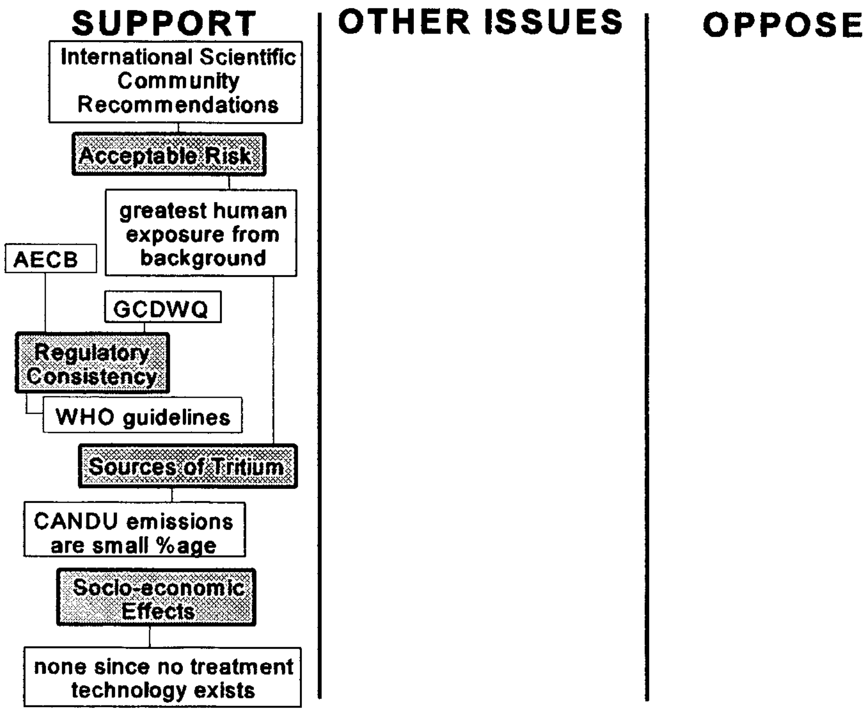


Diagram #A2: Regional Municipality of Durham

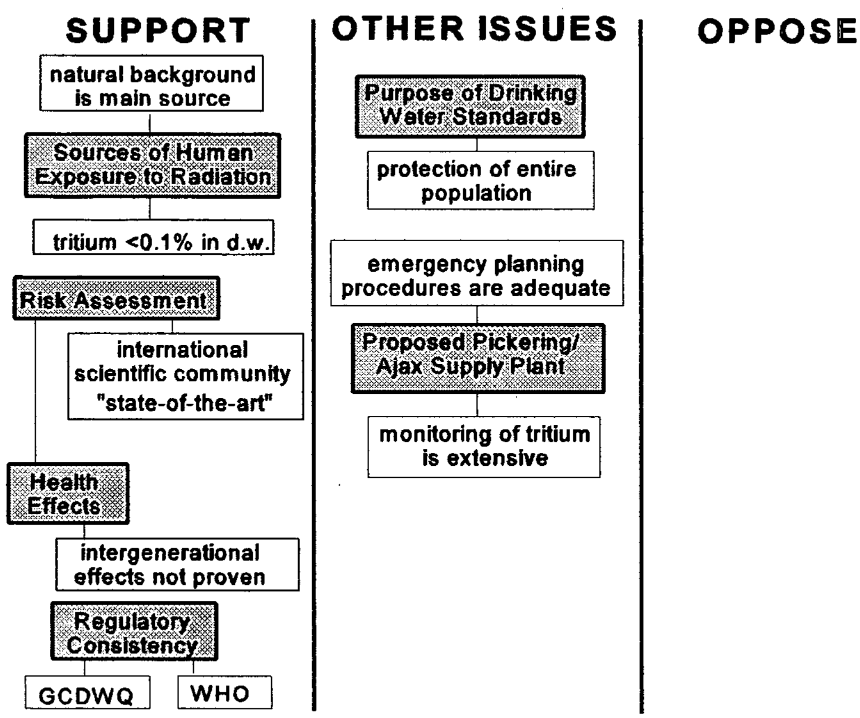


Diagram #A3: Guelph Field Naturalists

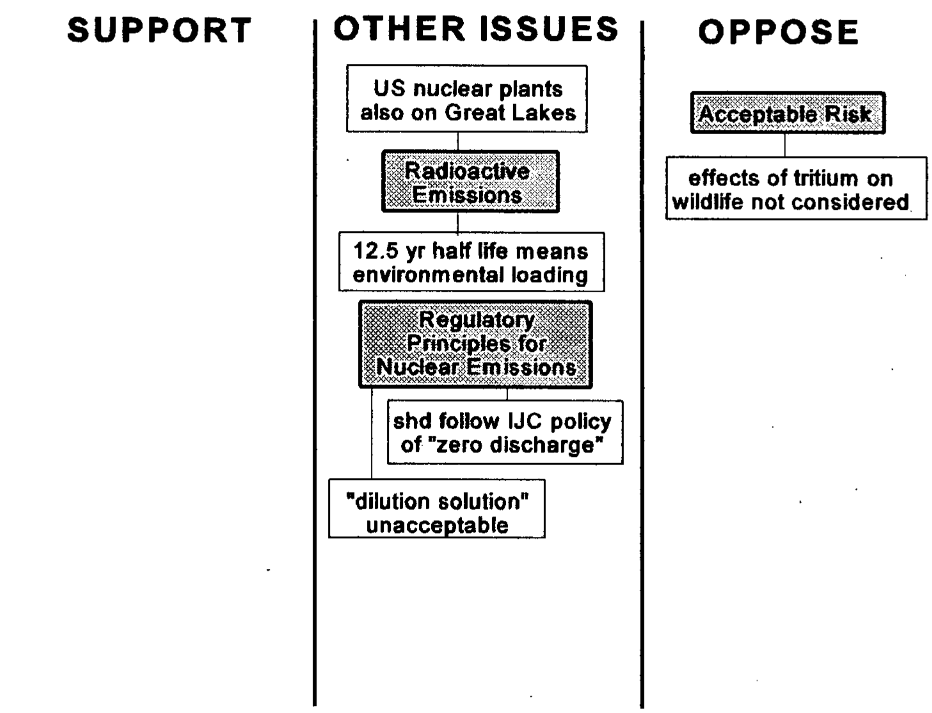


Diagram #A4: Conserver Society of Hamilton and District

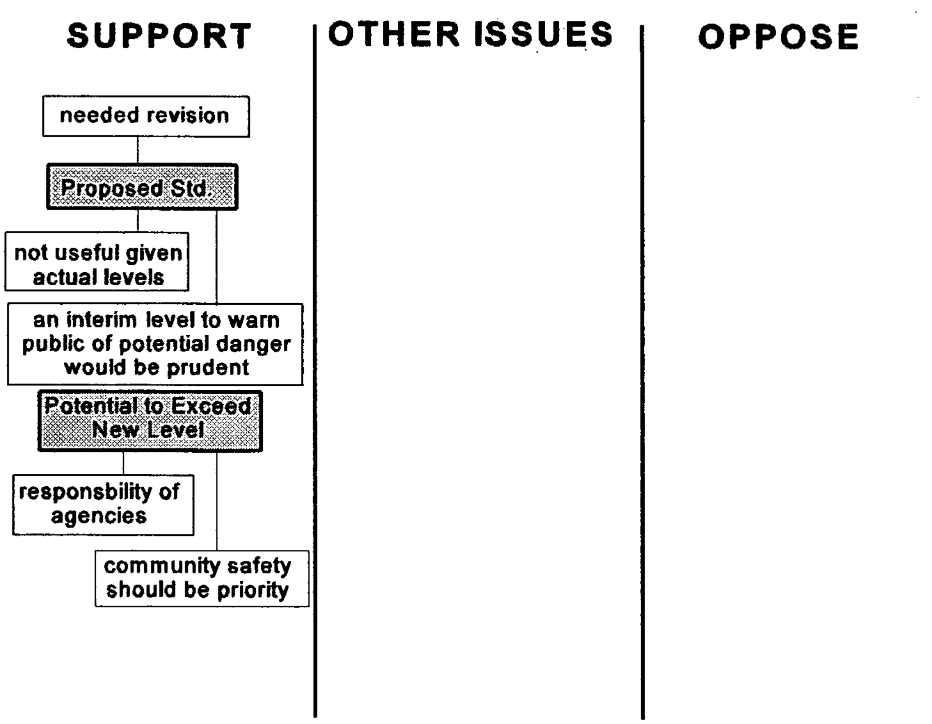


Diagram #A5: Ontario Hydro

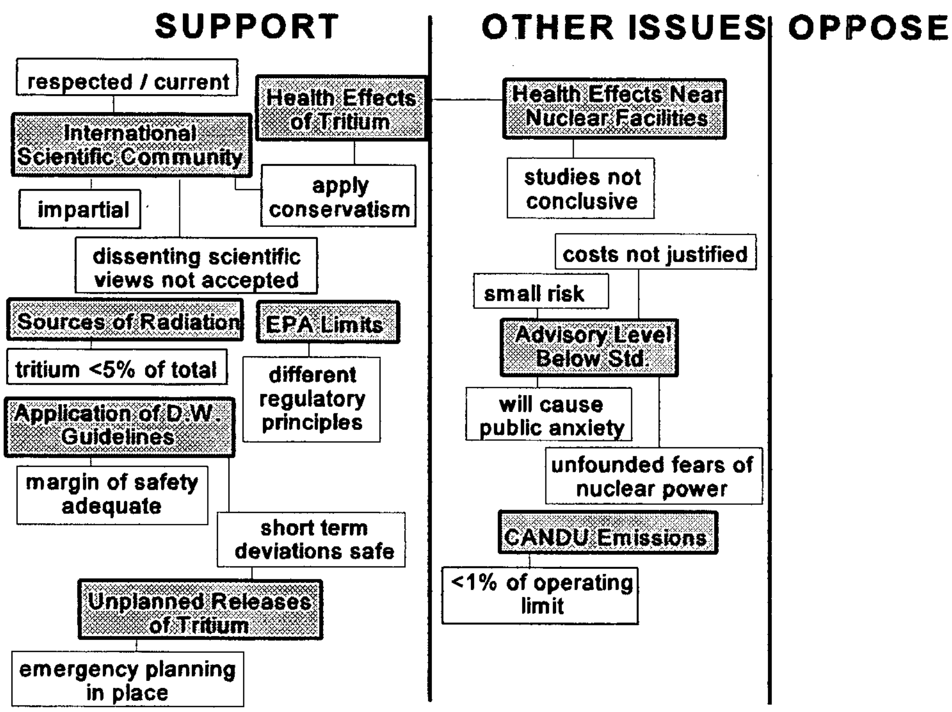


Diagram #A6: Energy Probe

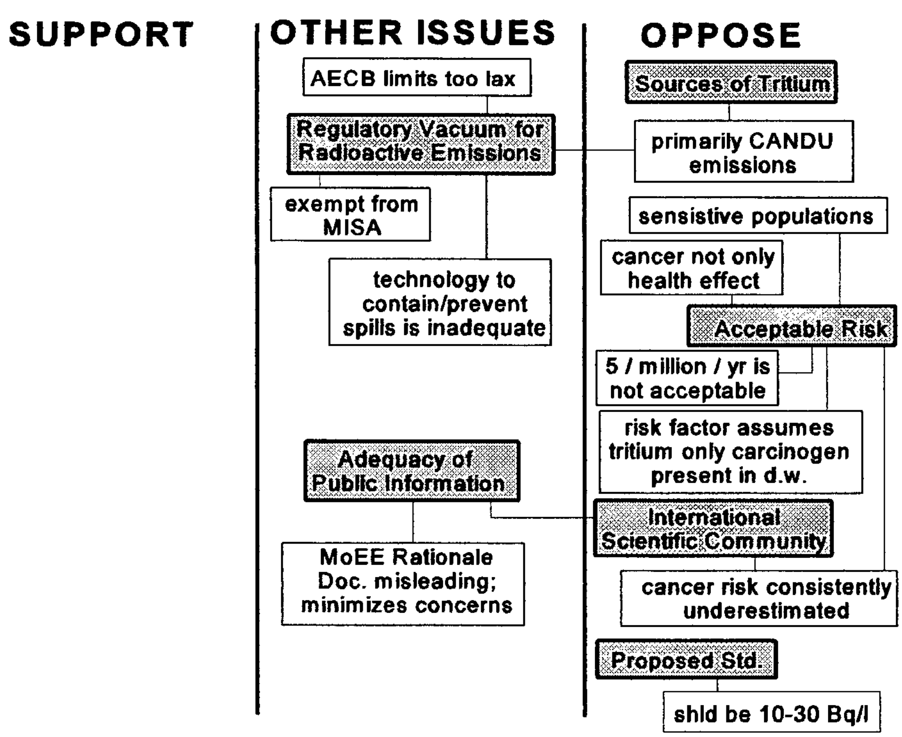


Diagram #A7: Pickering Ajax Citizens Together for the Environment (PACT)

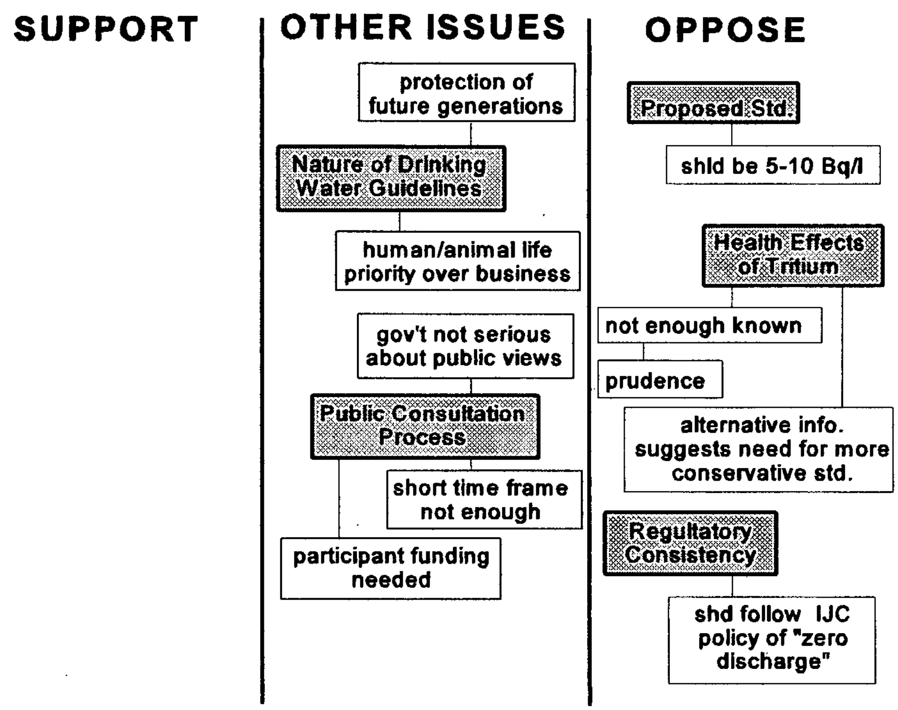


Diagram #A8: AECL Research Limted

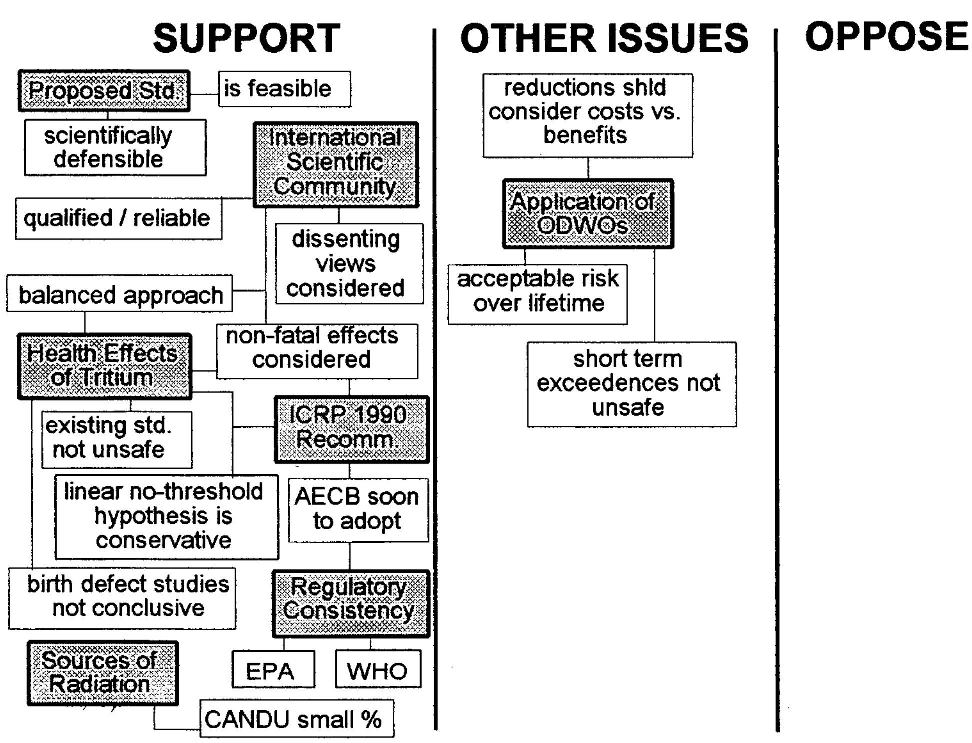


Diagram #A9: Durham Wetlands and Watersheds

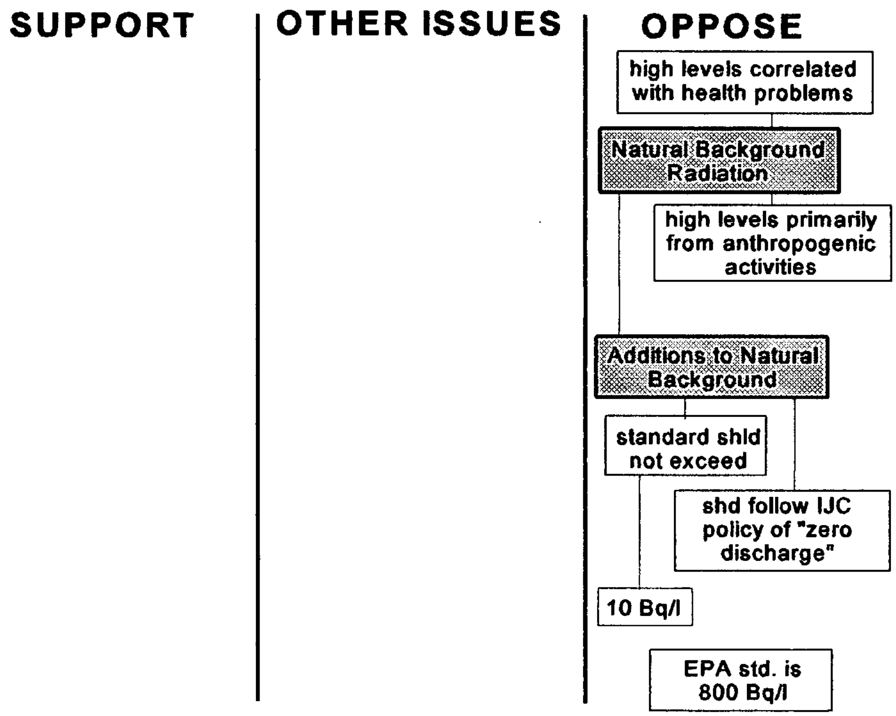


Diagram #A10: Town of Whitchurch-Stouffville

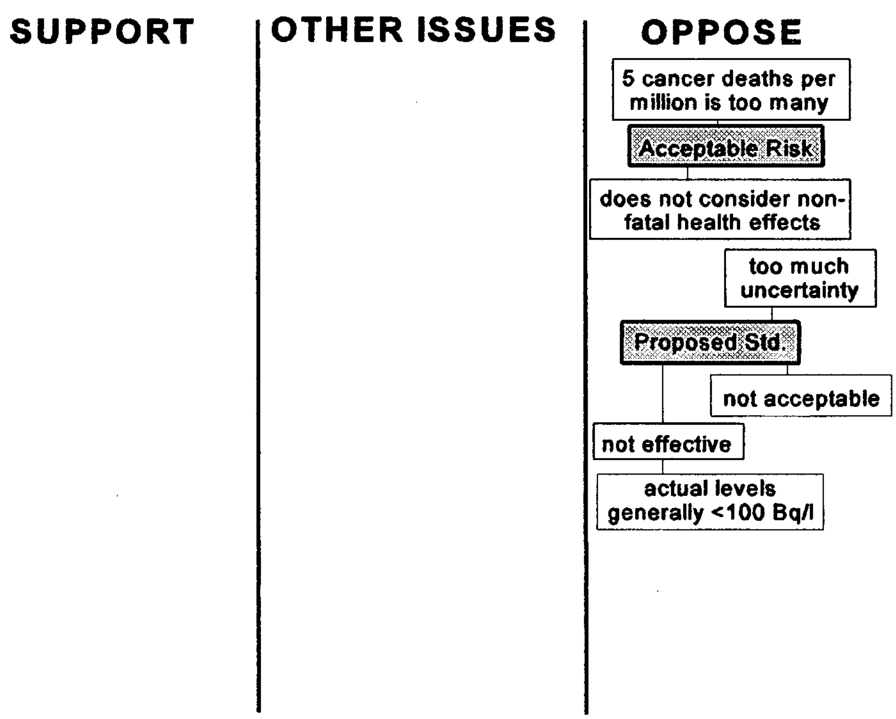


Diagram #A11: Ajax Citizens for the Environment

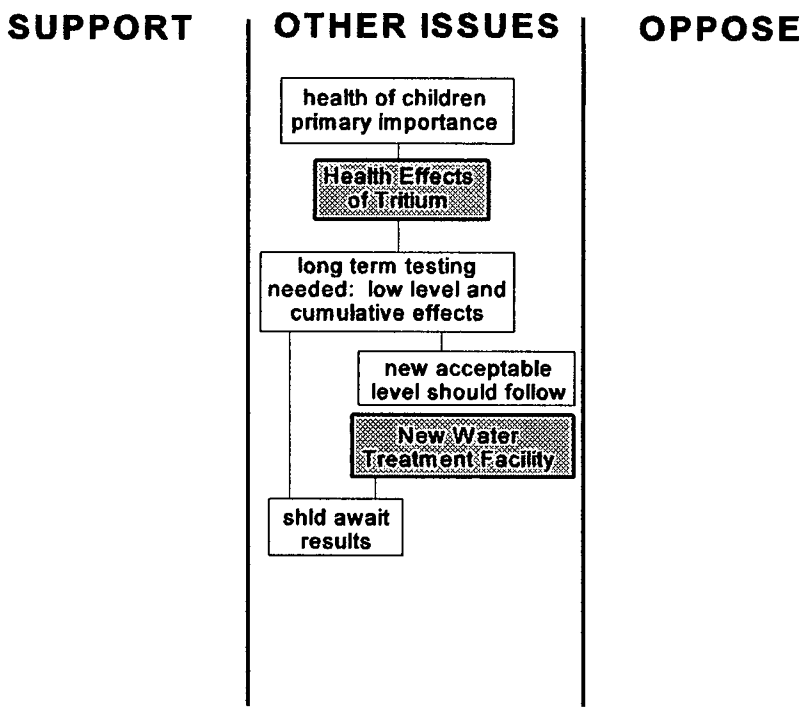


Diagram #A12: Citizens Network on Waste Management

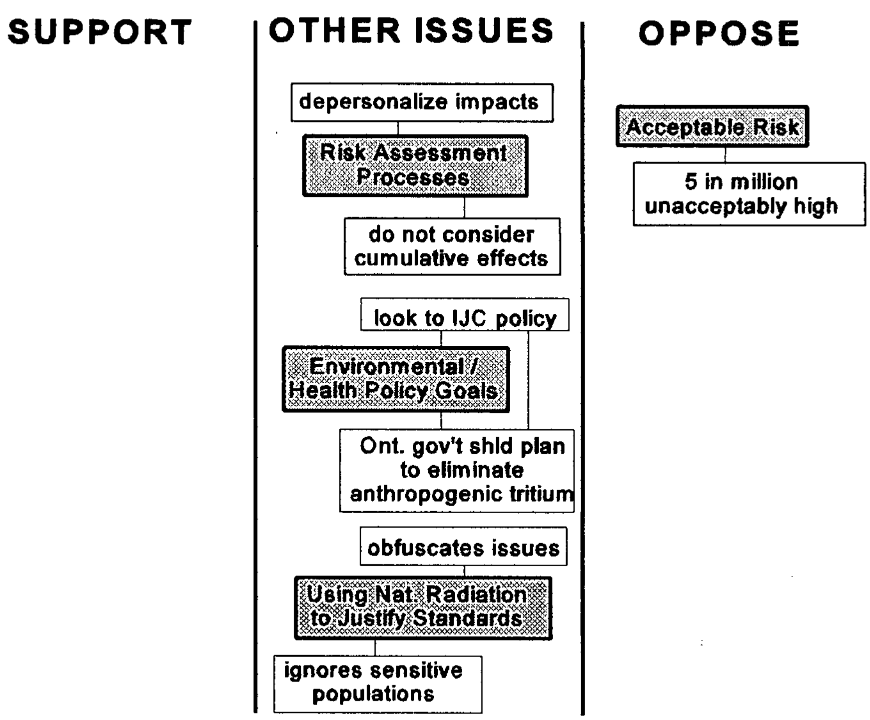


Diagram #A13: Town of Ajax in Regional Municipality of Durham

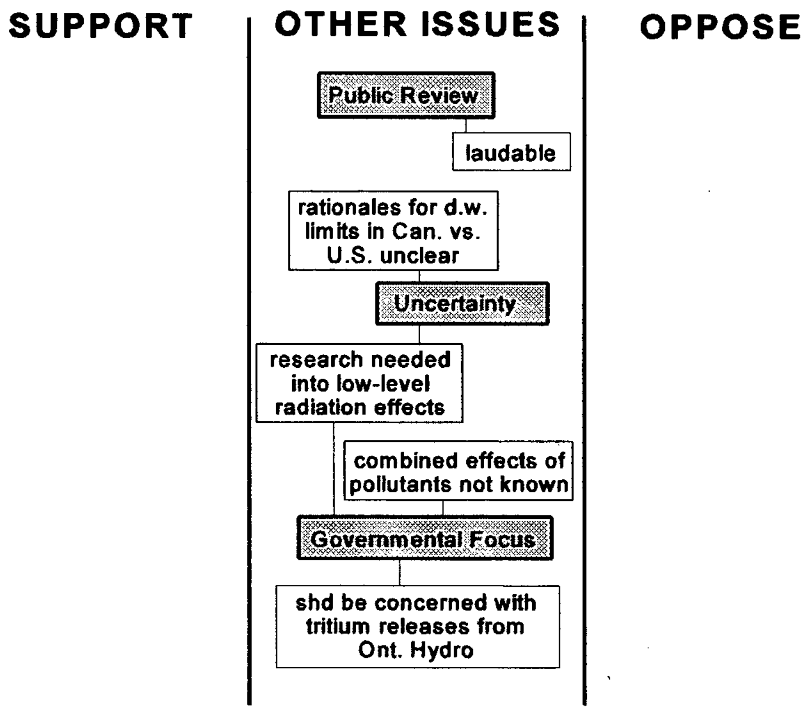


Diagram #A14: Unitarian Congregation of South Peel

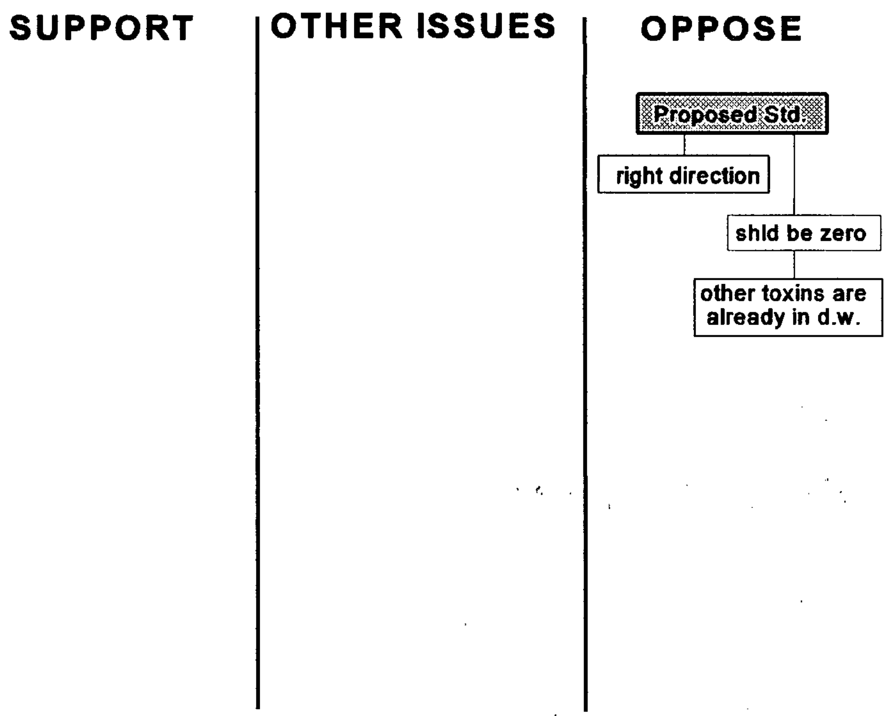


Diagram #A15: Consumers' Association of Canada (Windsor)

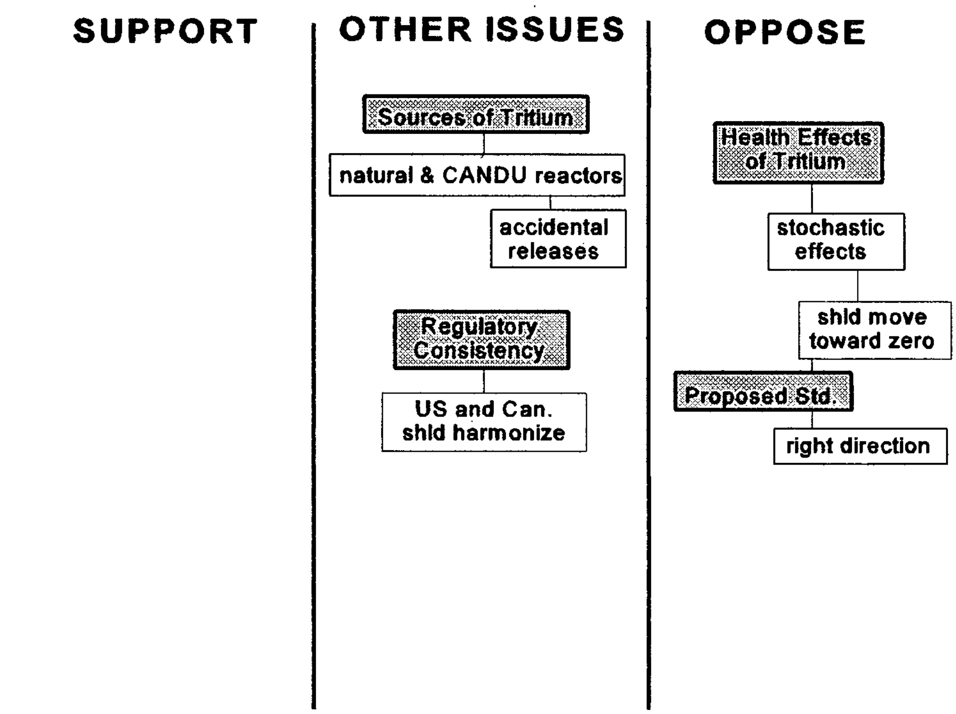


Diagram #A16: American Water Works Association

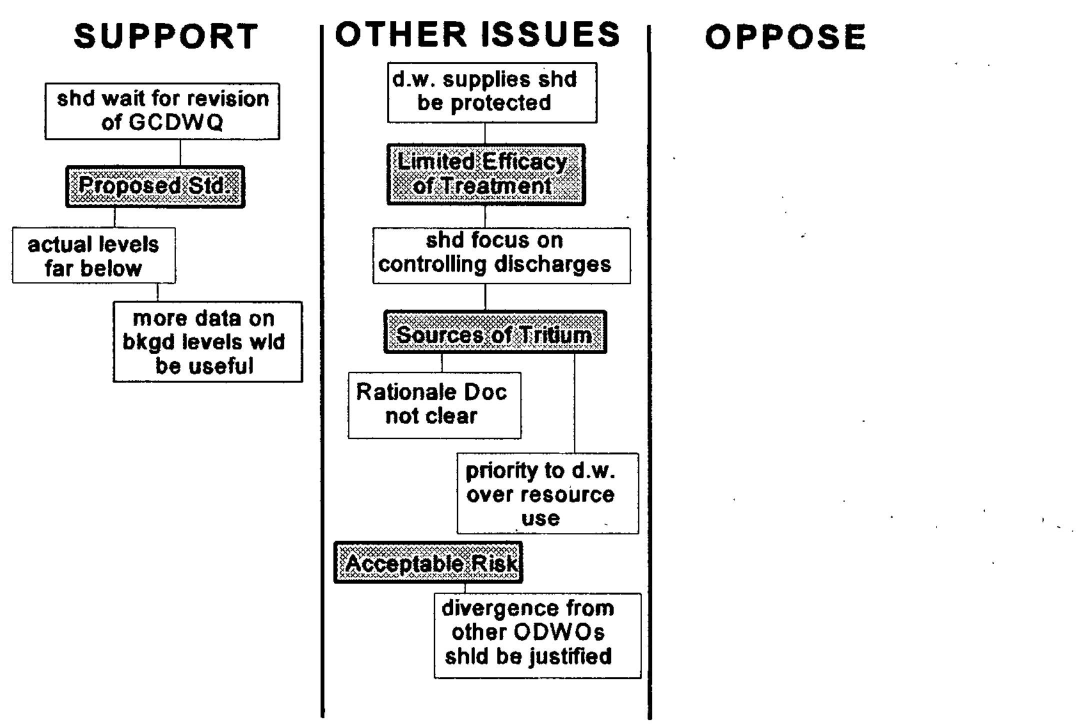


Diagram #A17: Durham Nuclear Awareness

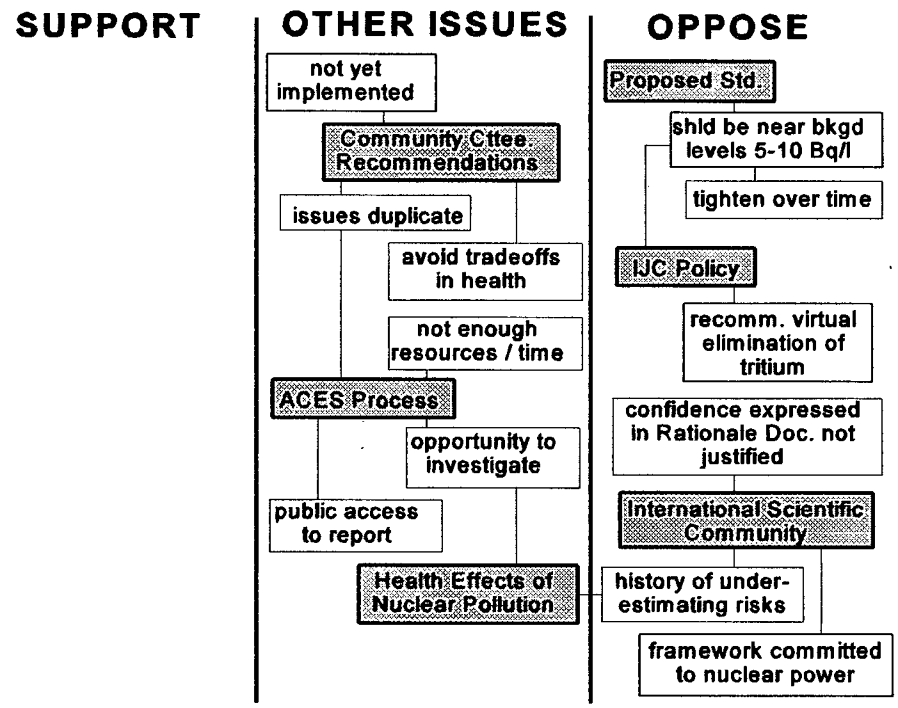


Diagram #A18: Black Hackle Engineering

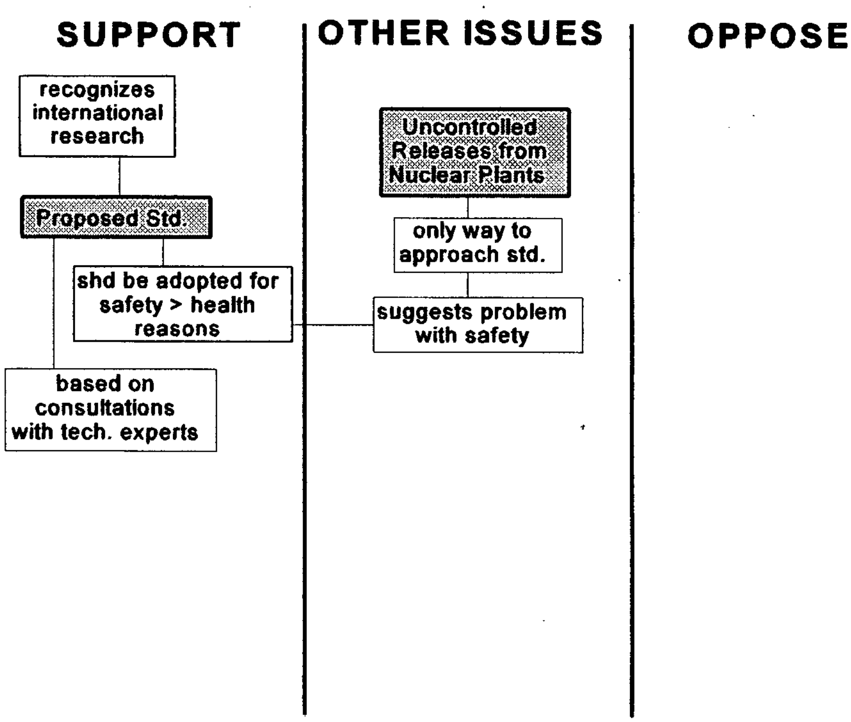


Diagram #A19: Ridgetown Public Utilities Commission

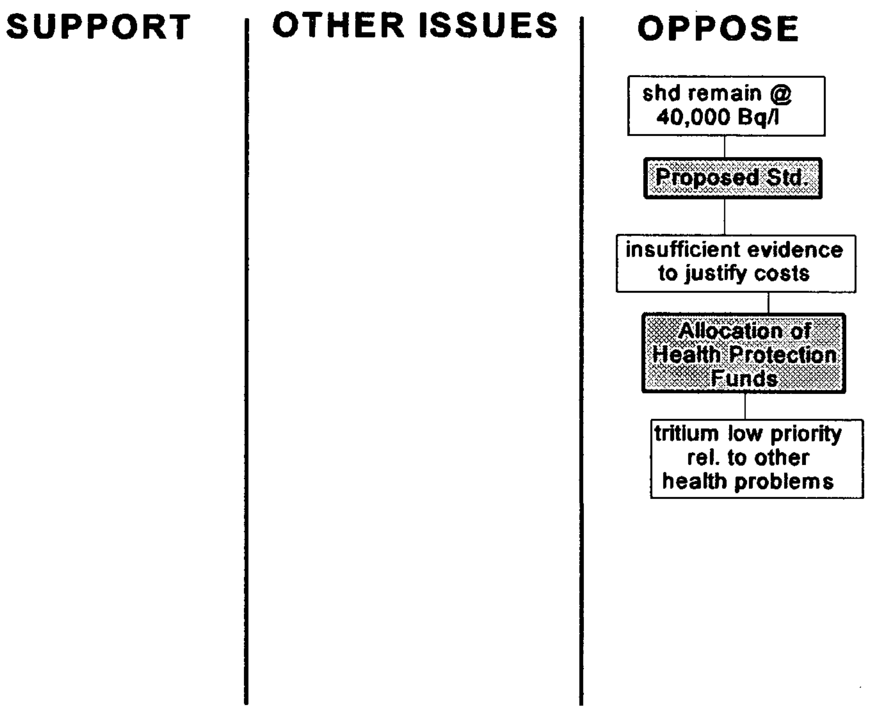


Diagram #A20: Ajax Save the Waterfront Committee (I)

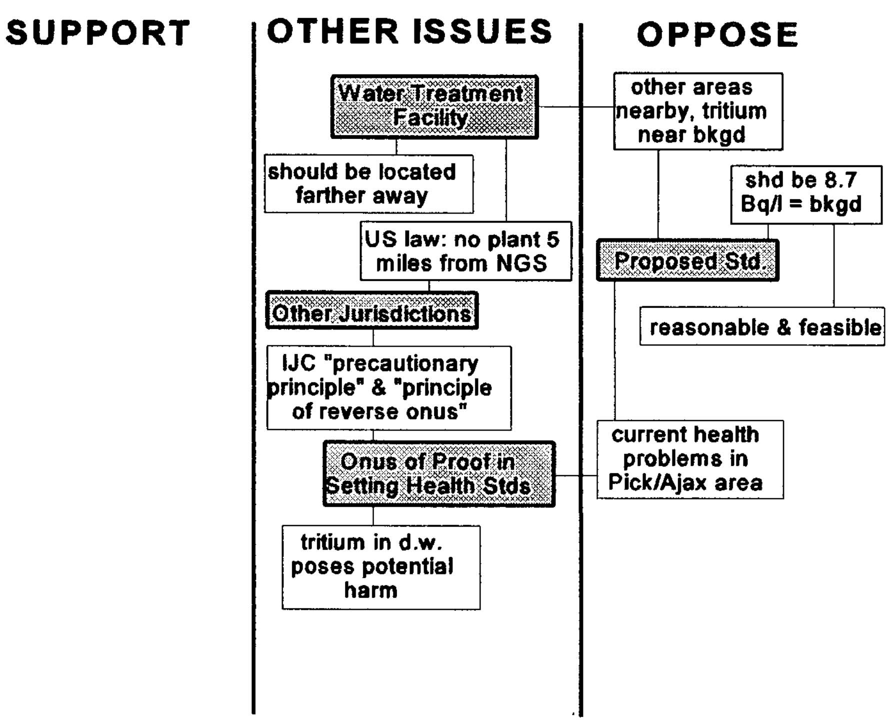


Diagram #A21: Ajax Save the Waterfront Committee (II)

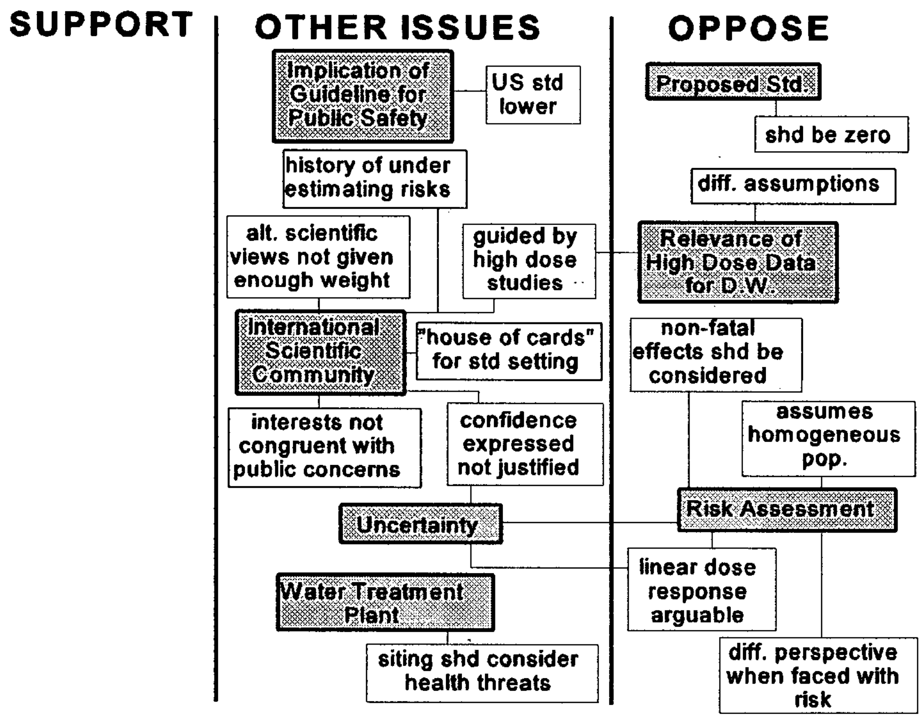


Diagram #A22: Royal Society of Canada, Canadian Academy of Engineering

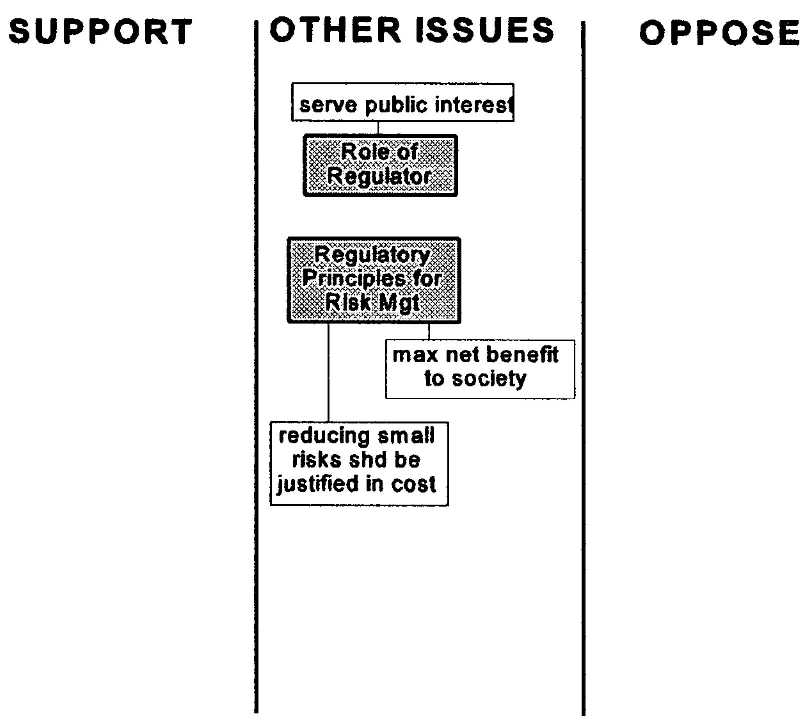


Diagram #A23: Community Liason Group - Siting Task Force

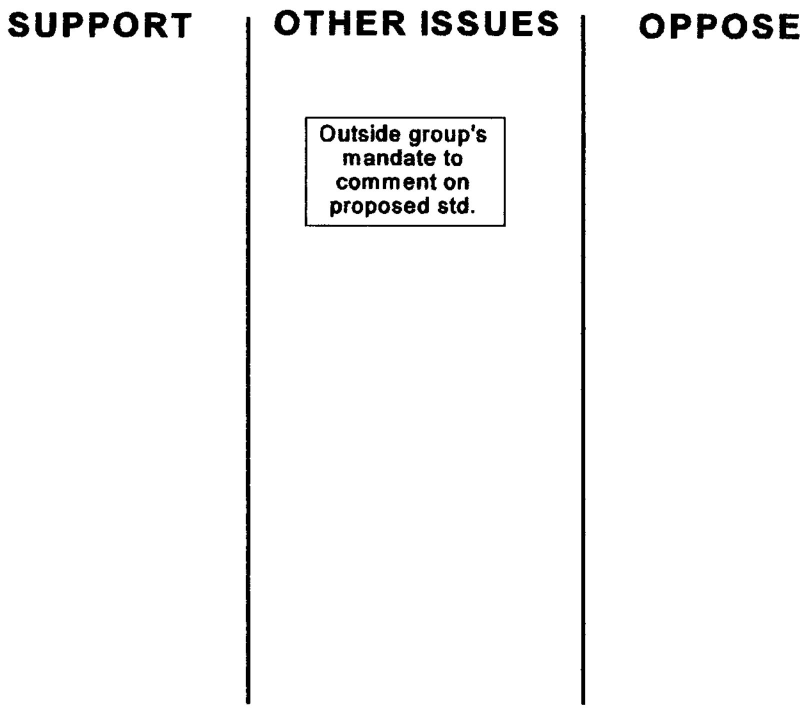


Diagram #A24: C. Bruce Bigham Consulting

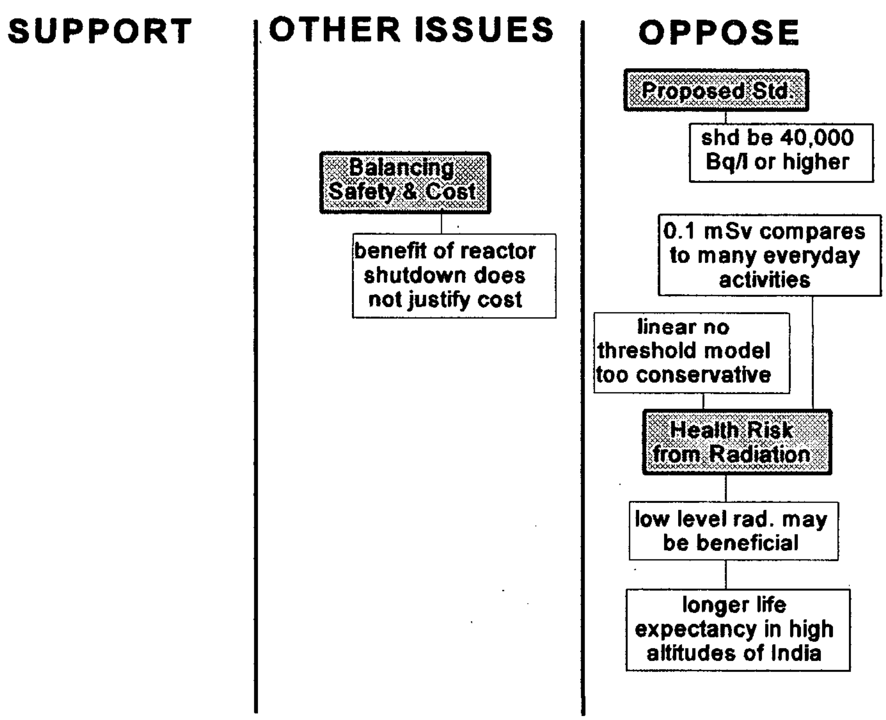


Diagram #A25: International Geochemical Mapping

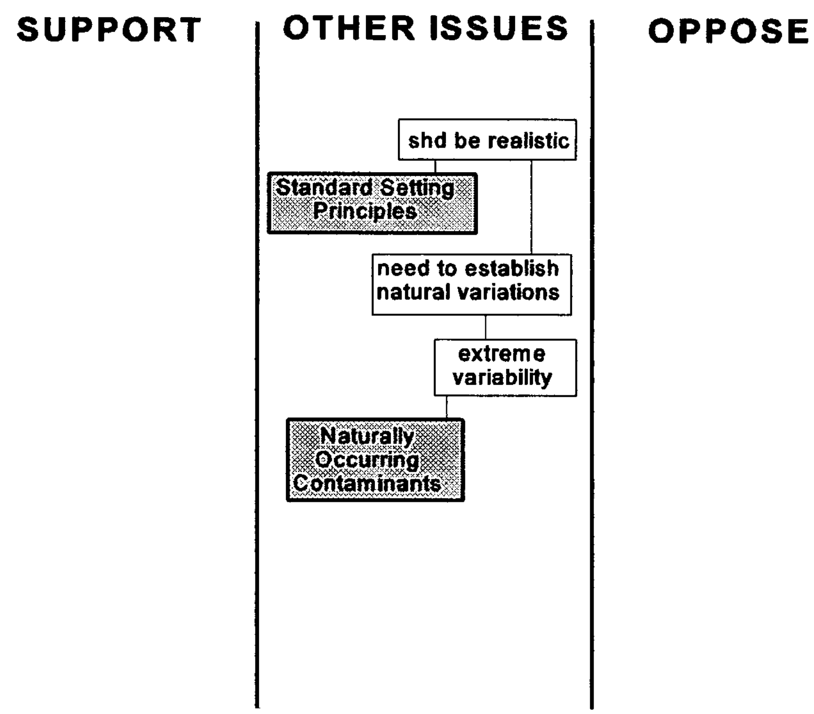


Diagram #A26: Windsor Utilities Commission

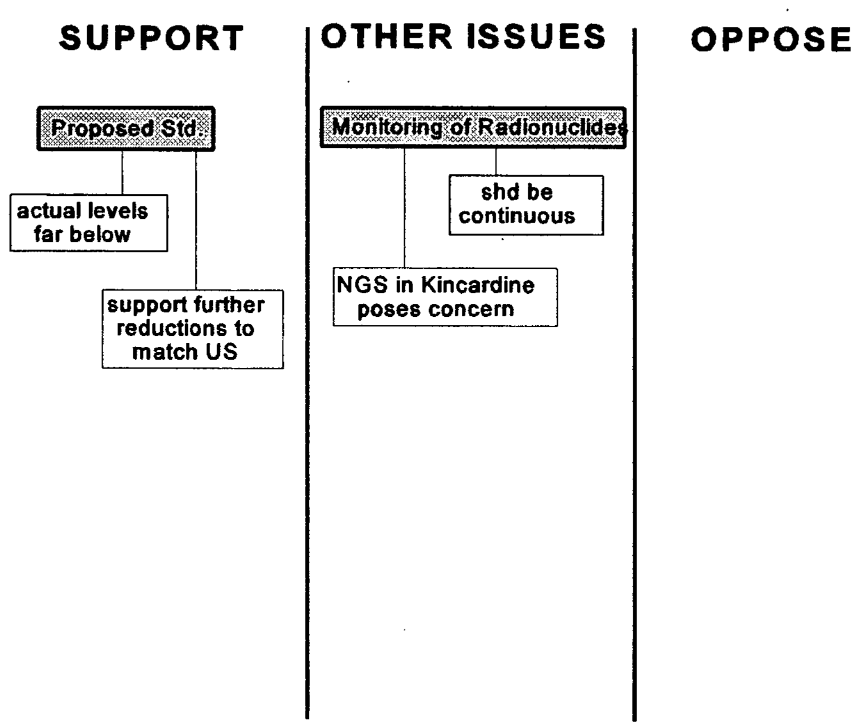


Diagram #A27: Town of Dryden Public Works

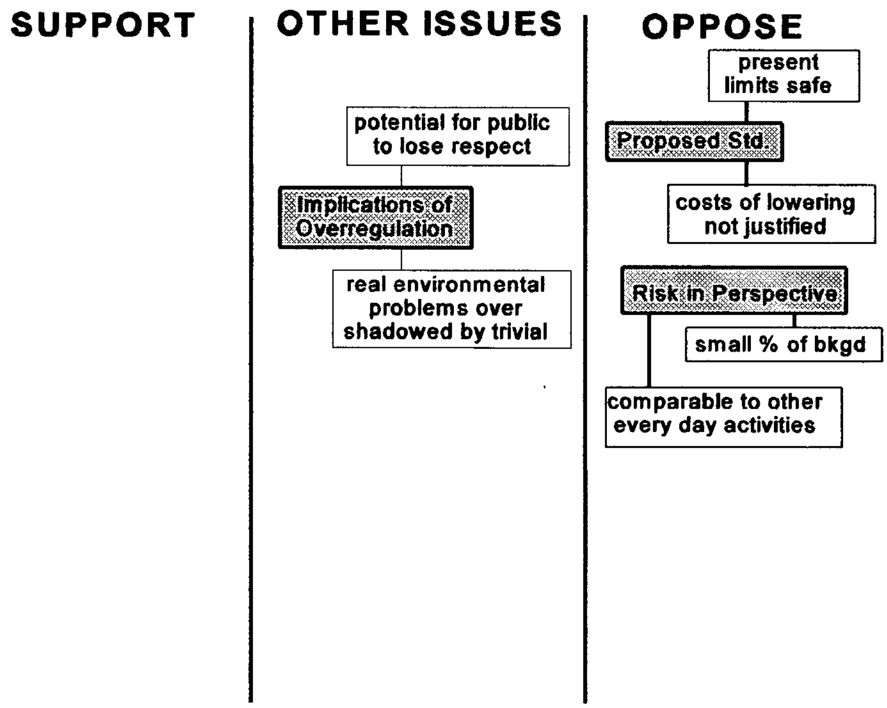


Diagram #A28: The Brereton Field Naturalists' Club

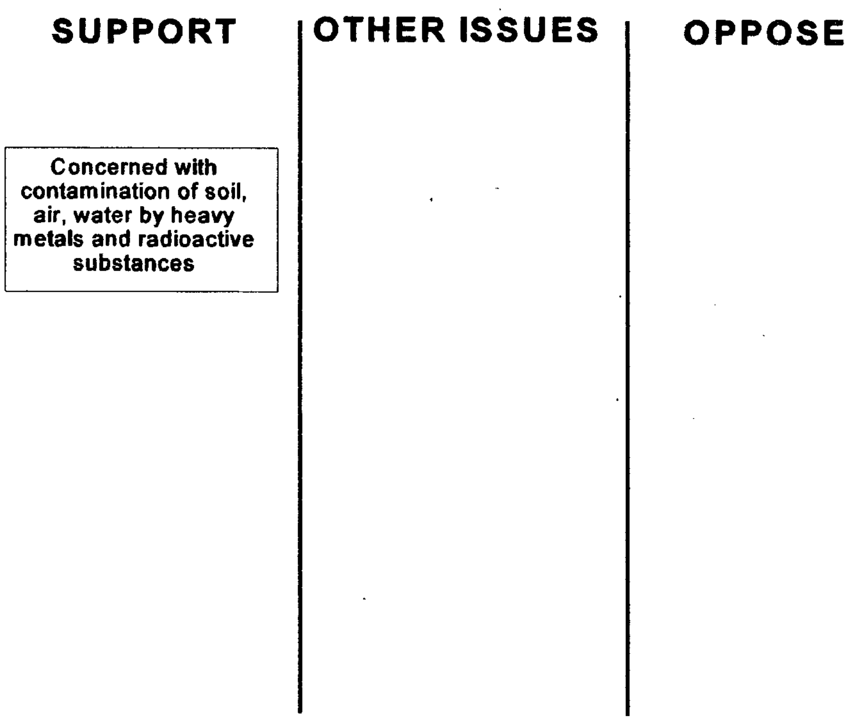


Diagram #A29: York Region Public Health Department

SUPPORT	OTHER ISSUES	OPPOSE
	Upgrading standards beneficial	
	Limited by lack of technical knowledge to comment on alternative levels	

Diagram #A30: The Beaver Valley Heritage Society

SUPPORT	OTHER ISSUES	OPPOSE
	Have no expertise therefore are unable to contribute to consultation	

Diagram #A31: Walter Brown Associates

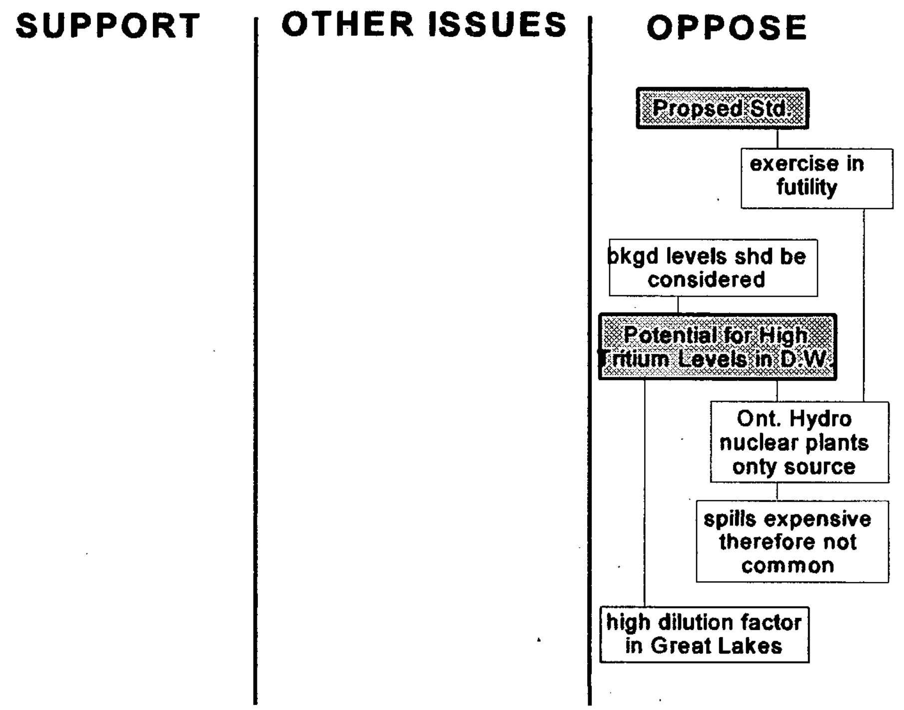


Diagram #A32: The Entry Group

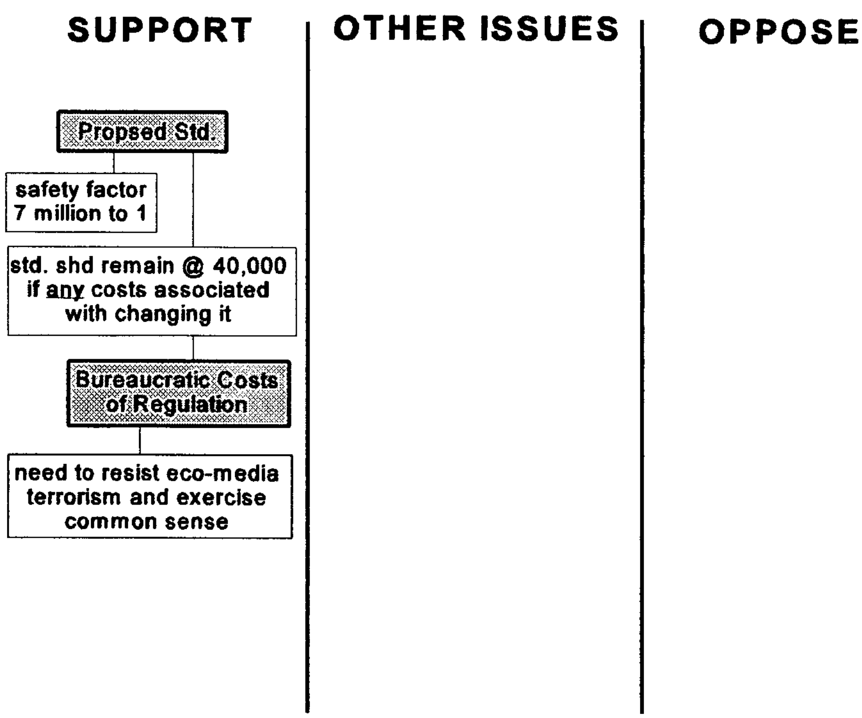


Diagram #A33: Pickering Beach Residents' Association

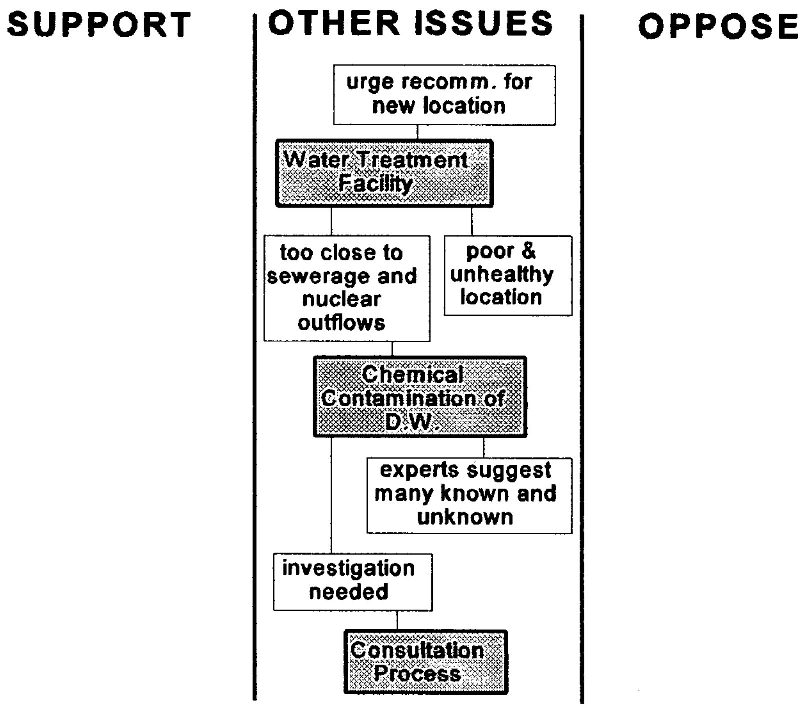


Diagram #A34: Etobicoke Health Department

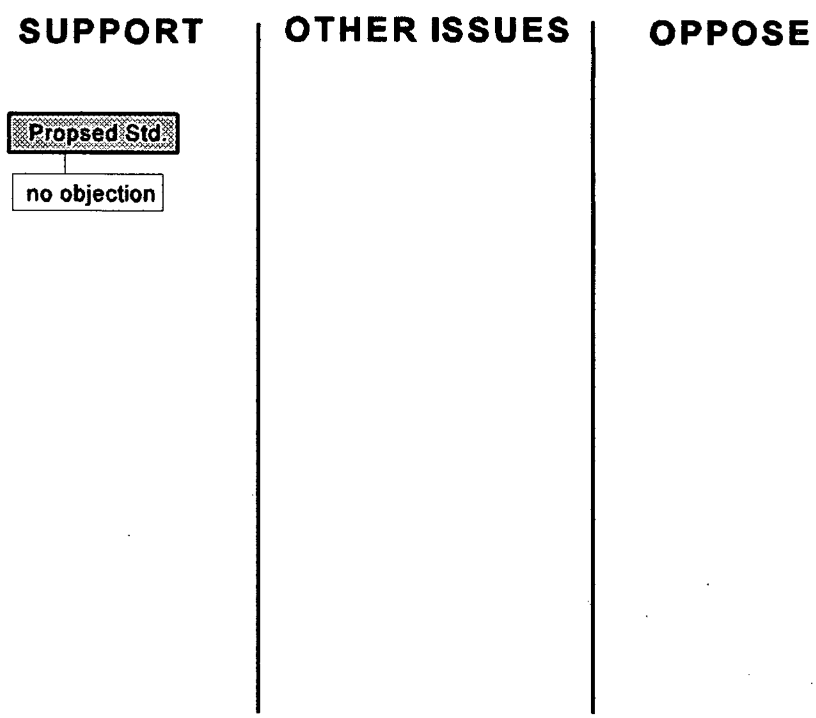


Diagram #A35: Concerned Citizens of Renfrew County

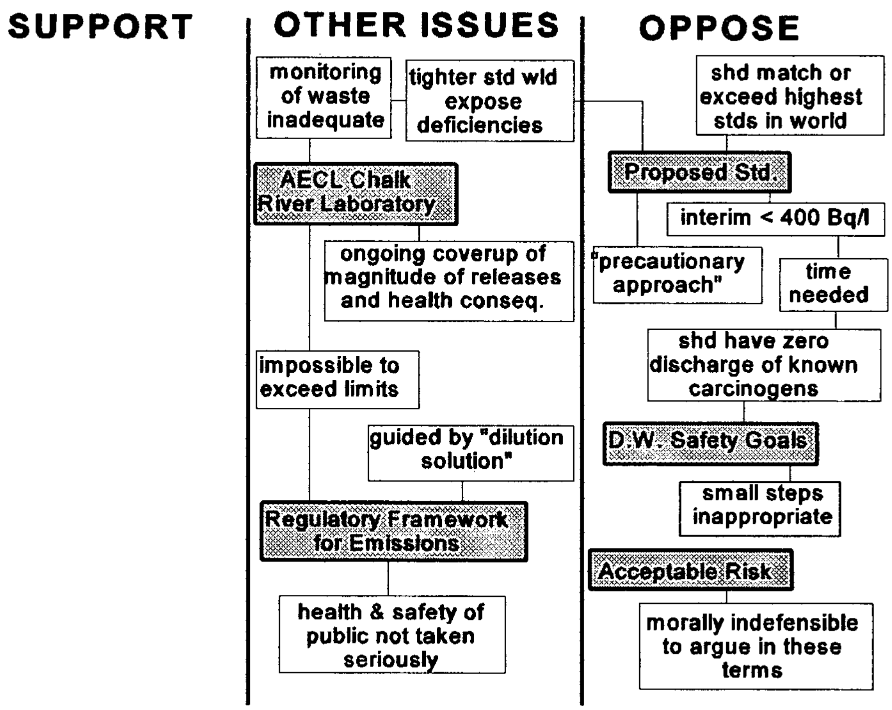


Diagram #A36: Sault Area Nuclear Awareness

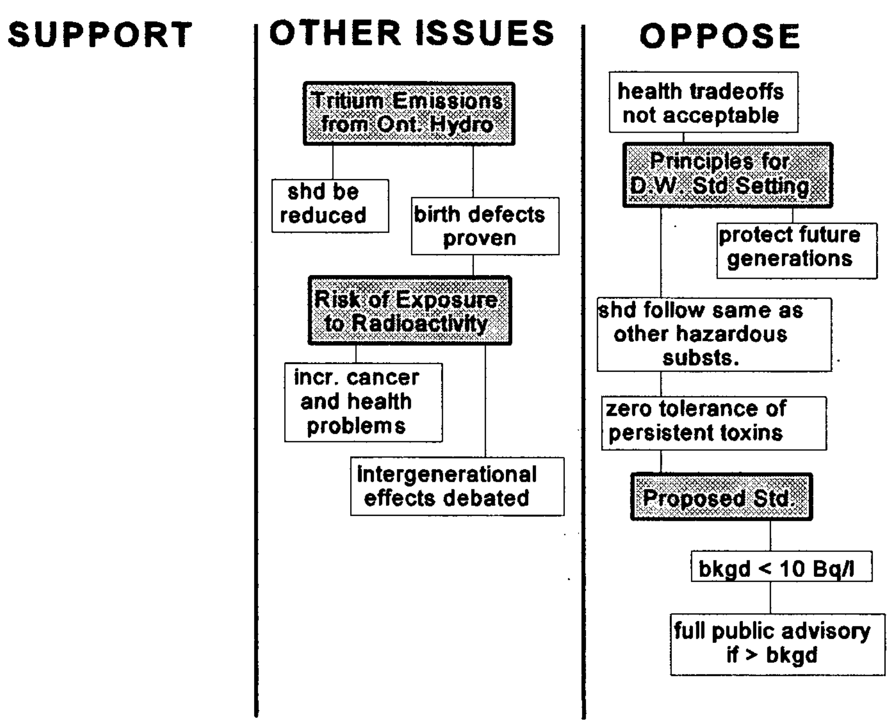


Diagram #A37: Bruce Peninsula Environment Group

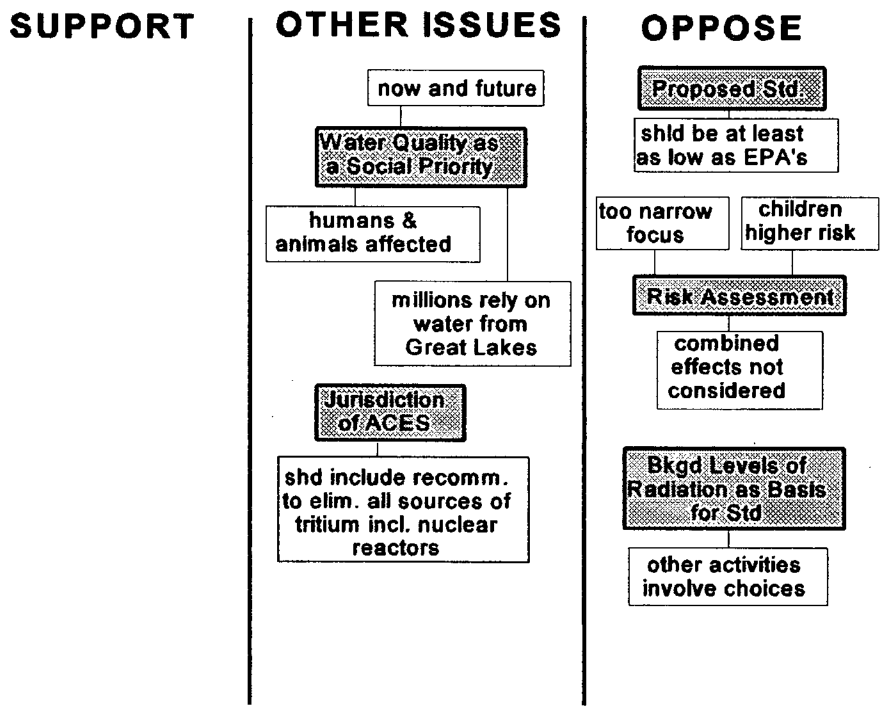


Diagram #A38: C.U.P.E. Local 1000, Power Workers Union

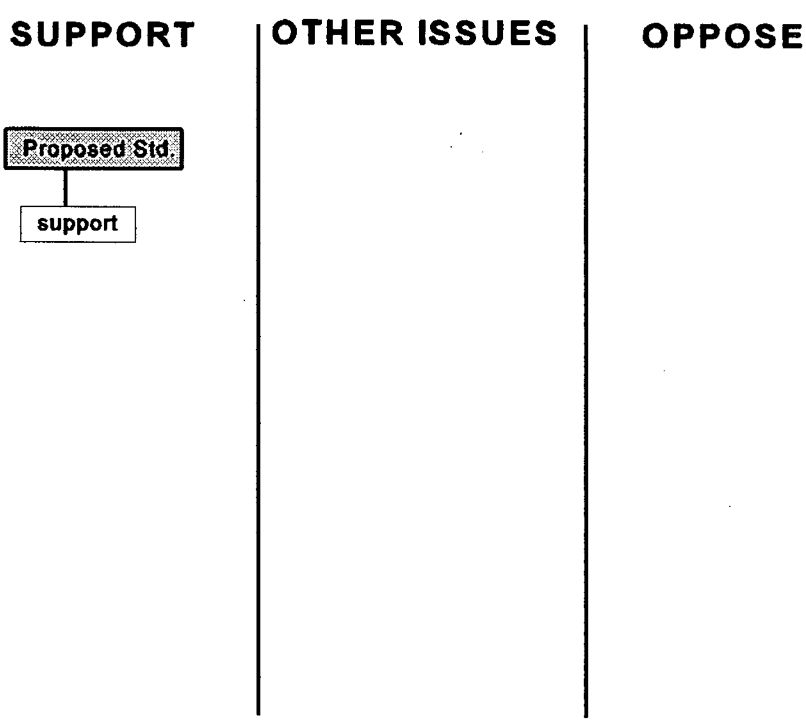


Diagram #A39: Individual Citizen

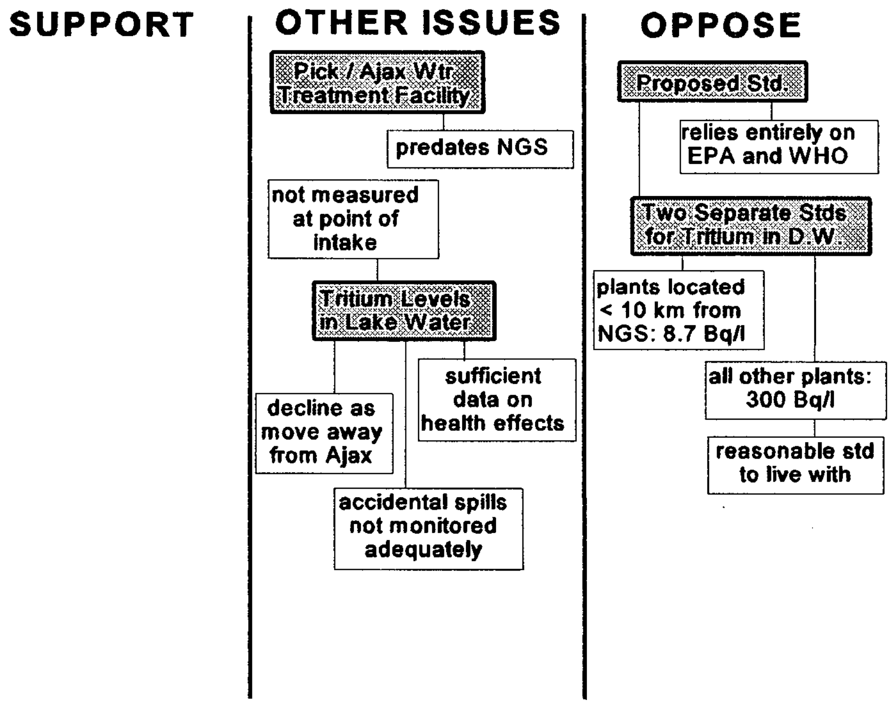


Diagram #A40: Individual Citizen

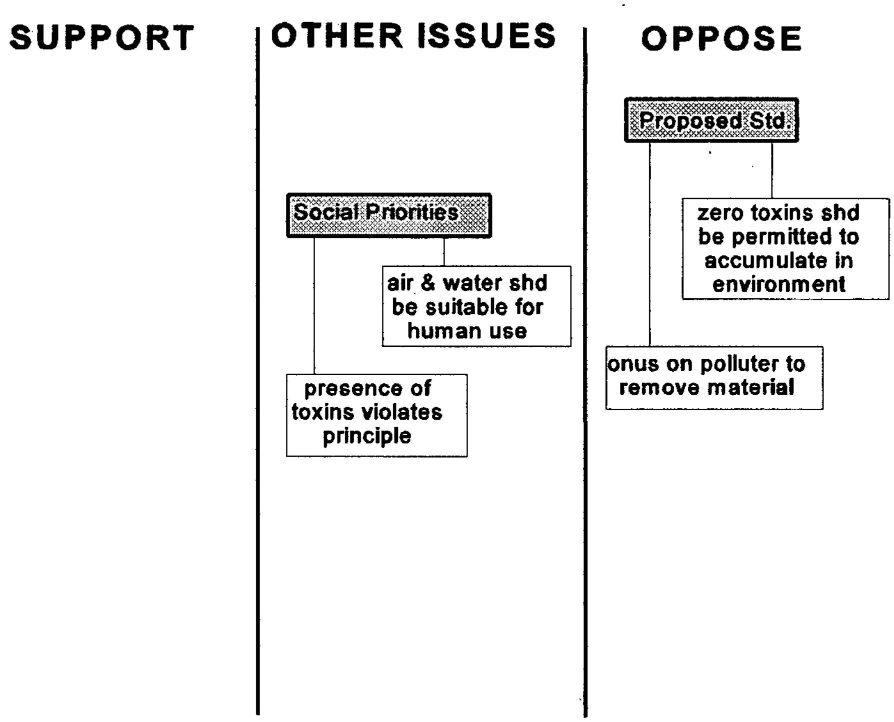


Diagram #A41: Individual Citizen

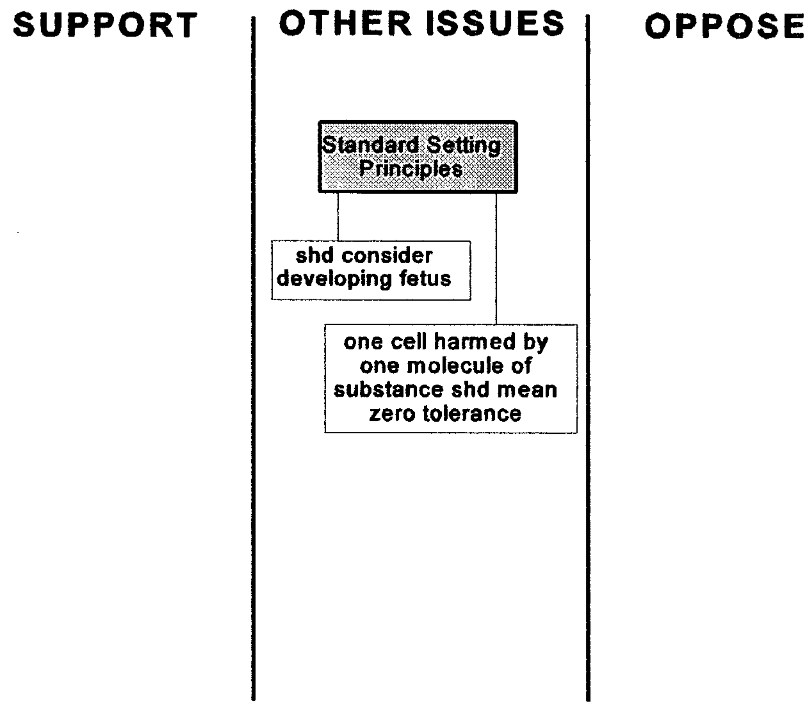


Diagram #A42: Atikokan Citizens for Nuclear Responsibility

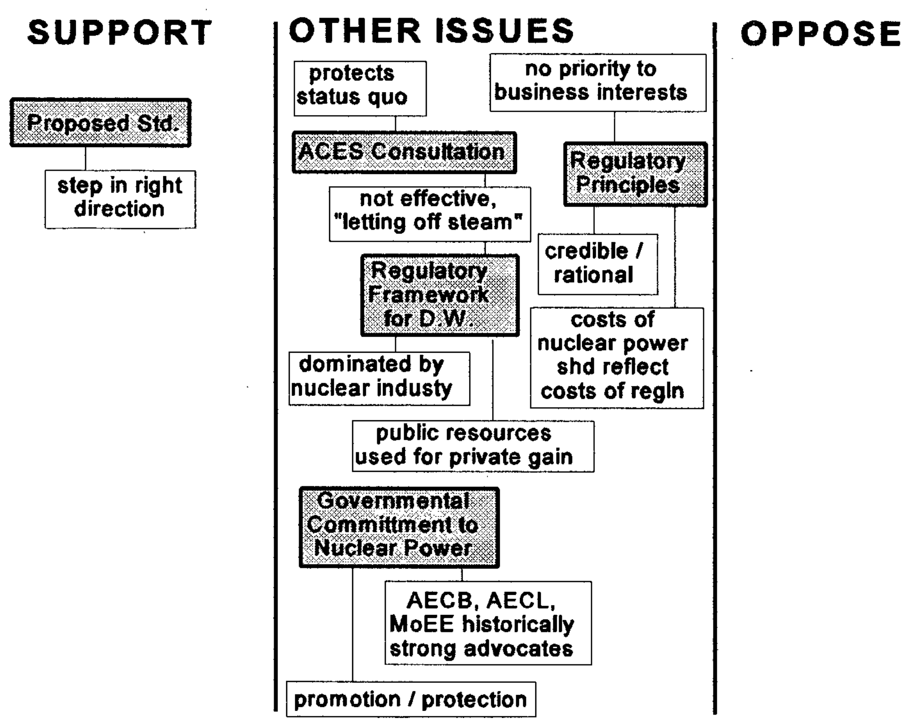


Diagram #A43: Individual Citizen

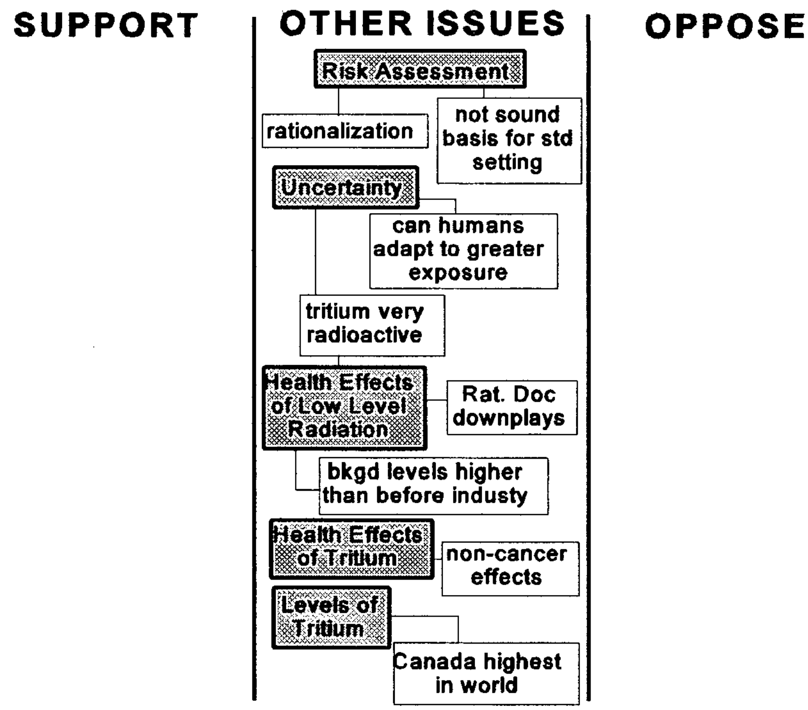


Diagram #A44: The Little Cataraqui Environment Association

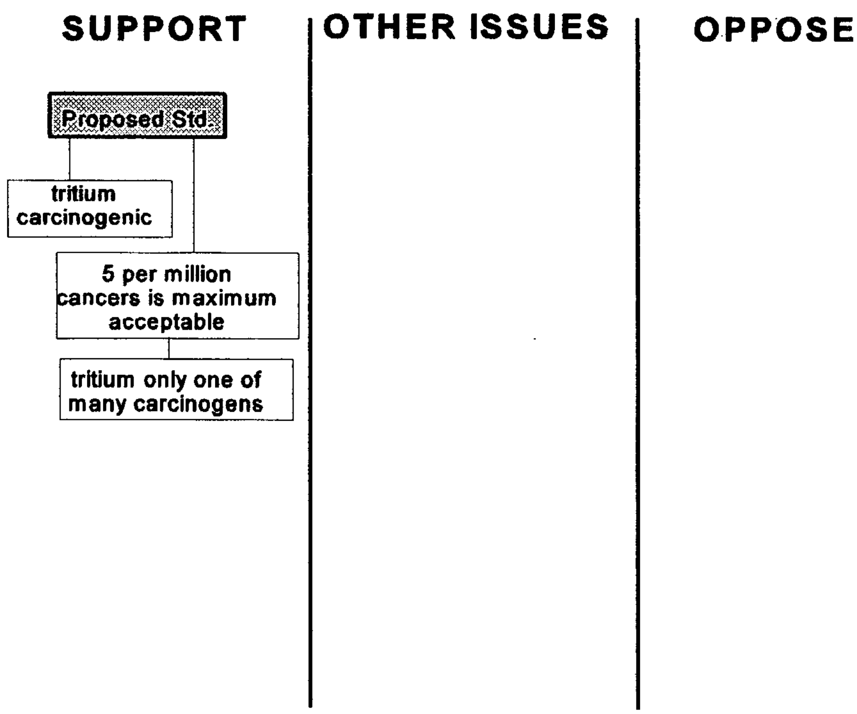


Diagram #A45: Individual Citizen

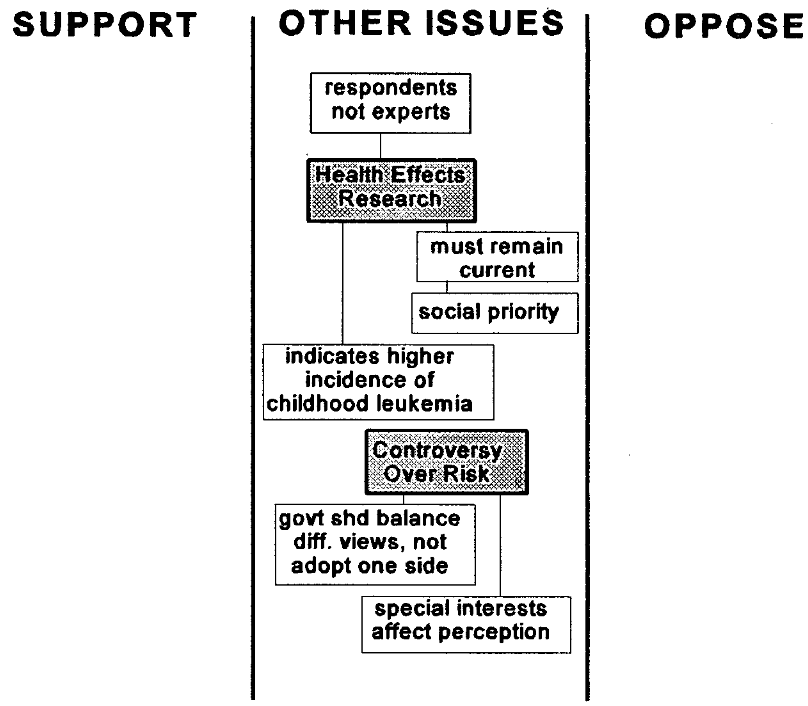


Diagram #A46: Individual Citizen

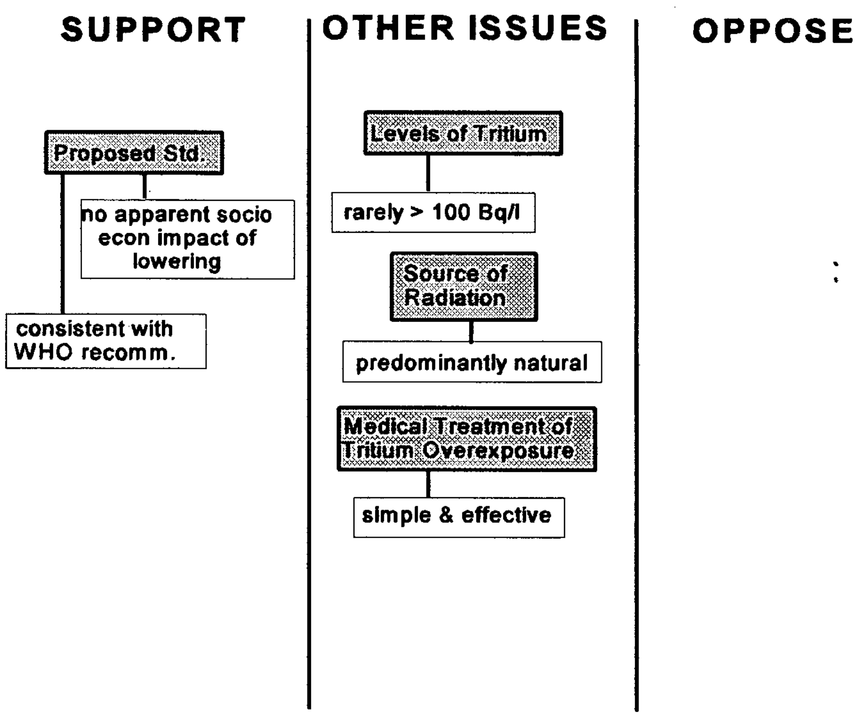


Diagram #A47: Individual Citizen

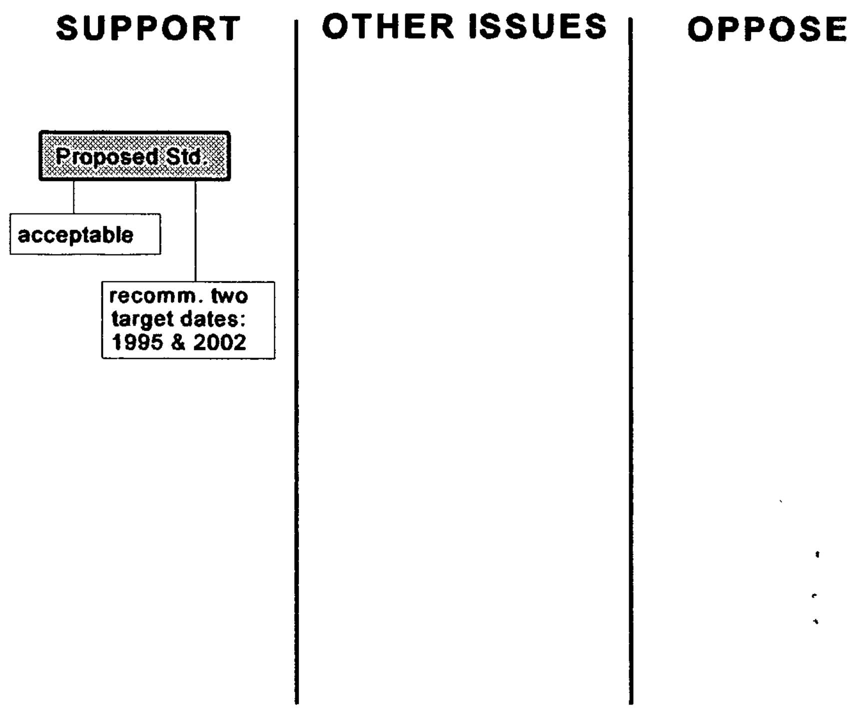


Diagram #A48: Individual Citizen

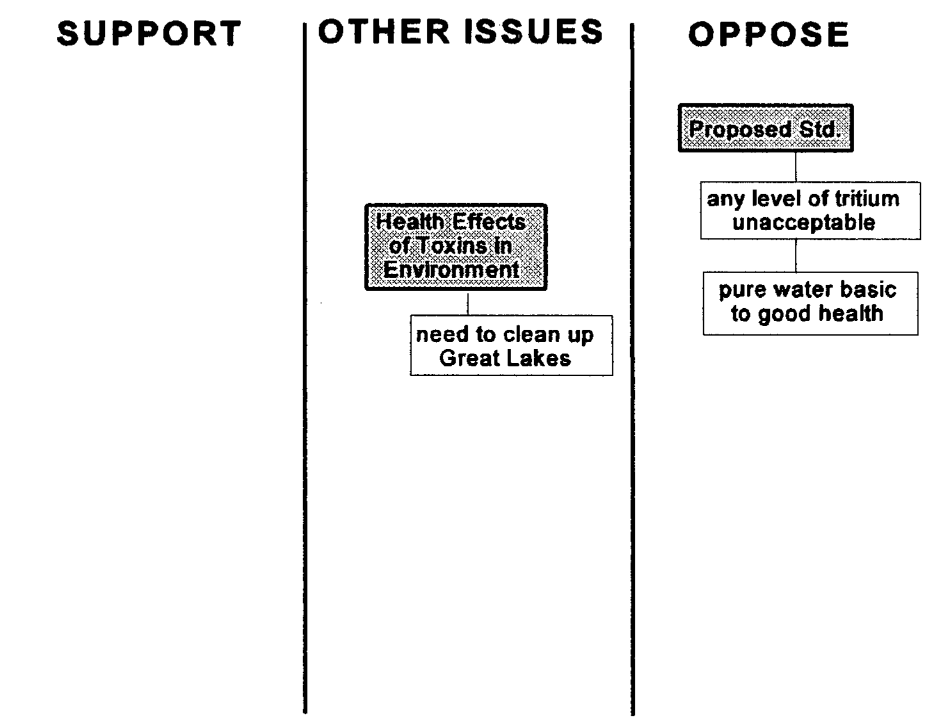


Diagram #A49: Individual Citizen

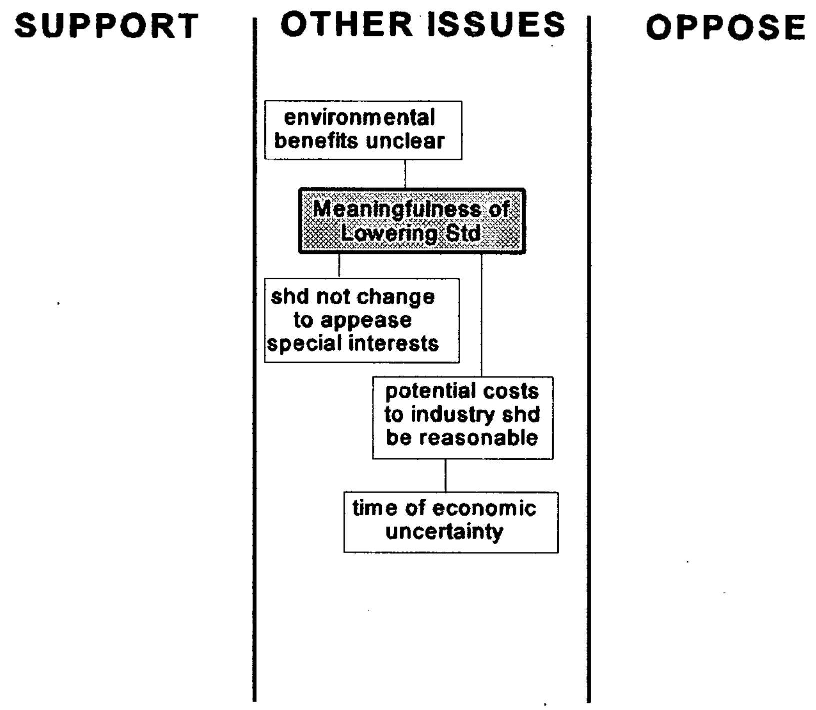


Diagram #A50: Individual Citizen

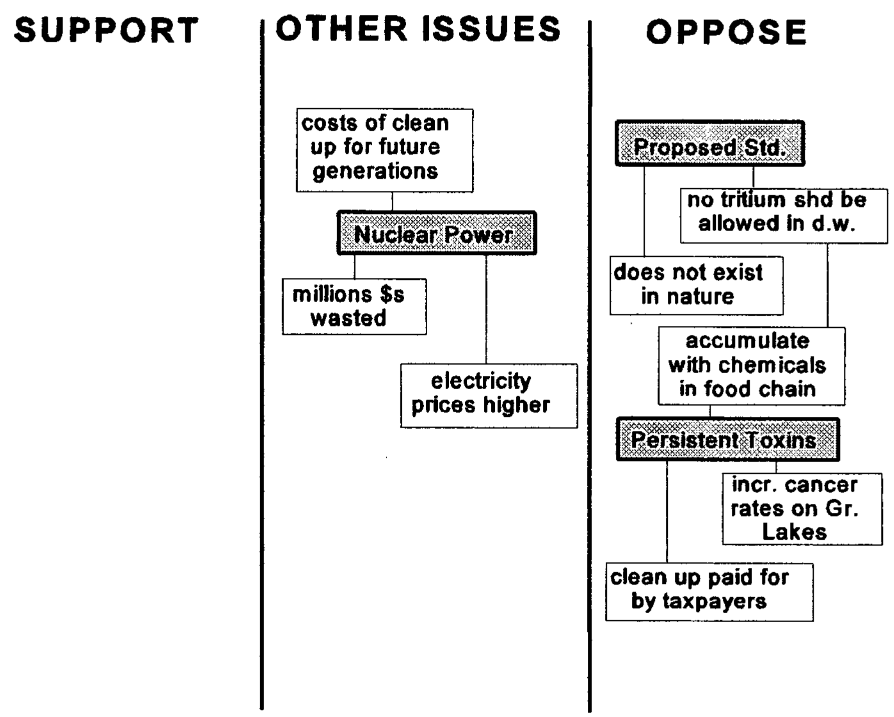


Diagram #A51: Individual Citizen

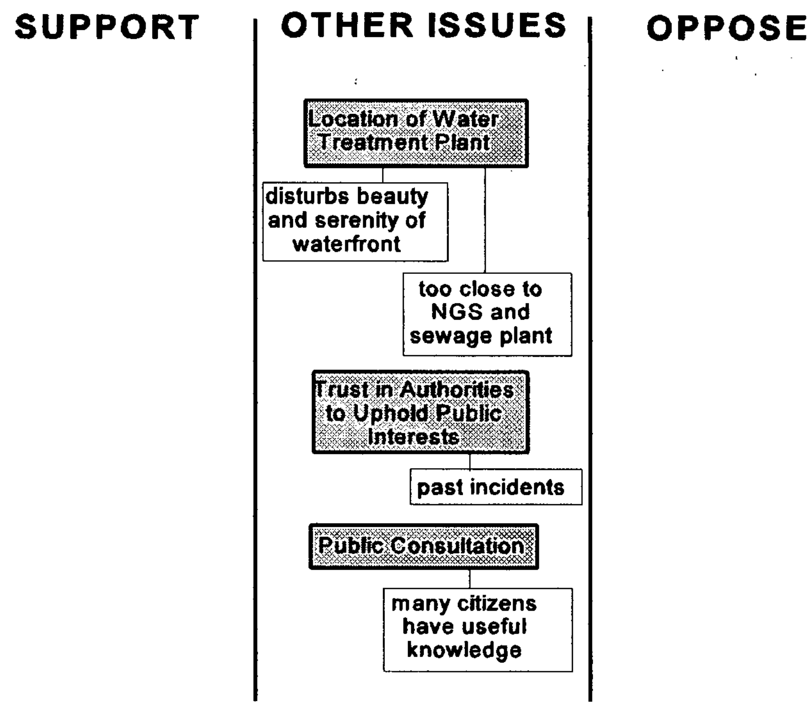
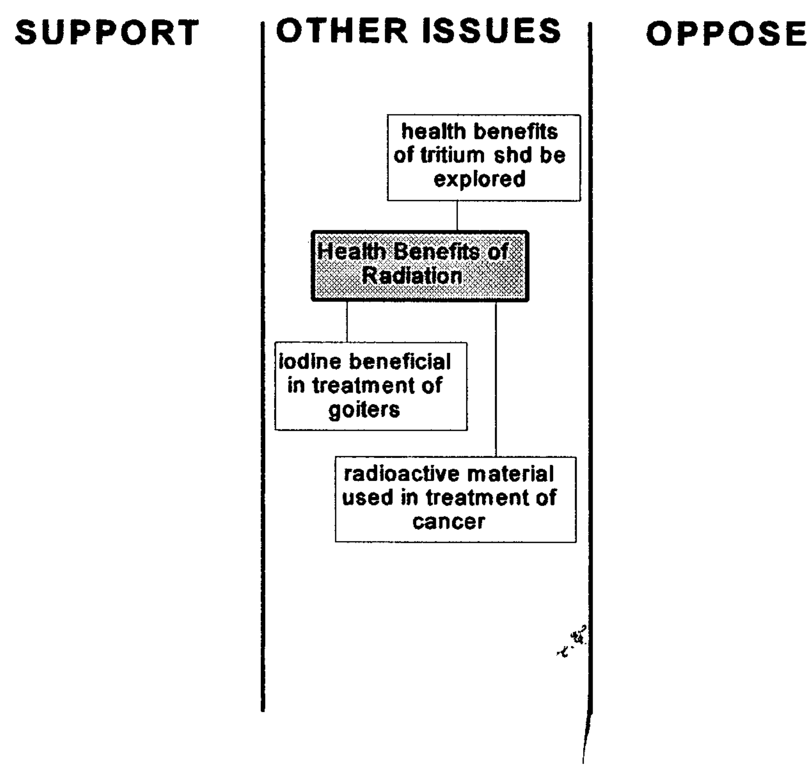


Diagram #A52: Individual Citizen



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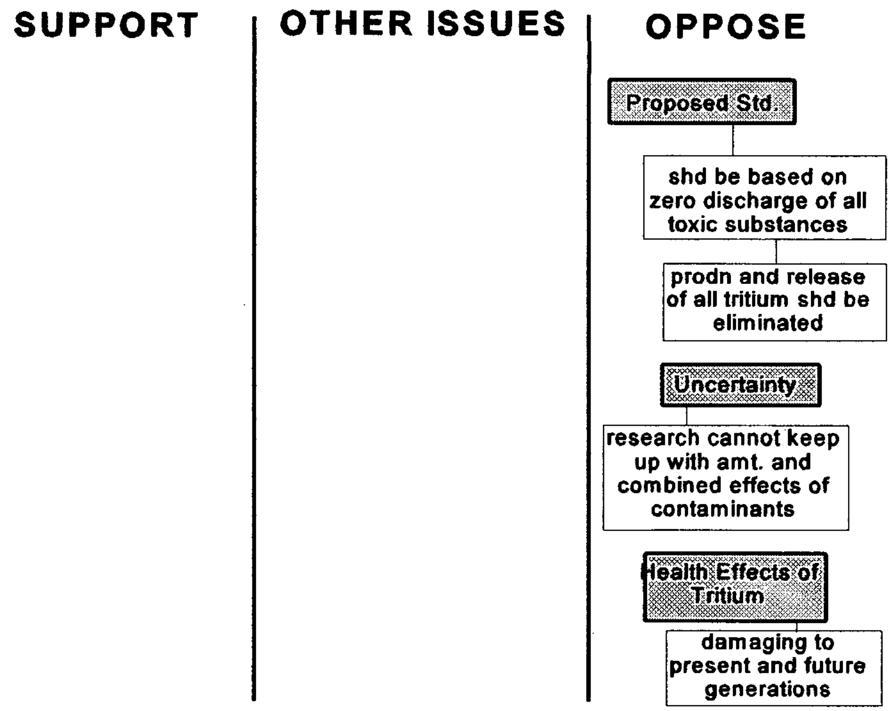

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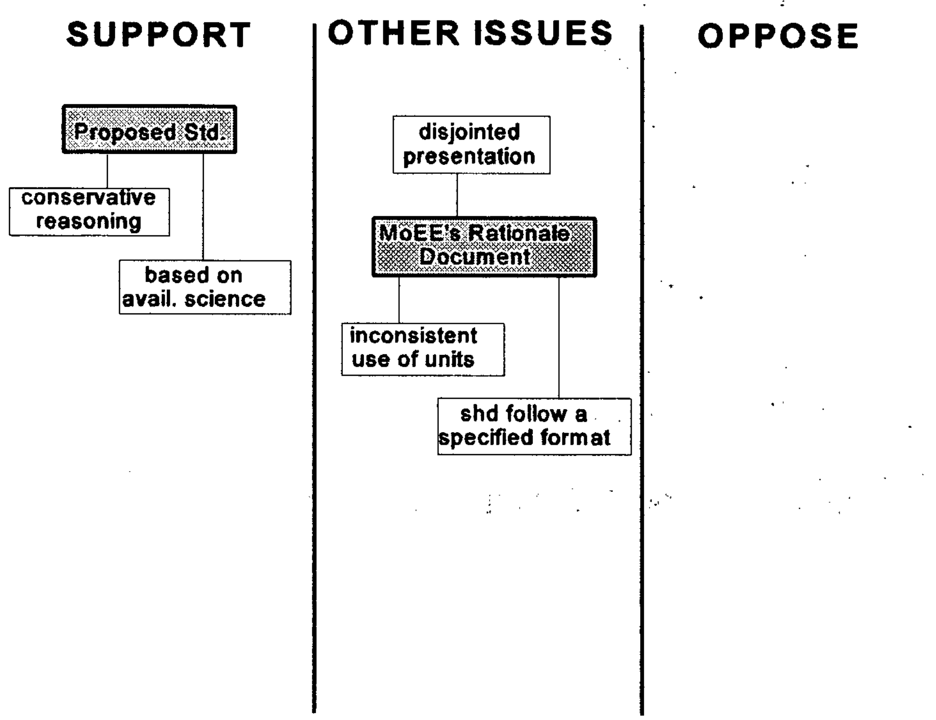

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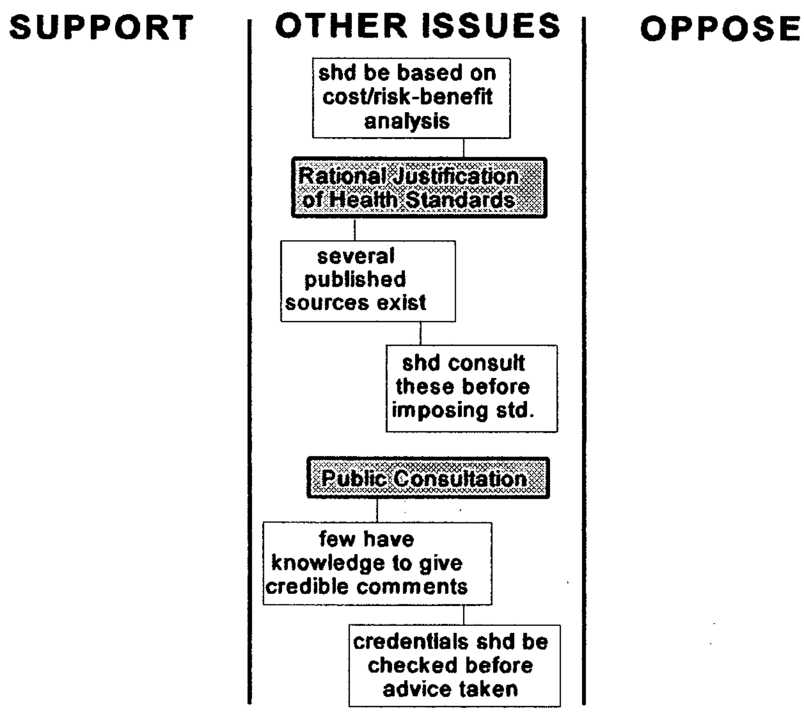
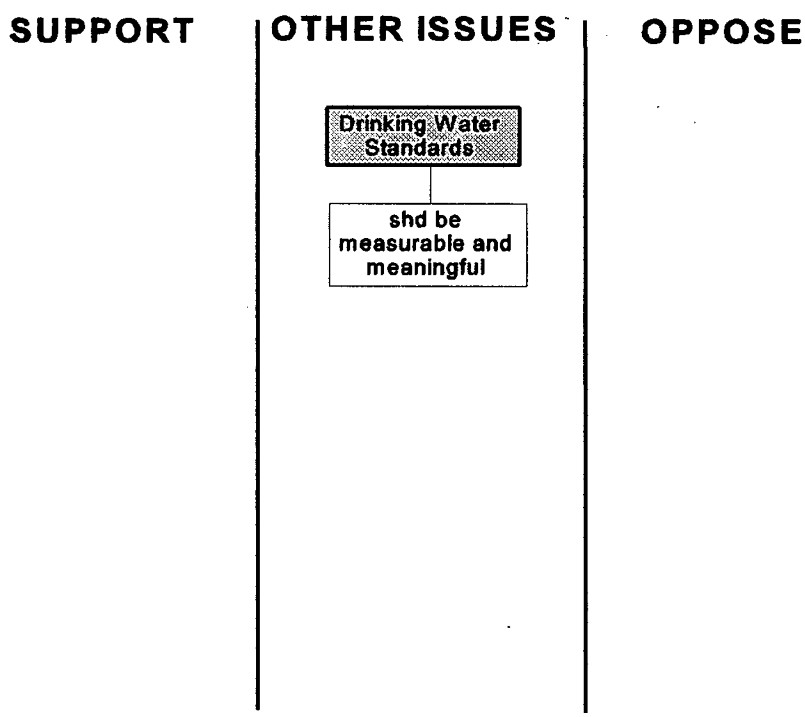


Diagram #A56: Elgin St. Thomas Health Unit



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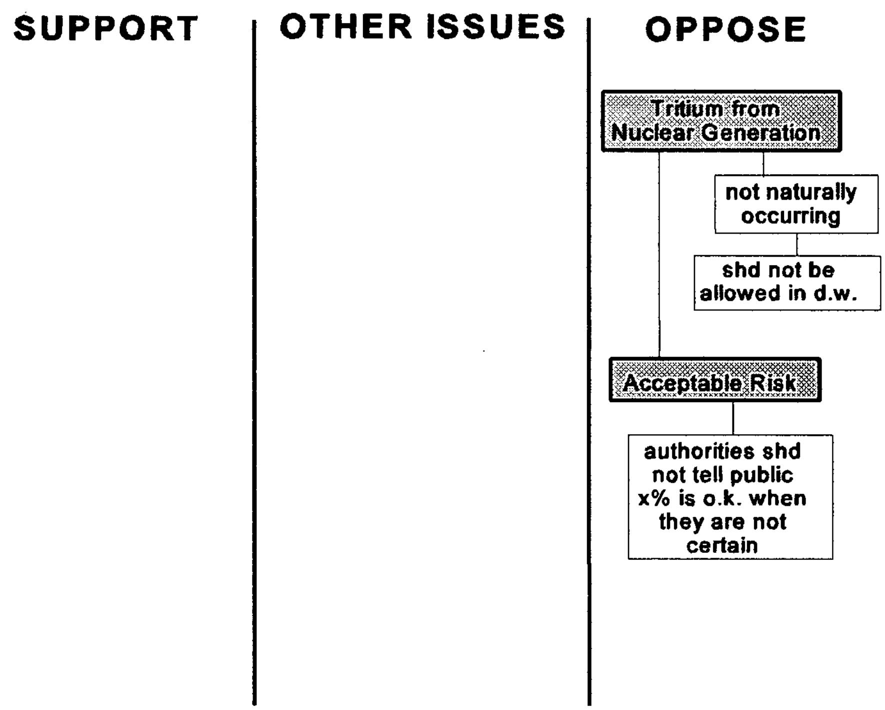

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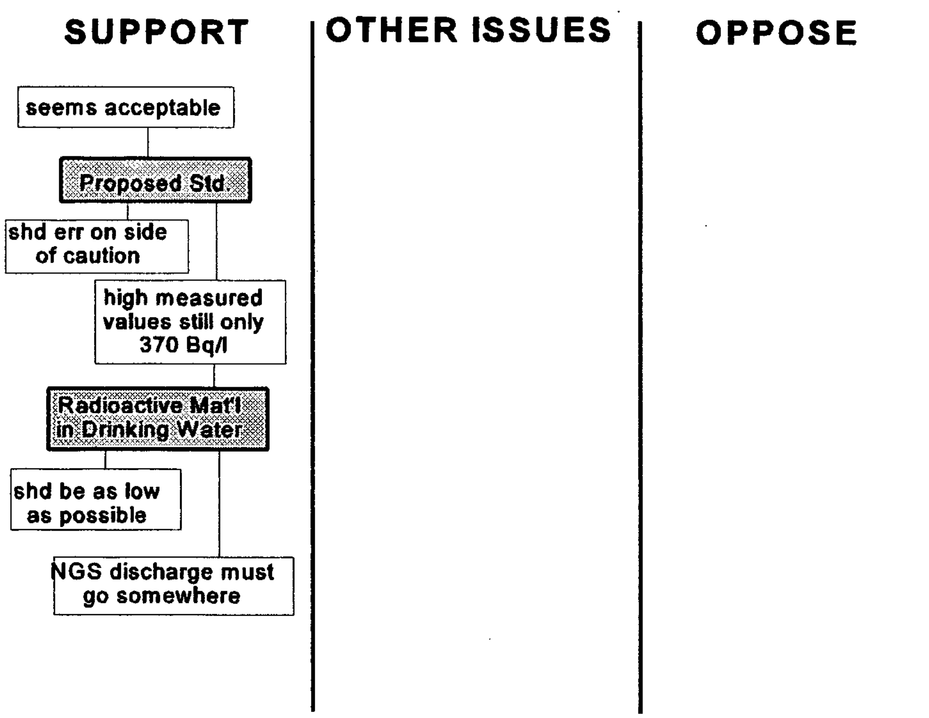

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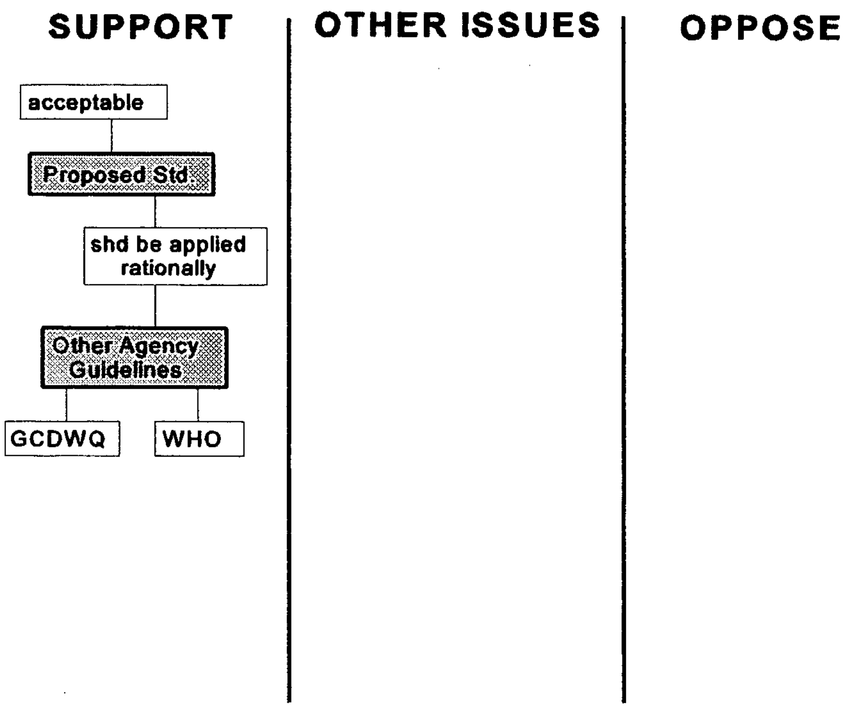

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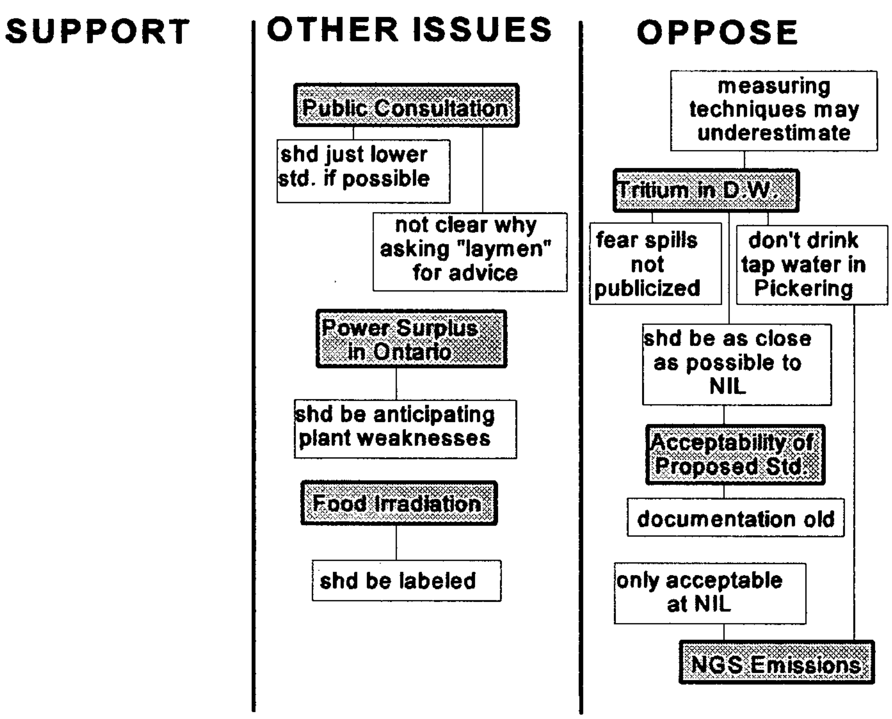
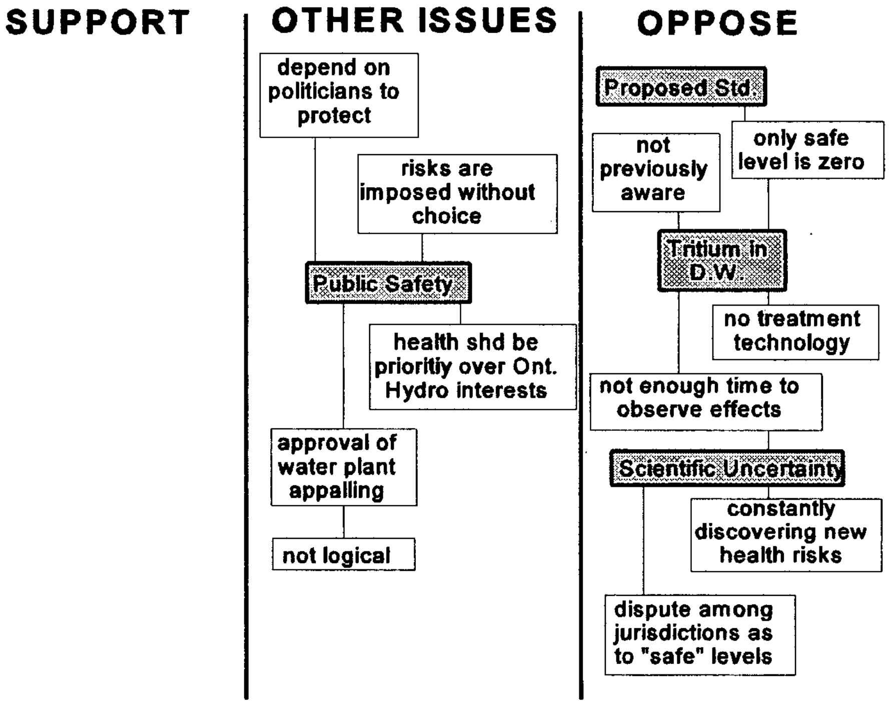


Diagram #A61: Individual Citizen



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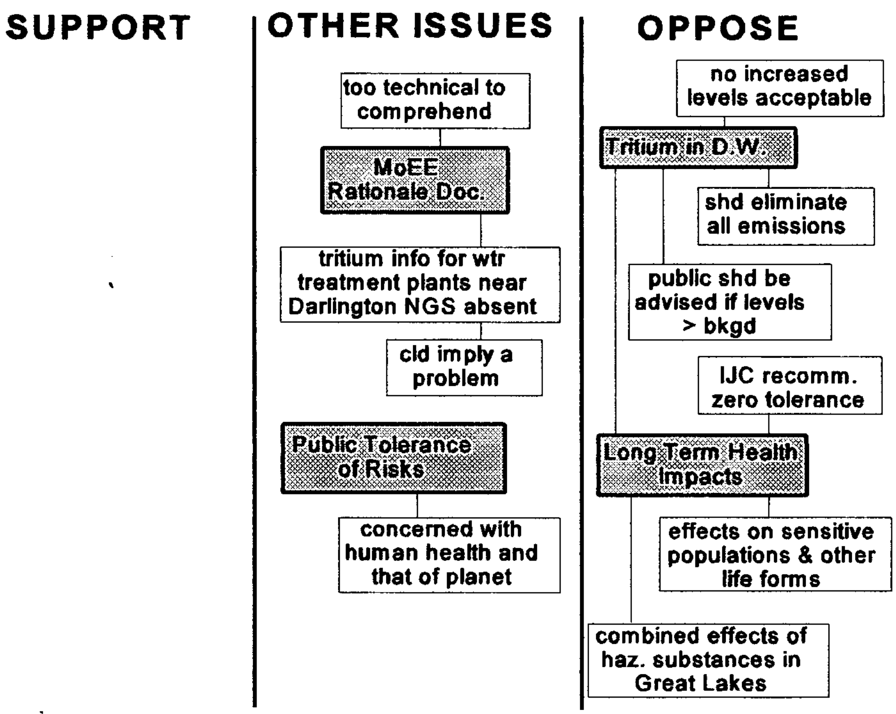

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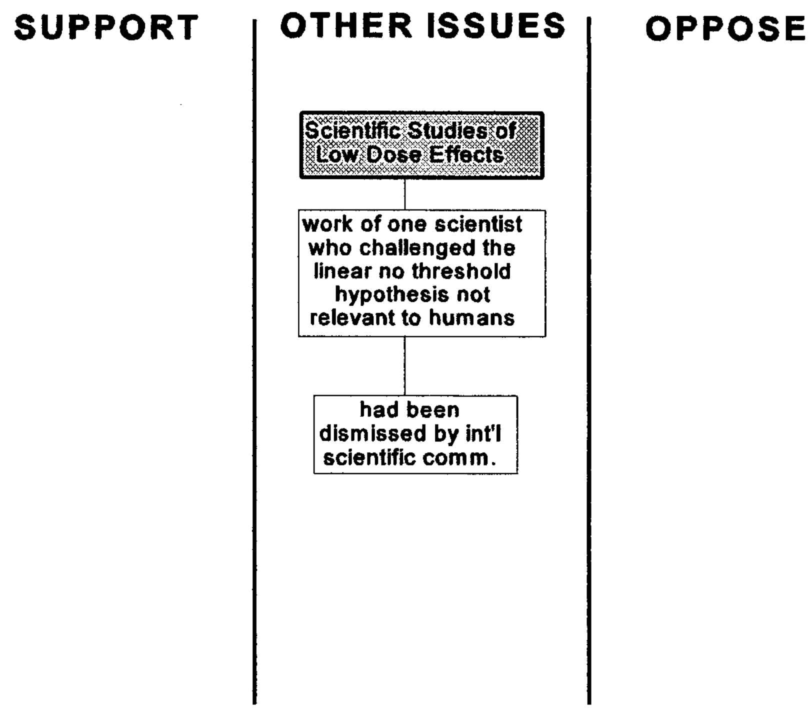

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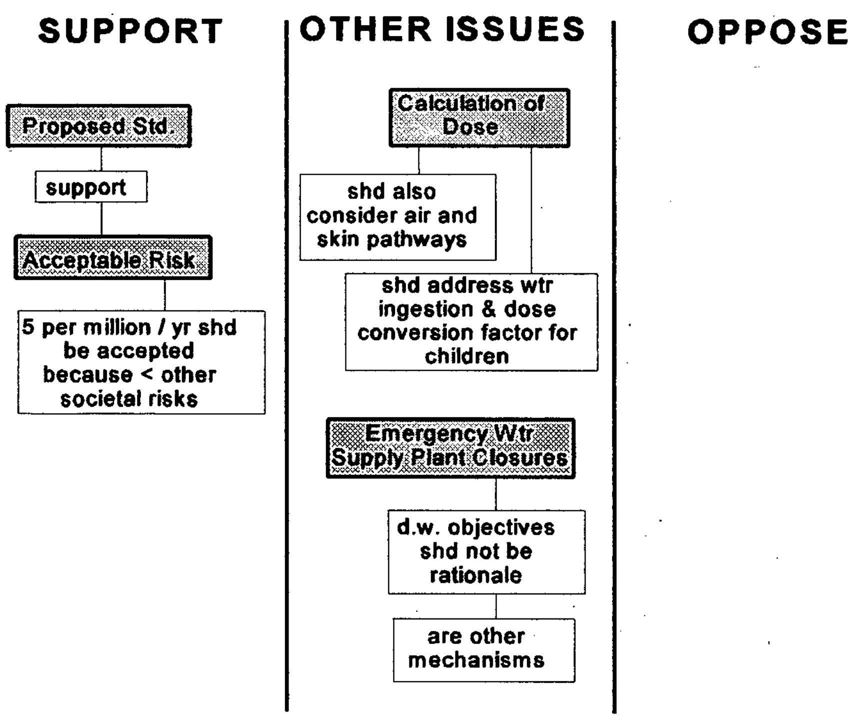
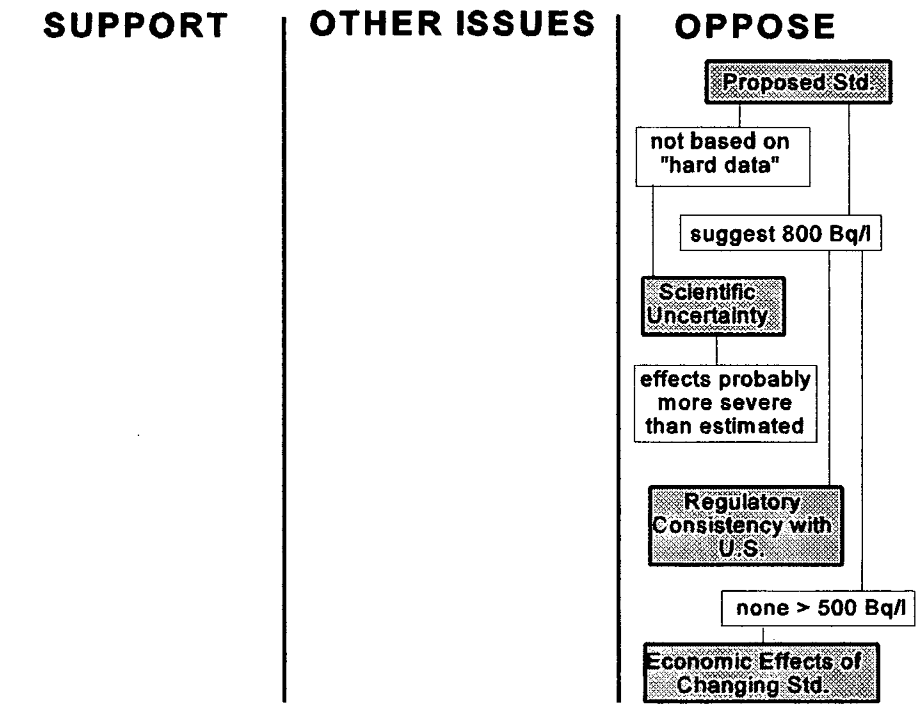


Diagram #A65: Individual Citizen



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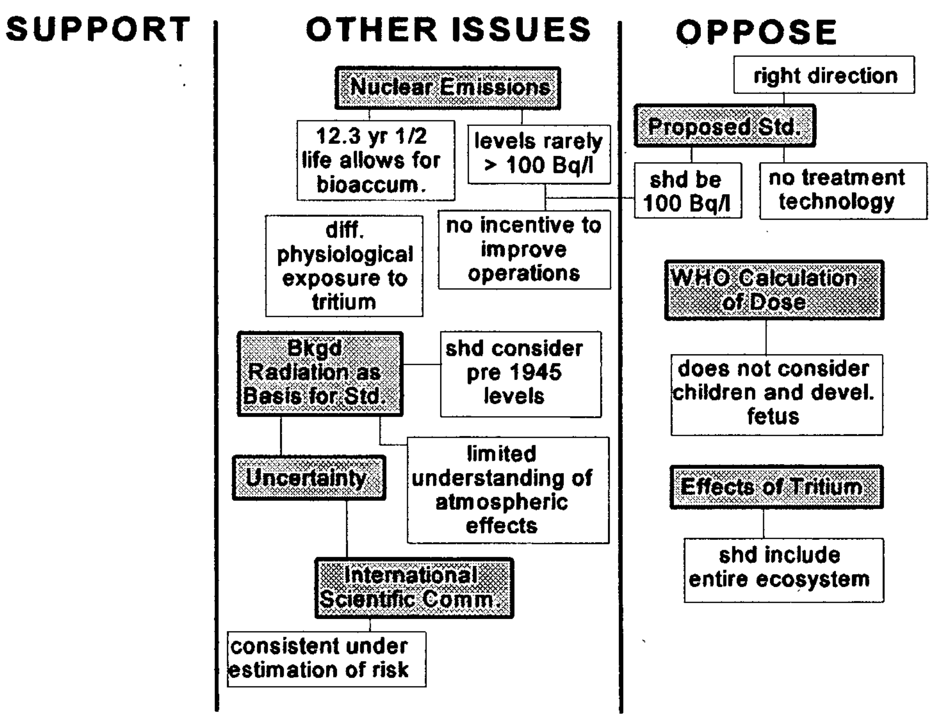


Diagram #A67: Individual Citizen

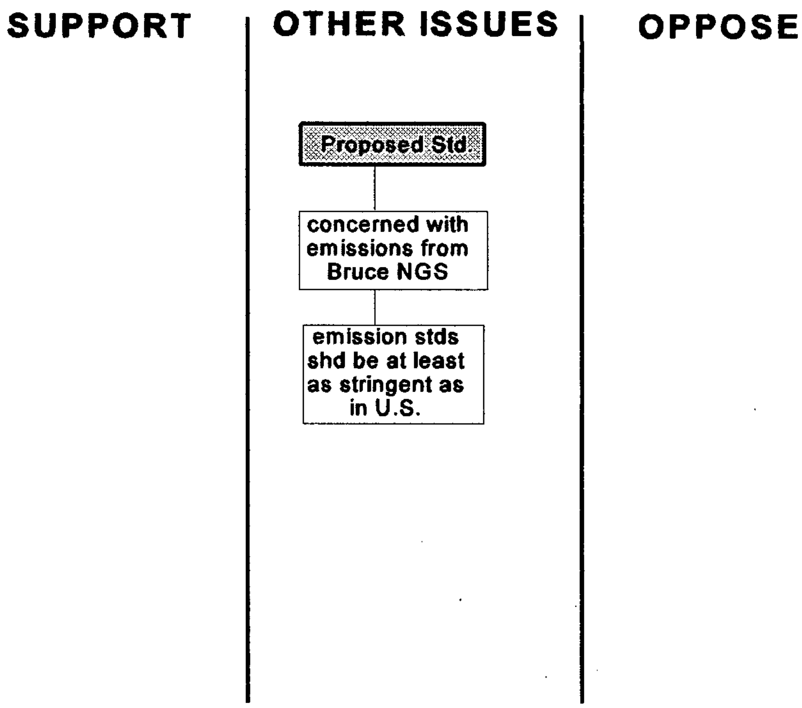
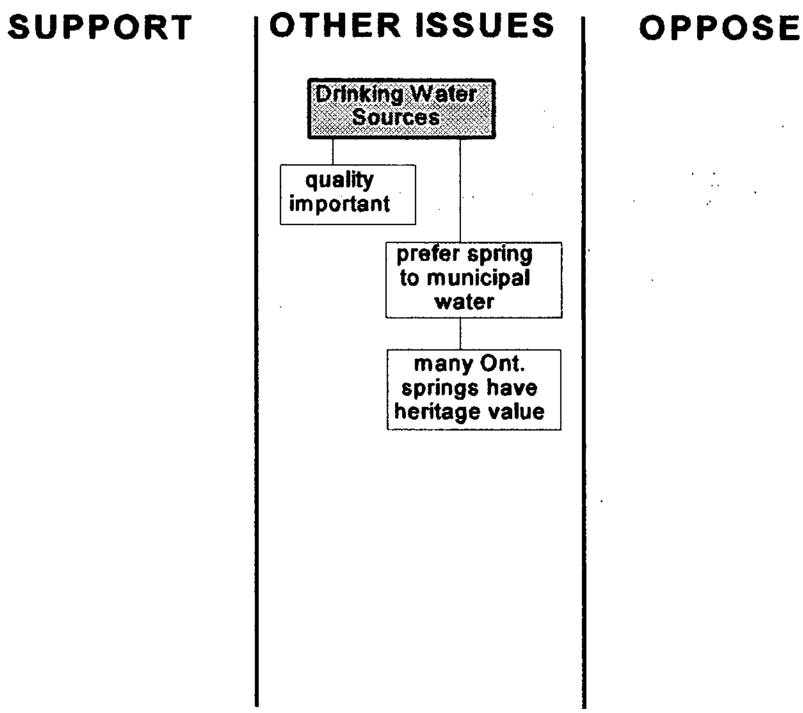


Diagram #A68: Individual Citizen



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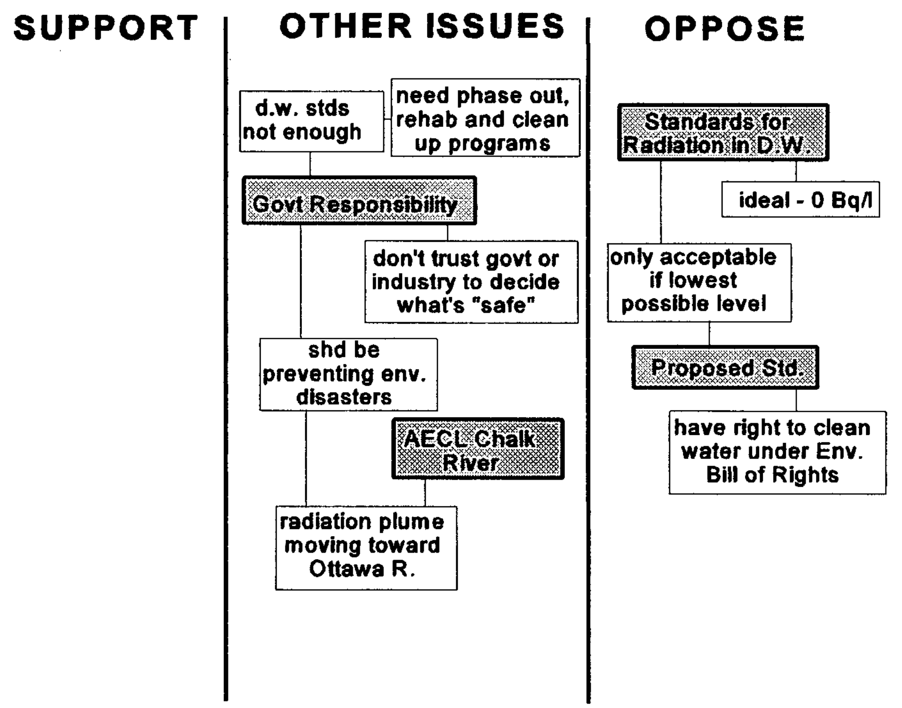

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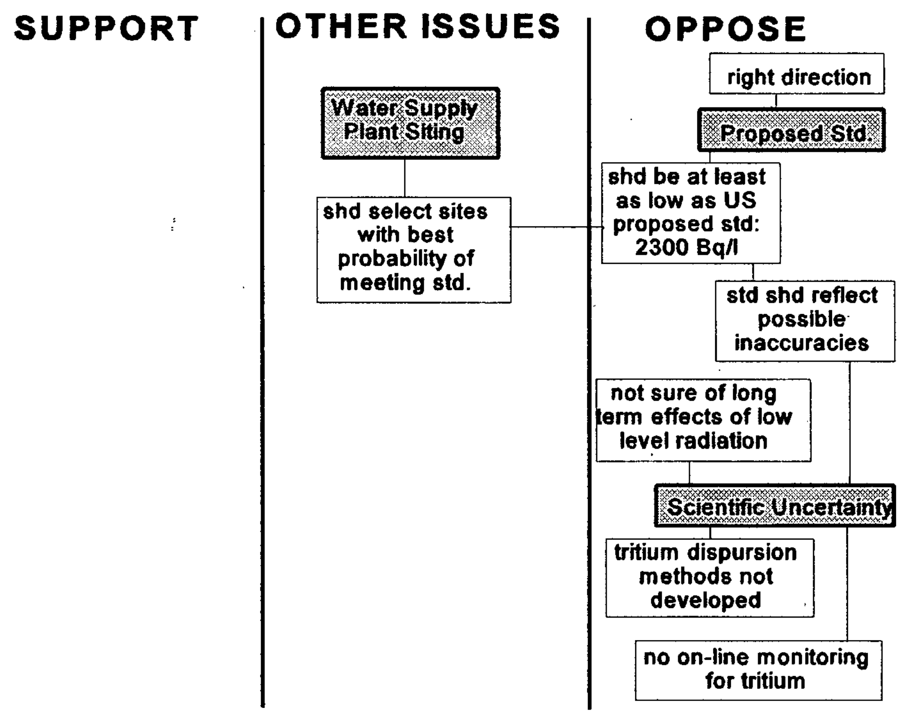

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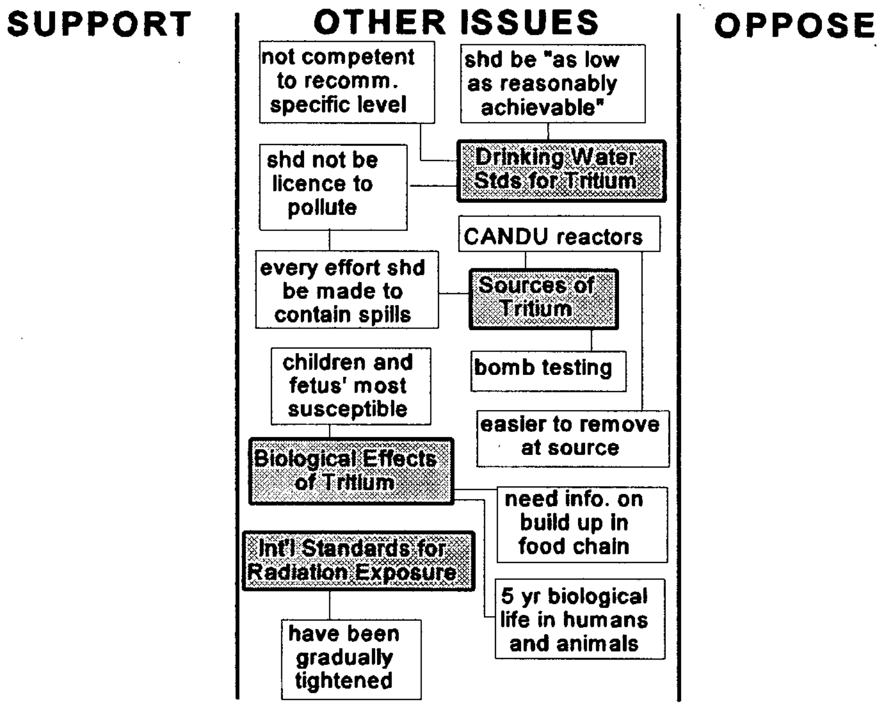

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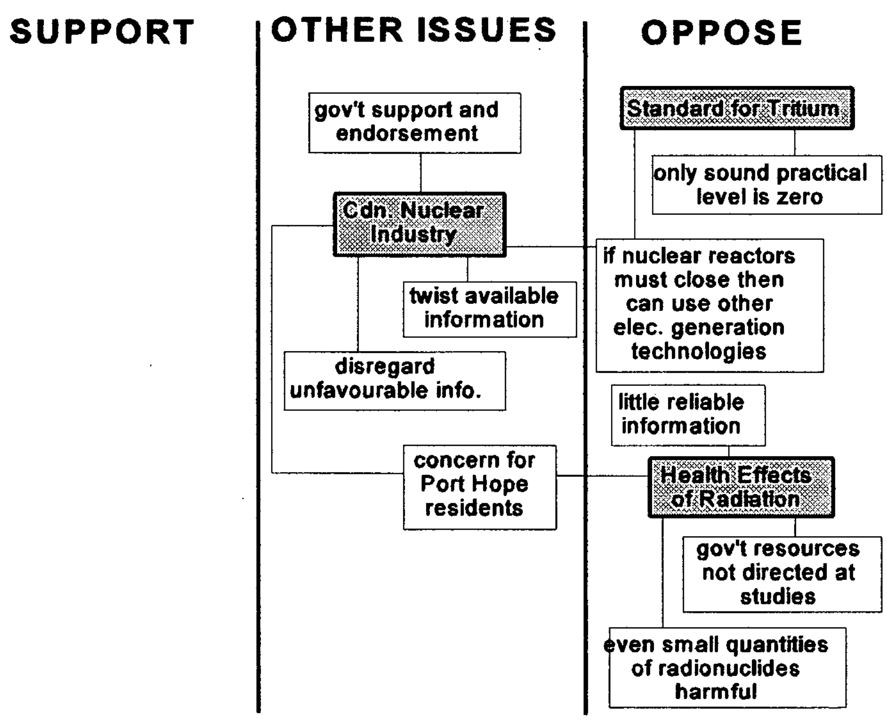

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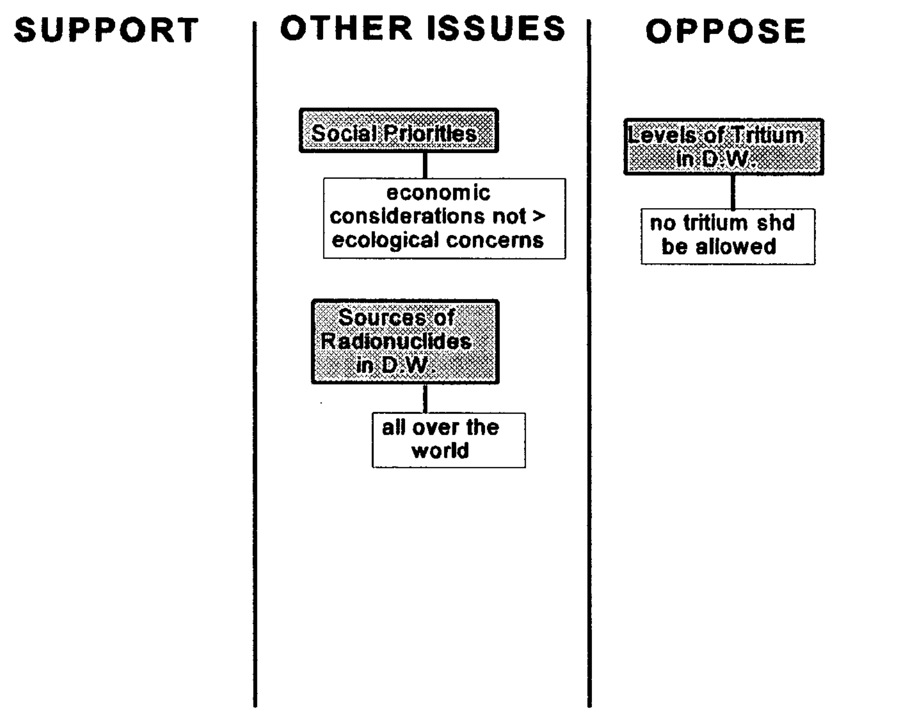

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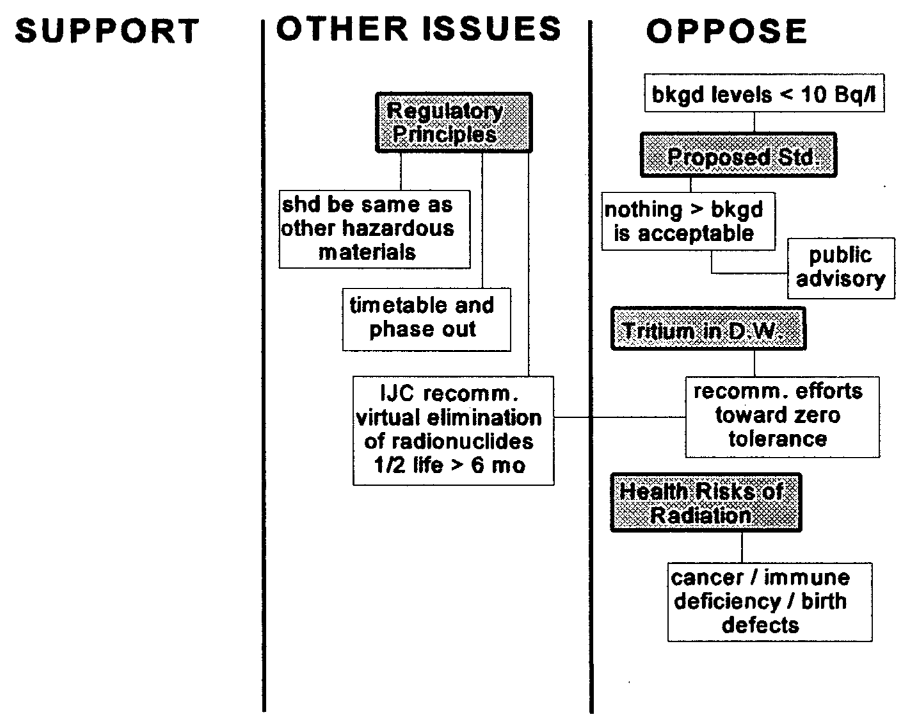
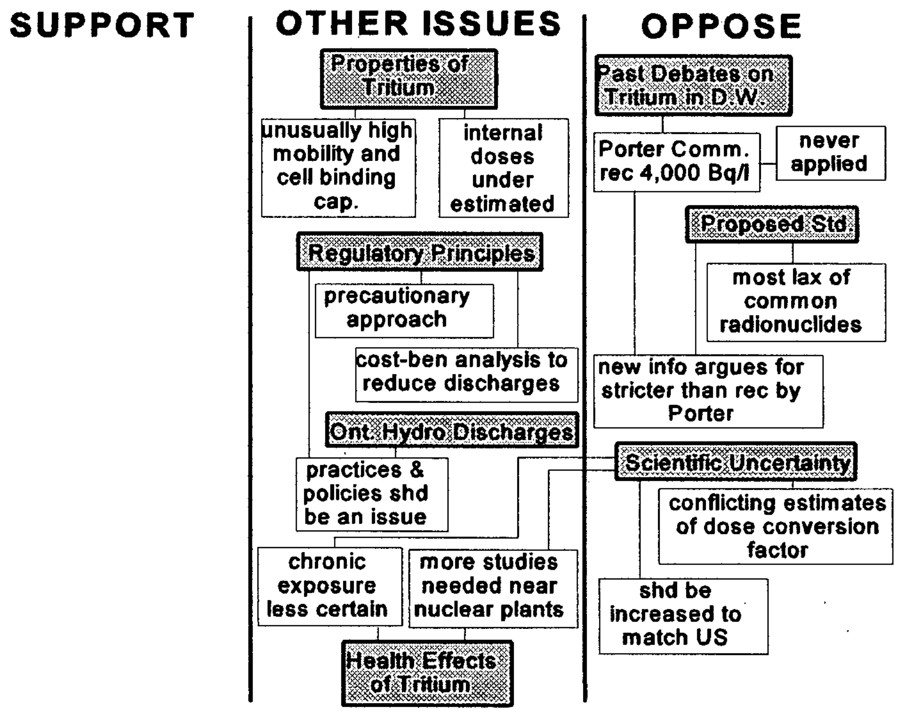


Diagram #A75: Nothumberland Environmental Protection



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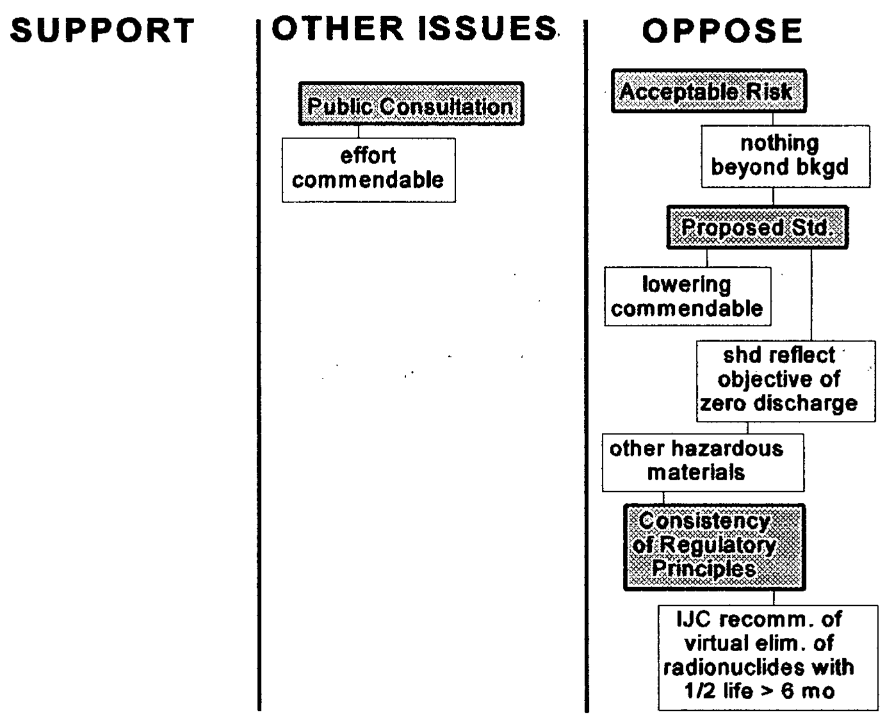

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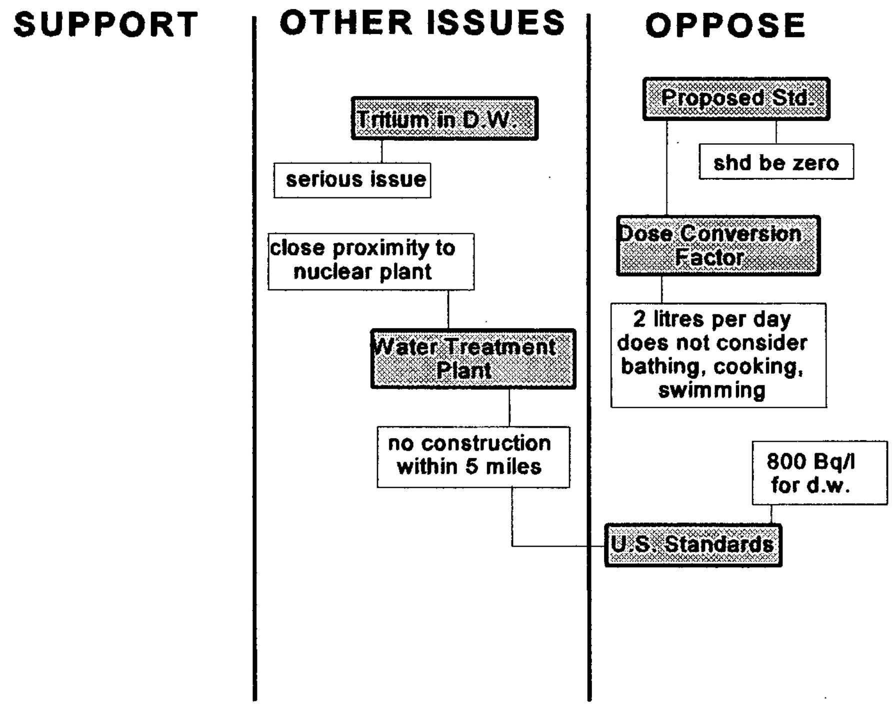

Appendix B

GLOSSARY OF TERMS

alpha-particle: helium nuclei (2 protons and 2 neutrons) emitted from a radioactive nuclide during the process of decay. (B)

Becquerel (Bq): the standard international unit of radioactivity of a radionuclide decaying at a rate, on average, of one spontaneous nuclear transition per second. (B)

beta-particle: electrons emitted from a radioactive nuclide during the process of decay. (B)

dose conversion factor: a quality factor which accounts for differences in biological impact of different types of radiation; expressed in Sv Bq^{-1}. (A and C)

dose equivalent: a measurement that relates absorbed dose of radiation with the biological impact of all kinds of ionizing radiation; calculated by multiplying the absorbed dose by a dose conversion factor that accounts for differences among different types of radiation. (C)

gamma-radiation: short wave electromagnetic energy emitted from a radioactive nuclide during the process of decay. (B)

half-life: the time required for an unstable element or nuclide to lose one-half of its radioactive intensity in the forms of alpha, beta, and gamma radiation. It is a constant for each radioactive element or nuclide. (B)

ionization: the process by which neutral atoms or groups of atoms become electrically charged, either positively or negatively, by the loss or gain of electrons. (B)

ionizing radiation: any radiation consisting of directly or indirectly ionizing particles or a mixture of both. (B)

radionuclide: atoms that disintegrate by emission of electromagnetic radiations, most commonly alpha, beta or gamma rays. (B)

rem: abbreviation for roentgen-equivalent-man; previous standard international dose equivalent unit equal to 0.01 Sv. (B and C)

sievert (Sv): standard international dose equivalent unit of 1 J kg^{-1}; also equal to 100 rem. (A and B)

tritiated water: indistinguishable from normal water except for additional protons in atomic structure.

tritium: an isotope of hydrogen with a mass of three. The structure is two protons, and one neutron in its nucleus. (B)

<u>Sources:</u>

A: ICRP Publication #26 (1977)

B: CRC Handbook of Chemistry and Physics, 70th Edition (1993)

C: MoEE Rationale Document (1993)