# NWMO Draft Study Report Choosing a Way Forward

### Introduction

As part of its mandate and stated mission, the Nuclear Waste Management Organization (NWMO) was tasked to study, evaluate and recommend on three options to the management, storage and disposal of nuclear fuel waste in Canada. The NWMO Draft Study Report *Choosing a Way Forward* outlines its considerations of the three options:

Option 1: Deep Geological Disposal in the Canadian Shield; Option 2: Storage at Nuclear Sites; Option 3: Centralized Storage, Above or Below Ground.

In the Draft Study Report the NWMO has defined a **Fourth Option**, a risk management approach called the **Adaptive Phased Management**, as a possible path. This option combines Options 1 and 3 to be implemented over a period of 300 years.

As reflected in the Nuclear Fuel Waste Act (NFWA) the sentiments and values of Canadian Society are that, *inter alia*, this generation of citizens which has enjoyed the benefits of nuclear energy has an obligation to manage this waste. This is consistent with the "polluter pays" principle. As waste already exists, this generation does not want to leave as a legacy the burden of providing for and funding the management of the waste we, as a society, have created. Safety and security are the key considerations that must drive the rationale for the selection of options.

These principles appear to have been modified somewhat to provide the responsibility to future generations to manage the waste in a safe and secure way; in effect building creative flexibility in the selection of options to let future generations decide on how to manage this (our) waste. This is reflected in the Adaptive Phased Management approach described in the Draft Study Report.

In effect, the Draft Study Report, while it purports to select the combination of Options 1 and 3, it also by the determined long time frame of 300 years of implementation has sequentially included all three options as part of the Adaptive Phased Management approach. In other words, the NWMO has made no clear choice or selection of options in its recommendation for the long-term management of nuclear fuel waste in Canada.

As outlined in the following rationale, this is not an acceptable "solution" to the issue of managing Canada's nuclear fuel waste.

### Passing The Burden to Future Generations

The Adaptive Phased Management approach appears to be driven by perceived social concerns, not technical or economic considerations. From the outset of the hearings conducted by the Seaborn Panel, it was clear the social issues were the dominant factors

over technical or economic considerations in determining the way forward. Hence its recommendation to develop an ethical and social assessment framework and to study and evaluate various options in dealing with the long-term management and disposal of nuclear fuel waste to develop an approach for managing nuclear fuel waste in a way that could achieve broad public support.

Societal considerations, however, include technology and its availability, as well as cost and other economic considerations. These constitute an integral part of societal concerns. These are important considerations in addition to the sentiments of Canadian society. Whatever is recommended has to be doable, taking into account social acceptability as well as responsible scientific and economic norms to meet safety and security standards. The final report of the Environmental Assessment Panel (Seaborn) states that within this context societal priorities are also important, including allocation of scarce human, financial and physical resources to nuclear wastes in relation to the other problems besetting society.

The perceived social concerns appear to be based on, perhaps a popular conception, that future technologies will offer solutions to disposal and management that would obviate the need for long-term storage or eventual disposal.

The NWMO has examined a number of international technologies, such as Reprocessing, Partitioning and Transmutation (see Appendix 8, *Reprocessing, Partitioning and Transmutation*, of the Draft Study Report). These processes involve chemical and physical processes to recover and recycle the fissionable isotopes in used nuclear fuel. These processes, intended to reduce the radiotoxicity and the chemical toxicity of the used nuclear fuel, have been 'screened out' (i.e. rejected) by the NWMO, as well as a number of other methods of disposal as described in Appendix 9, *Methods Screened Out*, of the Draft Study Report as being non-viable options for the management and disposal of Canadian used nuclear fuel.

Apart from the multi-generational and expensive economic commitment, an important consideration in rejecting Reprocessing is that it separates out weapons usable material (e.g. Plutonium) in the course of the process. There are basically two types of nations interested in reprocessing or enrichment programs; those that need the enriched uranium or Plutonium for their advanced type nuclear reactors and those that want to procure the Plutonium as weapons grade material. Canada does not fit into either of these two categories. Potential disreputable international markets for Plutonium might be happy that such materials would potentially be available, should Canada go the route of reprocessing, but I do not believe that Canada would want to be seen as a purveyor of such materials given global security threats.

Terrorist access (by force) to weapons grade materials in Canada would potentially be greatly enhanced (if that is the right term to use) once the Plutonium is separated from the nuclear used fuel. Plutonium within the existing fuel bundle represents about 0.37 percent of the used CANDU nuclear fuel and would be difficult to extract from its source. In its

present un-reprocessed form it is an unattractive source of weapons grade material, except perhaps for the manufacturing of so-called dirty bombs for terrorist purposes.

Even if Canada were to decide to wait for and eventually implement Reprocessing or Partitioning, there is limited or no market for the end products. Canada's CANDU (Canada Deuterium Uranium) nuclear generating plants are based on using natural, not enriched, uranium. Apart from possibly using some form of slightly enriched fuel (MOX) in the CANDU design, the market for the end products, if any, would have to be international export based. The exception would be if Canada decided to expand its nuclear generating capacity with imported foreign nuclear reactor technologies which use enriched fuel cycles instead of Canadian technology (the CANDU reactor design). This is not a likely scenario. Canada probably would not proceed with expensive and otherwise undesirable Reprocessing or Partitioning of used nuclear fuel if there would be no domestic market to offset the cost of doing so. There is no investment being made in Canada for any such processes. Shipping the used nuclear fuel to other countries (e.g. France) for reprocessing and returning the end products (new waste) for re-use, or final disposal in Canada is also not an acceptable option for Canada. Locating a Reprocessing facility in Canada would have to consider existing nuclear reactor site communities.

The faint hope that finding alternate solutions of future technologies (such as Transmutation) might render the fissionable material harmless, while no such technologies are available in Canada in the foreseeable future, is no reason to burden future generations by postponing the disposal option. The ancient alchemists hope of turning lead into gold is reminiscent of similar unfulfilled false hopes and the NWMO is right in screening out (rejecting) such options as a suitable solution for Canada.

And yet, in spite of that rationale and rejection of such options, the NWMO recommends an Adaptive Phased Management approach that reflects this very line of thinking, i.e. postpone the inevitable disposal solution for implementation by future generations, in the faint hope that such currently unforeseen solutions will appear, as by magic, on the horizon. There is no support in Canada's scientific community, or in the scientific communities of other countries such as the United States or those in Europe for this method of treating used nuclear fuel.

This approach violates the principle of not passing the burden to future generations. This is as inconsistent as the position advanced by the anti-nuclear movement when it professes that it wants to protect future generations from the burden of dealing with existing nuclear "waste" yet at the same time it opposes the adoption of any of the immediate disposal options. The "social concerns" advanced by the anti-nuclear movement before the Seaborn Panel as well as the NWMO involves a "hidden agenda". This movement really opposes an immediate disposal solution because it would remove the main impediment to the building of new nuclear power plants and the extension of the lives of existing nuclear power plants. It is well known in the nuclear power industry that solving the problem of what to do with the "waste" would remove the main obstacle to the expansion of the nuclear power industry. Thyssen Mining confirms that this

strategy is being successfully employed in Germany by the Green movement. Thyssen built a deep underground repository (about 900 meters deep), but it is still not in use because the Green movement blocked its implementation. The only reason for doing so was to keep the waste above ground as a problem that deters the expansion of the nuclear power industry.

A question that is related should be asked: Do the nuclear power utilities that control NWMO, have a genuine interest in adopting an immediate disposal option? Or is it financially in their interest to defer dealing with the problem to future generations so that the paying for the cost will also be deferred? (perhaps to the Government?). It is interesting that in the United States where nuclear utilities had to collect 1/10 of 1¢ per kilowatt generated and contribute this money as well as other funds, as needed, to a trust fund controlled by the Federal Government (which owns the "waste"), there is no plan similar to the Adaptive Phased Management. The decision has been made there to solve the problem immediately with the repository at Yucca Mountain. [Any hold up in progress is due to there not being a willing host (i.e. Nevada does not want it)].

The recently announced decision that New Brunswick will go ahead with the estimated \$1.4 billion overhaul of the 22-year old CANDU reactor at the Point Lepreau nuclear generating station indicates that such decisions are ultimately based on economic considerations ("This is the lowest-price option of all options on the table", according to New Brunswick Premier Bernard Lord) as part of overall societal priorities, and are not depending on the outcome of recommendations, or opposition to the disposal of the used nuclear fuel.

The decades (since the Hare Report in the 1970s) of delay in coming to a clear and doable recommendation on this issue has already passed the burden to at least two generations. The 300 year time frame of the Adaptive Phased Management approach adds many more (about 12) generations to this. NWMO's interpretation of *'the obligation to begin* (emphasis added) *provision for managing the waste'* having been added to the principle of not passing the burden to future generations, is quite different from having this generation not wanting to leave a legacy of the burden of the waste to future generations. It essentially nullifies the original principle. NWMO's proposed Adaptive Phased Management approach, by virtue of its long time of implementation to its final completion of the program, does not enhance but diminishes inter-generational fairness, by passing the burden without any defined or foreseeable benefits.

## Nuclear Reactor Sites as Disposal Site Communities

The long time frame of the proposed Adaptive Phased Management approach (300 years) implies that existing used nuclear fuel will have to remain at existing nuclear reactor sites for a much extended period of time (estimated at some 90 years) before being placed in the intended repository. Possibly well beyond the remaining service life of existing nuclear reactors and eventual additional ones in these communities (30-50 years?). Who will own the waste after existing nuclear reactors have been decommissioned and possibly corporate structures or ownerships have changed?

This may or may not be acceptable to the communities who are now hosting the nuclear reactor sites, as it is well in excess of the anticipated time of keeping the used nuclear fuel in these locations. Without the currently accepted employment and other economic benefits the nuclear generating stations bring to these communities and the acceptance by the nuclear workers of the safety and risks of these facilities, it is an open question if acceptance of the waste would extend beyond the life of the existing nuclear generating stations.

In terms of fairness to the current and future generations in these communities it would appear to be a breach of trust from the understanding that a solution to the disposal of the waste, as it currently is stored in water-filled pools and above-ground concrete silos, would be found within the current generation, or the life of the nuclear generating facility.

The concept of interim on-site storage is seriously compromised by another century-long extension to maintaining such facilities. The long-term safety and security of the current on-site storage would have to be reviewed and assessed, especially in light of potential political uncertainties and potential terrorist activities over time. There are no (known) contingency plans in place to deal with managing and/or disposing of currently existing nuclear used fuel in case of such or other emergencies at these locations. While the storage at nuclear reactor sites is rejected as a stand-alone option, by default it is included in NWMO's Adaptive Phased Management approach. This is a serious flaw in the rationale for long-term management and disposal of Canada's nuclear used fuel. That it is unfair is recognized as one of the limitations of the approach in the Draft Study Report.

Within this context it is of interest to note the following recent news article:

#### Ontario pays towns to take nuclear waste

Government-owned Ontario Power Generation paid more than \$3 million to municipalities on the shores of Lake Huron this spring as part of a deal clearing the way for construction of North America's first deep rock nuclear waste storage facility.

The cash, which some critics have decried as hush money aimed at silencing opposition, is the first installment of a "hosting agreement" that will see the utility pay the Ontario communities of Kincardine, Saugeen Shores, Huron-Kinloss, Arran-Elderslie and Brockton \$35.7 million over the next 30 years. In return, the five municipal councils have embraced OPG's plan to store low- and intermediate-level nuclear waste in a deep rock geologic repository at the Bruce nuclear plant in picturesque Kincardine. The plan for the repository includes digging 660 metres down into limestone and carving out 38 caverns, each as long as a football field, up to eight metres wide and 6.6 metres high.

April Lindgren Ottawa Citizen

While this is dealing with low- and intermediate-level nuclear waste, this is not the highlevel used fuel waste within the NWMO mandate. But it indicates a desire on the part of OPG, which is one of the companies supporting NWMO, to get on with the job of waste disposal. They are not waiting for NWMO to make its recommendation to government about the high-level waste.

In Holland, and perhaps in other countries as well, this type of waste is currently stored in above ground silos. That was the accepted method for this level of waste at that time, the end of the  $20^{\text{th}}$  century. The Canadian decision to deposit low- and intermediate-level waste in a deep rock geological repository reflects a change in security-related concerns relating to any nuclear waste to reduce risk from external sources.

## The Diminishing Value of the Existing Used Nuclear Fuel

In Appendix 2, *The Nature of the Hazard*, of the NWMO Draft Study Report, the characteristics of the used nuclear fuel as they evolve over time are shown. The radioactivity of used nuclear fuel (Bq/kg U) decreases to about one percent of its initial value after one year, decreases to about 0.1 percent after 10 years and decreases to about 0.01 percent after 100 years (source AECL 1994). This demonstrates the rapidly diminishing danger from radiation over the NWMO's planned period of handling the used fuel for storage and disposal.

When a bundle is discharged from the reactor, the heat output is about 37,000 watts (AECL 1994). The heat output drops to about 73 watts after one year, five watts after 10 years and one watt after 100 years. This demonstrates the rapidly diminishing economic value of the used fuel as a heat source to generate steam used to generate electricity, which is the only purpose of the nuclear fuel in the first place. When it is no longer economically justified to keep the fuel in the reactor at 37,000 watts heat output, what economic value is there at five or one watt of heat output?

Given these facts, why then would the NWMO recommend the Adaptive Phased Management approach to keep the option open for future generations to either render the fuel less harmful, or to save the nuclear used fuel for possible reuse (presumably as a potential energy generator) when the capacity to do so becomes virtually nil well within the time frame (300 years) of the proposed management process?

This does not appear to be based on any potential value-added or societal priorities of economic benefit to future generations. Is it driven by an emotional belief by some that somehow a new solution will arrive, like the cavalry over the hill, to provide relief to the currently undecided (or opposed to any solution), or is it a misapplication of the 4Rs waste management hierarchy (Reduce, Re-use, Recycle, Recover) to a substance of rapidly diminishing value?

These facts, as reported in its own Report, do not support NWMO's recommended Adaptive Phased Management approach.

### Diminishing Source of Canadian Expertise

There appears to be a societal undercurrent of distrust of the scientific community in its ability to deal with the issues of managing and disposal of nuclear used fuel, and perhaps other sources of radioactivity. There also appears a parallel school of thought that what other countries are doing is better than what we produce in Canada. These views undermine Canada's ability and capability to create an acceptable environment (political climate) of creating and maintaining adequate scientific and technical resources to implement any option with sound science and good practices.

Canada has established and maintains a stringent regulatory framework that regulates and controls Canada's nuclear industry. Yet, public opinion, whether based on actual knowledge or not, appears to discount the existence of this and the expertise it represents. Public opinion, whether informed or not, appears to carry proportionally more weight in the public dialogue environment and their reflection in resulting reports.

In 1998, the Seaborn Panel observed as conditions of the feasibility of implementation that:

"Finally, adequate human and financial resources will have to be available to implement the concept (of deep underground disposal) safely. We are convinced that appropriate human resources currently (1998) exist in Canada, as demonstrated by the involvement of world-class scientists and engineers in developing the concept, and by the ability of Canada to safely build large conventional projects. Thus the core question is whether adequate human resources will continue to exist in the future, and whether sufficient financial resources will ensure that they can be applied to this project. It is important to note that a specialist's technical skills are expensive and time consuming to develop. They can easily be lost if society does not value **and use** (emphasis added) them. The special skills needed will be available only if the further development and implementation of an acceptable project for managing nuclear fuel wastes is not unduly delayed."

Furthermore The Atomic Energy Control Board Staff reported:

"There is international consensus that the technology needed to safely dispose of nuclear fuel waste in a variety of media ... currently (1998) exists.... Thus there is no general need to delay until major technological advances are made, even though some advances may be needed for particular components of some designs."

Canada has had, at least in the last decades leading up to the completion of the work of the Seaborn Panel, a large pool of expertise within the nuclear community of scientists and engineers (mostly in AECL and Ontario Hydro) in the leading edge of knowledge in managing, storing, transporting and disposal technologies for nuclear waste. Whether that pool of expertise still exists is an open question. Some of that pool of expertise has diminished after the completion of AECL's substantial body of work on the Deep Geological Disposal Concept required for the environmental assessment process carried out by the Seaborn Panel and its Scientific Review Group in the 1990's.

Some of this expertise is now part of the Nuclear Generating Companies in Ontario, Quebec and New Brunswick. Collectively these sources, including those remaining at AECL contribute to the NWMO's body of scientific and engineering knowledge. Given that out of an expected 30 year career of a scientist or engineer, and about a 15year span within that career at the expert level, maintaining expert level in these fields over the perceived 300 years of implementing the proposed NWMO Adaptive Phased Management approach, twenty successive life cycles of experts would have to be created and maintained over the life of the program.

The long periods leading up to the implementation of the various phases of a disposal facility would make it difficult to maintain this high level of expertise within any commercial corporate entity over that extended time period in any structured manner. It is unlikely that any corporation would maintain and train future generations of scientist and engineers at considerable costs on speculation that these would eventually be required sometime in the future.

Unless there is a clear and early decision to proceed, Canada stands to lose a substantial body of expertise to deal with these issues. Foreign recruiters would be happy to offer Canadian scientists and engineers rewarding positions in their countries.

While Canada has considerable world-class expertise in hard rock mining, it already lags behind in what other countries are doing in the actual research, development and implementation of disposal facilities in geological rock formations and methods of storing and transporting used nuclear fuel. The current NWMO proposal of Adaptive Phased Management does not lead to an imminent implementation, only to the start of the siting process, that is if political approval is indeed forthcoming as planned.

As expressed by Aboriginal leaders, there are few opportunities for this high-end scientific and engineering level of work. There are very few Aboriginal students in the educational stream today to fulfill any substantial Aboriginal participation in these fields. Addressing higher level education programs in these fields is of paramount importance to both Aboriginal and non-aboriginal populations. In response to repeated concerns by Aboriginal leaders at the public dialogue sessions, further dialogue must include a strong educational component to deal with aboriginal participation in the scientific and technical resources required during planning and implementation. If not addressed, Canadian workers will then be reduced to the lower skill-levels of the human resources pool required for any serious program, unless the issue of training is addressed at an early stage of the process.

Unless a clear and expedient decision is taken to proceed with a disposal facility, Canada's current pool of expertise will diminish severely and Canada will have to rely on foreign resources to implement a future program, or consider exporting the waste. This is the economic reality of commercial operation of the nuclear industry in Canada. What happens if a political, or economic decision is made not to proceed or extend nuclear generating capacity beyond the life of the current facilities in about 30 to 50 years time? Where will be Canada's expertise in dealing with these issues if the program is not supported by the existing nuclear generating industry?

High-level human resources are the critical success factors in this undertaking, especially considering the stringent requirements of safety and security the Canadian regulators and the public expects and demands. There is a short remaining window of opportunity for implementing a Canadian program with the human resources in this specialized field. The NWMO proposal does not provide for that window to be exploited.

## Societal Changes over Time

Canada's population 'mix' has changed considerably over the past half century, since the end of the Second World War (WWII). While immigration into Canada first consisted mainly of European immigrants, during the later decades of the last century this has changed to greater numbers of immigrants from the Orient and South East Asia as well as an influx of refugees from Third World countries. Different religious and social values and norms are slowly making inroads into Canadian Society.

While this enhances the colourful mosaic of cultures in Canada, as reflected strongly and visibly in Canada's large metropolitan areas, social acceptance of certain values, which have evolved and existed since the formation of Canada as a nation, cannot be taken for granted to continue to exist forever. There is a growing awareness and acceptance of Aboriginal values in Canada. There is also a trend to become more self-serving and materialistic, rather than altruistic in response to society's needs.

Currently there is still a strong social value relating to the protection and sustainability of the environment, and a desire to be responsible citizens in caring about our legacy to future generations. This is reflected in the ethical questions raised in Appendix 6, *Ethical and Social Framework*, of the Draft Study Report. The questions raised by the NWMO's Roundtable on Ethics appear very much to be based on currently accepted societal norms and values, although largely in an abstract way. However no mention is made of potential changes in societal norms and values, which may result from significant changes in population from other parts of the world over time.

The global social and political environment has undergone substantial change since September 11, 2001. Increasing acts and threats of terrorism are becoming commonplace and impact on the collective thinking about safety and security. Kidnapping has become a terrorist industry in certain parts of the world. This has an impact on the rationale for added security in methods selected for storing, transporting and disposing of used nuclear fuel.

In a relatively short time frame, population cohorts are changing, i.e. the aging population, the upcoming wave of retiring 'baby boomers', creating greater burdens on

those remaining in the workforce and increasing demands on government provided health-related and other services and resources. Aboriginal needs are being recognized and need to be addressed, regarding health, education, employment and general participation in Canadian economic and social structure.

How stable will government institutions be, what will be the societal priorities over the next 300 years. At an average of four years per government cycle, this represents about 75 government election cycles over the NWMO planning period of 300 years. Will Canada be one, two or three independent nations or will it be an integral part of a greater North America? The growing influx of new Canadians from third world countries will increase demands for substantial aid on a global basis. With most of the population of the globe living in substantially different circumstances in terms of living in sub-standard housing, not having access to safe drinking water, insufficient nutrition, unable to read or write and about one in a hundred having a university or college education, societal priorities relating to aid in overcoming sub-standard living conditions will only increase. Climate change and resulting natural disasters are creating massive upheavals in populations, affecting millions of people. Canada's societal priorities will change to reflect these increasing demands.

While the Joint Waste Owners are mandated by the NFWA to make annual contributions to the Trust Fund for the long-term management of Canada's used nuclear fuel, government guarantees are in place to ensure adequacy of the funds. Who will be the waste owners beyond the service life of existing nuclear reactors, and the concomitant financial obligations to contribute to the Trust Fund. Will government guarantees take over in terms of ownership and financial responsibilities? Societal priorities may change over long periods of time, such as proposed under the Adaptive Phased Management approach.

While no one has a clear vision of the future, significant and persistent changes must be taken into account in how society may react to the question of how to deal with the used nuclear fuel waste, among many other, perhaps more pressing priorities. Currently there is a cultural and societal value in place to deal with this issue in a responsible and expeditious manner. This is a time and opportunity to take a clear decision, rather than postpone and defer to uncertain future conditions and societal values.

## The Way Forward

Large and complex construction projects are most successfully implemented within a well specified time frame, preferably within the life-span of one generation of dedicated scientific, engineering and managerial expertise. This enhances on-time and withinbudget performance. This has been abundantly demonstrated with such project as the C\$20 Billion Channel Tunnel Project connecting England and France with a fixed link, which was successfully implemented from planning to completion within a period of seven years. In terms of complexity, size and economic importance this project, completed in 1993, was called "The Project of the Century". There is no reason to believe that a C\$16.2 Billion Deep Geological Disposal Facility in the Canadian Shield could not be completed within a similar period of time for implementation. This is well within current capability of implementation.

Much emphasis is being placed on 'flexibility' and 'adaptability' to incorporating new approached and technologies when these become available. Compared to the super-fast developing electronic economic sector and specifically the Information Technology sector, the geo-science sector moves at a much slower rate of progress. Much of the flexibility and adaptability is generated within any large project to ensure that the end result is better or at least equal to specified performance levels. That is the nature of large projects. In spite of public desires or expectations that all issues are pre-solved before the start of the project, this is not reality. Innovation 'as you go' ensures successful completion meeting regulatory requirements or better. This was recognised and accepted in the Seaborn Report.

Informing the Canadian public has been and remains a challenge. This is reflected in the sparse attendance of the public dialogue sessions held by the NWMO across the country. NWMO's claim to have reached 50,000 Canadians since its inception do not represent the actual numbers of persons participating in the various dialogue sessions held across Canada. For instance, only 5 persons attended the forum in Regina and 14 in Vancouver. Even among the selectively invited attendees at the last Saskatoon forum, most said they did not have adequate knowledge. The NWMO's website contains a great deal of very valuable information, however, its format and content and the means required to retrieve and digest this wealth of information requires sophisticated computer facility better suited to the scientific community rather than the general public. It certainly is not a user-friendly instrument conducive to disseminate this information in a readily understandable form for the aboriginal and non-aboriginal populations.

In spite of its intentions, the current Draft Study Report does not build confidence in Canada's ability to deal with the used nuclear waste in a technically feasible and socially acceptable manner. The impression is created that the problems are so severe that current generation of Canadian expertise is unable to cope with this. This perceived lack of confidence does not inspire political acceptance, but instead encourages political deferral of decisions.

A clear decision and choice of options must be made now. Considering the many factors and the confluence of political will, financial resources, scientific, technical and managerial expertise and a healthy economic development climate currently existing in Canada, there is a clear window of opportunity to implement a Deep Geological Disposal option now.

The final NWMO Report and recommendation to Government must be clear, expressing confidence in Canada's ability to deal with this issue in a timely and expedient manner.

Respectfully submitted:

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