Risk Management Strategy in Respect of Effluents from Textile Mills that Use Wet Processing (TMEs) and Nonylphenol (NP) and its Ethoxylates (NPEs) Under CEPA 1999

Environment Canada

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Executive Summary

Issue and Background

On June 23rd, 2001, the Ministers of the Environment and of Health published their final decision on the assessment of effluents from textile mills that use wet processing (textile mill effluents or TMEs) and nonylphenol (NP) and its ethoxylates (NPEs) in the *Canada Gazette* and notified the public that they recommended TMEs, NP and NPEs to be added to the List of Toxic Substances in Schedule 1 under the *Canadian Environmental Protection Act, 1999* (CEPA 1999). Under subsection 91(1) of CEPA 1999, the Minister of the Environment proposed an instrument respecting preventive actions to manage TMEs, NP and NPEs on June 7th, 2003. The instrument was finalized on December 4th, 2004. This risk management strategy for the wet process textile industry outlines the risk management objectives and instruments chosen to address the environmental risks associated with TMEs, NP and NPEs.

TMEs are wastewater discharges from wet processing textile mills. The TMEs risk assessment indicated that untreated and primary-treated effluents are harmful to aquatic organisms. Effluents from well-designed and well-operated municipal wastewater treatment plants with secondary- and tertiary-treatment containing TMEs are generally not likely to cause environmental harm. However, other factors were considered in the elaboration of the strategy and objectives: the occurrence of overflows from municipal collection systems, the varying effectiveness of treatment at municipal wastewater treatment plants (MWWTPs) over time and from plant to plant as well as the varying weight of the TME volume with respect to the overall volume treated at the MWWTP.

The NP and NPE risk assessment revealed that environmentally harmful concentrations of NP and NPEs could be found in untreated and primary-treated MWWTP effluents. These concentrations can exceed levels above which chronic effects are observed in aquatic organisms. The concentrations of NP and NPEs found in secondary- or tertiary-treated effluents are usually less because NP and NPEs biodegrade during treatment. However, some of the biodegradation by-products, such as lower ethoxylated products or nonylphenol itself, are more persistent and more toxic than the parent NPEs discharged to the treatment plant.

According to the TMEs risk assessment, there were 145 mills in operation in Canada in 1996. Most mills were located in Quebec (58%), followed by Ontario (35%), Nova Scotia (3%), New Brunswick (2%), British Columbia (1%) and Prince Edward Island (1%). At that time, almost all textile mills (96%) discharged their effluents to municipal wastewater treatment plants (MWWTPs), of which 60% had secondary treatment, 29% had primary treatment, 9% had tertiary treatment and 2% had no treatment.

Risk Management Objectives

For TMEs: Achieve and maintain an acute toxicity level which is equivalent to, or less toxic than, an inhibiting concentration (IC_{50}) of 13%, measured according to the method description provided in the document *Biological test method: Toxicity Test Using Luminescent Bacteria* (EPS 1/RM/24, November 1992), for a test duration of 15 minutes. Dilution of the textile mill effluent should not be used to achieve this risk management objective. The toxicity objective has to be achieved by the 2009 calendar year.

For NP and NPEs: Reduce use of NP and NPEs by at least 97% on a mass basis relative to the annual use for the 1998 base year. Should there be no NP and NPE use data for the 1998 calendar year, the first year after 1998 for which there is data should be used as the base year. The reduction objective has to be achieved by the 2009 calendar year.

These risk management objectives applies to mills discharging to MWWTPs. For mills discharging directly to the environment (6% or 8 mills, according to 2002 data), no specific risk management objective is proposed other than continued compliance with the *Fisheries Act*.

These risk management objectives derived from a study on best available techniques economically achievable performed for Environment Canada. It was determined that the industry can achieve in many cases the TME objective, while making cost savings. The NP and NPE reduction objective was determined to be achievable at modest cost.

Risk Management Instrument

The risk management instrument retained to meet the risk management objectives is pollution prevention planning. The cornerstone of CEPA 1999 is pollution prevention, which encourages pollution reduction at the source rather than treatment. In this respect, the retained instrument is coherent with CEPA 1999. Pollution prevention under CEPA is described as "the use of processes, practices, materials, products, substances or energy that avoid or minimize the creation of pollutants and waste and reduce the overall risk to the environment or human health". Information on pollution prevention may be found on the Canadian Pollution Prevention Information Clearinghouse website.

Pollution prevention as a risk management instrument is complemented by technology transfer (a technical guide and other technical information are available on the Canadian Center for Pollution Prevention website dedicated to the textile industry), financial incentive (textile mills can take advantage of Industry Canada's financial assistance program for the textile industry called CANTEX to finance some pollution prevention initiatives) and reporting (as the pollution prevention requirements will eventually end, Environment Canada will want to continue assessing TMEs, NP and NPEs in Canada).

The other risk management instrument examined in detail was a regulatory package. Although a regulatory package may be successful in meeting the risk management objectives, it was determined, on the basis of a cost-benefit analysis that requiring pollution prevention planning would prove to be more efficient.

Consultations

Environnement Canada has consulted stakeholders at different stages of the

development of the risk management strategy for the wet processing textile industry. Bilateral consultations took place between Environment Canada and groups of stakeholders, such as aboriginal groups, provinces, textile industry representatives and associations up until the formal multi-stakeholder June 2002 consultations.

As per Environment Canada's commitment to the CEPA National Advisory Committee (CEPA NAC), the proposed risk management strategy was presented on April 30th, 2002 along with the global risk management strategy concerning NPEs.

Formal multi-stakeholder consultations on the proposed risk management strategy and instruments were held in June 2002, simultaneously with consultations on products containing NP and NPEs, as many parties have a stake in both risk management strategies. Comments received up until September 16th 2002 were taken into account in the preparation of the present strategy. Stakeholders were generally in agreement with the proposed risk management instrument, namely pollution prevention planning.

Environment Canada has therefore moved ahead with the strategy and developed a working document which outlines proposed pollution prevention planning requirements for NP, NPEs and TMEs for the wet processing textile industry. The working document was sent to stakeholders for review and comment in January 2003. It has been used as a basis for the preparation of the Notice.

The proposed Notice, published on June 7th, 2003, was followed by a 60-day comment period. The final notice was published on December 4th, 2004.

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List of Acronyms

AEs	Alcohol ethoxylates
AP	Alkylphenol
APEs	Alkylphenol ethoxylates
BAT	Best available technology
BATEA	Best available techniques economically achievable
BOD	Biochemical oxygen demand
CEPA 1999	*Canadian Environmental Protection Act, 1999*
CEPA NAC	CEPA 1999 National Advisory Committee
CCME	Canadian Council of Ministers of the Environment
COD	Chemical oxygen demand
IC_{50}	Median inhibiting concentration
EU	European Union
IPPC	Integrated Pollution Prevention and Control
MWWTP	Municipal wastewater treatment plant
NPDES	National Pollutant Discharge Elimination System
NP	Nonylphenol
NP TEQ	Toxic equivalency units for nonylphenol
NPEs	Nonylphenol ethoxylates
NPRI	National Pollutant Release Inventory
OP	Octylphenol
OPEs	Octylphenol ethoxylates
OSPARCOM	Oslo and Paris Commission
P2	Pollution prevention
TME	Textile Mill Effluent (effluent from textile mill that use wet processing)
US EPA	United States Environmental Protection Agency

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1. Issue

On June 23rd, 2001, the Ministers of the Environment and of Health published their final decision on the assessments of effluents from textile mills that use wet processing (textile mill effluents or TMEs) and nonylphenol (NP) and its ethoxylates (NPEs) in the *Canada Gazette* and notified the public that they proposed to recommend that TMEs, NP and NPEs be added to the List of Toxic Substances in schedule 1 under *the Canadian Environmental Protection Act, 1999* (CEPA 1999). The final decision to declare TMEs, NP and NPEs toxic followed the publication of the draft Priority Substances List Assessment Reports for TMEs, NP and NPEs in which it was concluded that although not harmful to human health, these substances were harmful to the environment.

Under subsection 91(1) of CEPA 1999, the Minister of the Environment had to propose a regulation or an instrument respecting preventive or control actions to reduce or eliminate the environmental and health risks associated with these substances no later than June 23rd, 2003. The instrument had to be finalized by December 23rd, 2004.

This textile sector risk management strategy outlines the risk management objectives and instruments proposed to reduce the environmental risks associated with TMEs, NP and NPEs. The stakeholder consultation approach is also described.

2. Background

TMEs are wastewater discharges from Canadian textile mills produced during wet processes such as scouring, neutralizing, desizing, mercerizing, carbonizing, fulling, bleaching, dyeing, printing, and other wet finishing activities. Effluents resulting from dry processing (carding, spinning, weaving and knitting), from laundering or from the manufacturing of synthetic fibers using chemical processes, were not included in the definition of TMEs in the risk assessment.

TMEs are complex mixtures of chemicals, whose composition varies over time and from one mill to another. Untreated TMEs may include high concentrations of suspended solids, metals, NP, NPEs and other organic substances. Untreated TMEs can also exhibit extreme pH variations and elevated temperatures.

As for NP and NPEs, they constitute a major class of surfactants used in the textile wet processing industry. Quantities of NP and NPEs used and released in the textile sector are not well known. According to studies carried out for Environment Canada[1,2], it is

[1] ToxEcology – Environmental Consulting Ltd. *Nonylphenol and Nonylphenol Ethoxylates*, *Details on Use in Product Categories, Product Imports, Economic Importance to Producers, and Country Specific Actions in Europe*. Prepared for Environment Canada. July 2001. Protected information.

estimated that the textile sector is responsible for about 10% of the NP and NPEs used and 18% of the NP and NPEs released annually in Canada. The use of NP and NPEs is concentrated primarily within knitting and weaving mills (approximately 75%).

The wet processing segment of the textile industry is mainly concentrated in Quebec and Ontario. As of 1996, there are 145 wet processing textile mills which employ approximately 23,000 people (0.17% of the national employment figure). Wet processing textile mills are labour intensive with an average of 159 employees per plant as compared to 53 per plant for manufacturing in general. Wet processing textile mills are part of a relatively small sector which constitutes 0.2% of the Canadian Gross Domestic Product in terms of value-added. Canadian textile producers are specialized in products that are in high demand abroad (the US being the major importer of Canadian exports). Textiles are a highly cyclical industry, whose growth slows severely in a recession, and then grows rapidly in tandem with a booming economy.

3. Why We Need Action on TMEs, NP and NPEs

The respective risk assessment reports for TMEs, and for NP and NPEs concluded that these substances are *"entering or may enter the environment in a quantity or concentration or under conditions that have or may have an immediate or long-term harmful effect on the environment or its biological diversity".*

According to the TMEs assessment report, untreated TMEs are harmful to aquatic organisms. Primary-treated TMEs are also harmful to aquatic organisms, though slightly less than untreated effluents. There is no evidence that TMEs discharged from well designed and well operated on-site or municipal wastewater treatment plants (MWWTPs) using secondary or tertiary treatments cause environmental harm. It should be noted however, that although the assessment report recommends that TMEs be considered toxic under CEPA 1999, any level of wastewater treatment is specified.

The NP and NPE risk assessment revealed that environmentally harmful concentrations of these substances could be found in untreated and primary-treated effluents from MWWTPs receiving effluents from textile mills. These concentrations can exceed levels above which chronic effects are observed in aquatic organisms. The concentrations of NP and NPEs found in secondary- or tertiary-treated effluents are usually lower because NP and NPEs biodegrade during treatment. However, some of the biodegradation by-products, such as lower ethoxylated products or nonylphenol itself, are more persistent and more toxic than the parent NPEs discharged to the treatment plant.

NP and NPEs have been reported to cause endocrine disruption in a variety of aquatic organisms. Studies have shown that NP and NPEs can bind to the estrogen receptor and subsequently act as endocrine disrupters by interfering with normal endocrine system function. The NP and NPE risk assessment examined the available information on the issue and determined that estrogenic responses occur at concentrations similar to those at which chronic toxicity occurs. However, the relative importance and significance of these estrogenic responses in aquatic organisms to the individual or population are not currently well understood.

[2] Crechem Technologies Inc. *Background study on Canadian Wet Processing Textile Mills Industry and Their Effluents*. Prepared for Environment Canada. August 2000.

TMEs as well as NP and NPEs are considered Track 2 substances under the federal Toxic Substances Management Policy[3]. Accordingly, they must be managed throughout their entire life cycles to prevent or minimize their release to the environment.

4. Exposure Sources

The presence of TMEs, NP and NPEs in the environment is solely a consequence of human activity, and all TMEs, NP and NPEs are ultimately released to the environment either prior to or after treatment on-site or at a MWWTP.

From the 1996 data, most wet processing mills are located in Quebec (58%), followed by Ontario (35%), Nova Scotia (3%), New Brunswick (2%), British Columbia (1%) and Prince Edward Island (1%). Almost all (95%) TMEs were ultimately discharged to fresh water, the remaining being discharged to marine waters.

According to the TMEs risk assessment, in 1996, approximately 105,000 m^3 of TMEs were released daily to the Canadian environment. Out of the 145 mills, 139 mills (96%) discharged their effluent to municipal wastewater collection systems and treatment plants before reaching receiving waters. All but two of the municipal wastewater collection systems to which TMEs were discharged had some form of wastewater treatment. The highest percentage of TMEs received secondary treatment (60%), followed by primary (29%), tertiary (9%) and no treatment (2%).

Table 1 presents the number of textile mills per province and by type of wastewater treatment received.

Table 1 Textile Mills Per Province by Type of Wastewater Treatment (in 1996)

Province	Type of Treatment				
	Untreated	Primary	Secondary	Tertiary	Total
British Columbia	0	2	0	0	2 (1%)
Ontario	0	2	40	8	50 (34%)
Quebec	2	36	41	5	84 (58%)
New Brunswick	0	1	2	0	3 (2%)
Prince Edward Island	0	0	1	0	1 (1%)
Nova Scotia	1	1	3	0	5 (3%)

The major route for the releases of NP and NPEs to the Canadian environment is through the discharge of industrial and municipal wastewater effluents. The NP and NPE

[3] Government of Canada. *Toxic Substances Management Policy*. June 1995.

risk assessment report mentions that TMEs are a major source of release of NP and NPEs. Untreated TMEs can have very high concentrations of NP and NPEs.

NP and NPEs can also be found in municipal and industrial wastewater sludges, because NP and NPE biodegradation products adsorb to sludge particles. NP and NPEs in sludge are known to biodegrade. However, the extent and rate of this biodegradation will be influenced by several factors such as the chemistry of the specific NP or NPE in the sludge, sludge treatment conditions, final sludge disposal route and whether conditions are anaerobic or aerobic.

5. Key Issues and Considerations

5.1 Variable Effect of Wastewater Treatment on TMEs, NP and NPEs

As previously mentioned, the level of wastewater treatment (primary, secondary or tertiary) considerably affects the toxicity of TMEs and the concentrations of NP and NPEs released to the environment. Untreated and primary-treated TMEs are harmful to aquatic organisms and may contain concentrations of NP and NPEs above levels of concern for aquatic toxicity. However, TMEs from well designed and well operated secondary and tertiary treatment plants are usually not harmful to aquatic organisms and are expected to have lower concentrations of NP and NPEs.

Nevertheless, not all secondary or tertiary treatment plants are equally as effective at treating industrial wastewater. For example, some municipal wastewater treatment plants may be effective at treating domestic wastewater, but may not be suitable for industrial effluents. The section on municipal wastewater effluent of Environment Canada's *State of the Environment Report*[4] and a study entitled *Toxic Potential Assessment of Municipal Wastewater Treatment Plant Effluents in Quebec*[5] under the St. Lawrence Vision 2000 program state that wastewater treatment plants providing the same level of treatment may vary considerably in the quality of their effluents depending on a variety of factors, including the plant's design, the skill of its operators, fluctuations in the flow level and the season of the year.

Finally, the discharge of untreated effluent is frequent in municipalities with combined sewer systems (storm water, domestic and industrial effluents collected in the same sewer system) at times of heavy rains. According to a study carried out by Dessau-Soprin in 2002[6] on the analysis of direct discharges of textile mills effluents following overflows in municipal wastewater collector network, the potential for TMEs to reach the environment through overflows without being treated is real and not negligible. *The State of the Environment Report* also identified combined sewer overflows as an important source of pollution in the Canadian environment.

[4] Environment Canada, *The State of Municipal Wastewater Effluents in Canada (State of the Environment Report),* 2001, p. 16.

[5] Ministère de l'Environnement du Québec and Environment Canada, *Toxic Potential Assessment of Municipal Wastewater Treatment Plant Effluents in Quebec* – Final Report, 2001, section 4.4.

[6] Dessau-Soprin, *Analyse du potentiel de rejets directs d'effluents d'usines de textile canadiennes suite à des épisodes de débordement des réseaux collecteurs municipaux d'eaux usées*, Conclusions, March 2002

5.2 Risk Management Strategy for Municipal Wastewater Effluents

Because 96% of textile mills discharge their effluent to municipal wastewater collection systems, the proposed strategy for the textile sector must be in line with the proposed risk management strategy for municipal wastewater effluents that Environment Canada is currently developing. An overall objective of the municipal wastewater effluents strategy is the improvement of the quality of the effluent throughout Canada which will likely lead to an upgrade of many MWWTPs.

Since most textile mills discharge their effluents to municipal collection systems, the Assessment Report recommended that discussions take place with the appropriate authorities (municipal or provincial) to address the risks. Part of Environment Canada's strategy for municipal wastewater is to initiate discussions with the provinces and territories on exploring cooperative arrangements to develop consistent goals.

In the case of TMEs, because pollution prevention opportunities to reduce their toxicity are readily available, the risk management of TMEs will focus on the source, that is the textile mills.

5.3 Concept of Whole-Effluent Toxicity for TMEs

Textile mills use several hundred different chemicals in their processes. Consequently, the effluents are mixtures of substances and vary considerably within a mill and from one mill to another. It would have been virtually impossible for the TMEs risk assessment to identify each one of these substances and determine its respective contribution to the overall toxicity of TMEs. This is why the TMEs risk assessment focused on the toxicity of the whole effluent rather than on individual constituents of TMEs.

Consequently, the risk management instrument developed under CEPA 1999 can only address TMEs as a whole-effluent and not the individual constituents of TMEs which are not, in most cases, toxic under CEPA 1999.

5.4 Risk Assessment Recommendations

The TMEs risk assessment report recommends that pollution prevention opportunities and control technologies for the management of TMEs be identified and evaluated. Pollution prevention opportunities should include, among other things, reducing material inputs, re-engineering processes to reuse by-products, improving process management practices and employing substitution of less polluting chemicals.

Both the TMEs and NP and NPE risk assessments recommended that the concentrations of NP and NPEs in TMEs be reduced.

Finally, because solutions for reducing the toxicity of TMEs vary significantly from mill to mill, it was recommended in the TMEs risk assessment that options to reduce environmental risk consider site specific solutions.

5.5 Existing Canadian Legislation, Regulations and Guidelines

There are no federal regulations which directly govern the releases of TMEs, NP or NPEs. The mills that discharge directly to the environment (eight mills) are subject to subsection 36(3) of the *Fisheries Act* which prohibits any deposit of a deleterious substance (that is harmful to fish, fish habitat or the use by man of fish) into waters frequented by fish. Municipalities discharging TMEs must also comply with the *Fisheries Act*.

The draft *Canadian Water Quality Guidelines* from the Task Group of the Canadian Council of Ministers of the Environment (CCME) has established guidelines for NP and NPEs. For the protection of aquatic life, the draft Canadian guidelines recommend an ambient concentration of 1.0 μg/L in freshwater and 0.7 μg/L for marine waters, as expressed in toxic equivalency units for nonylphenol (NP TEQ)[7].

Since 2003, more facilities have to report their NP and NPE to the National Pollutant Release Inventory (NPRI). Indeed, the 10-ton reporting threshold is applicable from now on to all NP and NPEs instead of being applicable to each of them (28 of them are listed). Facilities manufacturing, processing or using listed NP or NPEs above 10 tons must then report to NPRI their NP and NPE releases to environment and transfers for disposal or recycling. However, as reporting is requested for the NP and NPE category as a whole, detailed information concerning NP and NPE release or transfer profiles is not available.

There are also no provincial regulations specific to TMEs. Provinces do however issue permits to authorize the discharge of effluents by textile mills (some do not if the discharge goes to a MWWTP). Provinces also issue permits for MWWTPs. In Ontario, mills discharging to MWWTPs are required to meet municipal sewer use by-laws. Municipalities are empowered under the *Ontario Municipal Act*[8] to pass local sewer by-laws.

The City of Toronto recently enacted a revised sewer use by-law that includes discharge limits for all non-domestic users of the sewer system. The NP and NPE discharge limit for sanitary, combined and storm sewers is 10 μg/L and the discharge limit for NP alone is 1 μg/L[9]. The NP and NPE discharge limits are almost equivalent to eliminating the use of NP and NPEs. The City of Toronto by-law also requires specific industrial, commercial and institutional sectors, such as health care facilities and textile mills, to prepare and implement a pollution prevention plan. In the case of textile mill sector, the pollution prevention plan will include NP and NPEs.

The City of Kingston also recently revised their sewer use by-law and it includes the same NP and NPE discharge limits[10] as the City of Toronto.

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[7] Environment Canada. *Canadian Environmental Quality Guidelines for Nonylphenol and its Ethoxylates (Water, Sediment and Soil). Scientific Supporting Document.* National Guidelines and Standards Office, Environmental Quality Branch, Environment Canada. Ottawa. 2001. Unpublished draft.

[8] Municipal Act, 2001, S.O. 2001, c. 25

[9] City of Toronto Municipal Code, Part II General By-laws No. 457-2000, Article I, Sewers 681-2 Sanitary and Combined Sewer Requirements.

[10] City of Kingston By-law No. 2000-263, Consolidated sewer use by-law for sanitary, combined and storm sewers: October 10, 2000. Section 2, Table 1 – Limits for sanitary and combined sewers discharge and Section 3, Table 2 – Limits for storm sewer discharge. *(http://www.city.kingston.on.ca/pdf/bylaws/bl_2000-263.pdf).*

5.6 American Legislation and Regulations

In the United States, textile industry guidelines have been in place since 1974. These guidelines fall under the purview of the *Clean Water Act*[11]. They delineate the minimum effluent standards that each state must enforce. States may adopt more stringent standards if needed. The Act's standards are based on the best available technologies (BAT). Standards are different for new and existing mills and cover chemical oxygen demand (COD), biochemical oxygen demand (BOD), suspended solids, sulfides, phenols and chromium. Some mills are required to hold *National Pollutant Discharge Elimination System* (NPDES) permits if they discharge large volumes of effluents to streams and rivers. These permits, issued by the US Environmental Protection Agency (US EPA) or a state environmental agency, contain, among other things, limits on discharge as well as monitoring and reporting requirements. Aquatic toxicity may be regulated through NPDES permits.

Mills that discharge wastewater to MWWTPs are not generally required to obtain an NPDES permit for such discharges but are usually required to obtain a permit from their local MWWTP. Local permits are generally based on the equipment and treatment facilities available at the MWWTP. Pretreatment standards are covered in the general provisions of the *Clean Water Act*. These provisions forbid the discharge of textile mill effluents that would cause a MWWTP to violate its NPDES permit or interfere with MWWTP operations.

It should be noted that CEPA 1999 does not allow Environment Canada to target most of the parameters covered by the American *Clean Water Act* in a CEPA instrument. Only substances considered toxic under CEPA can be included in a CEPA instrument. However, it would be possible to target substances that are not considered toxic under CEPA through a *Fisheries Act* regulation.

The US EPA is considering national water quality criteria for nonylphenol. The proposed criteria are a four-day average concentration of 5.9 μg/L of nonylphenol, not exceeded more than once every three years, and a one-hour average concentration of 27.9 μg/L of nonylphenol, not exceeded more than once every three years.

5.7 European Legislation

The most relevant European Union (EU) regulation for TMEs is the *Integrated Pollution Prevention and Control Directive 96/61*[12]. This directive sets up a European permitting system based on the best available technologies (BAT) for textile mills exceeding a treatment capacity of 10 tons of fiber per day. The permits are based on Europe-wide emission limit values for water discharges of regulated toxic substances (like cadmium, chlorinated solvents or waste oils), as well as new parameters for the EU such as suspended solids, BOD, COD and halogenated organic compounds. The permits are to be issued by all EU national governments, which by EU law, are required to integrate the EU *Integrated Pollution Prevention and Control* (IPPC) regulations within national laws. Germany, the United-Kingdom, the Netherlands and Sweden all have permitting systems based on BAT which are broader than the EU directive.

[11] *Clean water Act*, 33 U.S.C. s/s 1251 et seq. (1977).
[12] European Union. *IPPC Directive 96/61 concerning integrated pollution prevention and control*, 1997.

With regard to NP and NPEs, European efforts to restrict or phase out the use of these substances have been driven in large part by the Oslo and Paris Commission (OSPARCOM), the marine convention for the protection of the northeast Atlantic. Concerns with endocrine disruption strongly motivated action in Europe. Many countries have banned the use of NP and NPEs either through voluntary initiatives or regulations. In Germany and the UK, the producers of textile and leather auxiliaries and the wool industry, along with other sectors, have committed themselves to voluntarily phasing out the use of NP and NPEs.

In November 2001, the EU published a Commission Recommendation on the results of the risk evaluation and the risk reduction strategies for NP and NPEs[13]. This document recommends that more research be conducted on the effects of NP and NPEs on human health. It also recommends that marketing and use restrictions of these substances be considered at the EU level. The textile sector is among the key sectors to be considered.

5.8 NP and NPEs Substitutes

The NP and NPE risk assessment report cautions against the possible replacement or substitution of these substances with other alkylphenols (APs) and their ethoxylates (APEs), such as octylphenol (OP) and its ethoxylates (OPEs), which have similar chemical properties. Unfortunately, OP and OPEs also have similar toxicological properties and greater estrogenic properties, such that a simple replacement of NP or NPEs by other AP or APEs, such as OP and OPEs, might not reduce the risk to the environment.

When choosing substitutes to NP and NPEs, special care must be taken to ensure that environmental risks are reduced. A study examining alternatives to NP and NPEs conducted for Environment Canada[14], revealed that the main substitutes for these substances, alcohol ethoxylates (AEs)[15], have more favorable environmental profiles than NP and NPEs. AEs are readily and ultimately biodegradable, and their biodegradation intermediates are less toxic than the parent surfactant. In addition, neither AEs nor their breakdown products have been associated with the 'endocrine disruptor' issue. The alternative AE-based products are generally as effective as NP and NPE-based products, but they may be more expensive depending on the product category. In Europe, where NP and NPEs are being phased out in many countries, the main alternatives to NP and NPEs have been AEs. An important effort in research and development has been taking place in Europe to develop alternative products. Canada can build on these efforts.

Regarding the availability of AEs as replacements for NP and NPEs, one of the main concerns raised is that the world's supply of AEs has been limited in recent years. Recent expansions in AEs supply that have been completed in 2002 are expected to alleviate the current tight supply of detergent grade alcohols. Hence, the availability of detergent grade alcohols should not be a constraint to increased use of AEs as

[13] Official Journal of the European Communities, *Commission Recommendations of 7 November 2001* (notified under document number C(2001) 3380).

[14] ToxEcology Environmental Consulting Ltd. *Alternatives to Nonylphenol Ethoxylates: Review of Toxicity, Biodegradation, & Technical-Economic Aspects*. Final Report March 14th, 2002 Prepared for Environment Canada. 77 p.

[15] The study mentioned of other alternative surfactants, some for specific applications. Examples of other alternatives are glucose-based surfactants or blends of alternative non ionic surfactants.

replacements for APs and APEs.

6. Risk Management Objectives

6.1 TMEs Risk Management Objectives

Risk management objectives for mills discharging directly to the environment and for mills discharging to MWWTPs are addressed separately because the legal framework in each case is different.

6.1.1 Mills Discharging to MWWTPs

The first step in establishing the risk management objectives for TMEs was determining which parameters would be targeted. Reducing whole-effluent toxicity was determined to be the most suitable objective given the chemical complexity of TMEs. Toxicity serves as a surrogate and allows for site-specific solutions. Aquatic toxicity can be measured through acute toxicity bioassays as prescribed in various federal and provincial regulations.

The next step was determining the scope for the risk management objectives. This meant determining whether or not mills discharging to secondary or tertiary MWWTPs should also be subject to such objectives, considering the risk assessment's findings that such wastewater treatments generally reduce considerably the aquatic toxicity of TMEs.

Due to the concerns expressed in Section 5 regarding the variable effectiveness of secondary and tertiary treatment plants and sewer overflows, this strategy proposes that all textile mills discharging to MWWTPs — and not only those discharging to primary MWWTPs — be required to reduce or maintain, depending on if they meet the risk management objectives, the toxicity of their effluents.

Requiring mills to reduce the toxicity of their effluents is consistent with the federal government's commitment to pollution prevention. It will avoid mills adopting poor environmental practices simply because they discharge to secondary or tertiary MWWTPs and hence will ensure a level playing field among the mills. Reducing TME toxicity prior to its discharge to a MWWTP will also alleviate the pollution load on MWWTPs and is in line with the risk management strategy for municipal wastewater effluents being developed.

The last step in establishing the risk management objectives was determining the magnitude of the toxicity reduction required. Intuitively, it could be expected that mills discharging to primary MWWTPs should be required to reduce the toxicity of their effluent more so than mills discharging to MWWTPs with secondary or tertiary treatment.

TMEs treated by primary MWWTPs are potentially more environmentaly harmful than TMEs treated by secondary or tertiary MWWTPs. In order to produce an effluent of comparable quality, a mill discharging to a primary MWWTP would virtually have to install its own secondary treatment plant on-site. However, a secondary treatment plant requires a substantial investment (over $1 million for a medium-sized mill) and would

likely not be technically achievable because of lack of space for construction of the facility (most of these mills are located in Montreal, where little space is available).

Furthermore, the risk management strategy for municipal wastewater effluent will likely bring primary MWWTPs to a level equivalent to secondary treatment. Therefore, it is proposed that mills discharging to primary MWWTPs have the same risk management objective as mills discharging to secondary and tertiary MWWTPs.

Considering that TMEs discharged to MWWTPs are ultimately treated, determining the magnitude of the risk management objective meant determining the acceptable toxicity level that would likely result in a non-toxic TME after treatment under average conditions.

To that effect, available toxicity data for untreated and treated TMEs was examined to evaluate the average toxicity reduction resulting from a MWWTP. Based on this analysis, it was proposed that the toxicity risk management objective be expressed in terms of a median inhibiting concentration (IC_{50}) objective, using the method described in the document *Biological test method: Toxicity Test Using Luminescent Bacteria* (EPS 1/RM/24, November 1992), for a test duration of 15 minutes. The review of IC_{50} data suggests that a volumetric concentration IC_{50} of 13% of the TME before it is discharged to the municipal wastewater collection system would generally ensure a non-toxic effluent.

Effluent volume is a very important factor in meeting the toxicity risk management objective. Dilution of TME should not be used by a mill to meet the objective. For example, a mill should not be allowed to increase its water consumption to meet the objective.

The timelines to meet the toxicity risk management objective is five years, or by 2009.

6.1.2 Mills Discharging Directly to the Environment

Mills discharging directly to the environment (6% or 8 mills, as per 2002 data) must comply with subsection 36(3) of the *Fisheries Act*. Five of the eight mills should be able to comply because they have a secondary treatment plant on-site. The other three mills would need to make significant investments to comply with the *Fisheries Act*. Among these three mills, two discharge to municipal wastewater collection systems that do not have any form of treatment. In these two cases, it is expected that the risk management strategy for municipal wastewater effluents and other provincial initiatives will bring these municipal wastewater collection systems to a level of treatment equivalent to secondary treatment. As for the third mill, it discharges directly to the environment without adequate treatment and Environment Canada has been looking into this case.

A specific risk management objective for mills discharging directly to the environment would likely require that it be imbedded in a regulation. Otherwise, it would create confusion as to whether or not meeting the objective ensures compliance with subsection 36(3) of the *Fisheries Act*. A regulation for these eight mills may not be recommended considering that most mills discharging to the environment already comply with subsection 36(3).

Risk management objectives for TMEs:

- **For mills discharging to MWWTPs:**
  Achieve and maintain an acute toxicity level which is equivalent to, or less toxic than, an inhibiting concentration (IC_{50}) of 13%, measured according to the method description provided in the document *Biological test method: Toxicity Test Using Luminescent Bacteria* (EPS 1/RM/24, November 1992) for a test duration of 15 minutes. Dilution of the textile mill effluent should not be used to achieve this risk management objective. The toxicity objective should be achieved by the 2009 calendar year.
- **For mills discharging directly to the environment:**
  No specific risk management objective other than continued compliance with the *Fisheries Act* requirements.

6.2 NP and NPE Risk Management Objectives

6.2.1 Mills Discharging to MWWTPs

Although concentrations of NP and NPEs are generally lower in effluents from secondary and tertiary treatment plants, some of their degradation products are more toxic than the parent NPE compounds. For that reason, and because of the variable effectiveness of MWWTPs and sewer overflows, a single risk management objective for NP and NPEs should be established for all mills no matter what level of treatment their effluent is subject to.

The proposed risk management objective for NP and NPEs used and released in the textile sector is the reduction of NP and NPEs use to levels that reflect the best available techniques economically achievable (BATEA) in order to reduce environmental risks associated with these substances.

The study examining NP and NPE alternatives[16] identified many substitutes available to replace NP and NPEs in surfactants used in the textile industry. Many of the substitutes are more readily biodegradable and are less toxic. The biodegradation by-products of these substitutes are also less toxic and do not exhibit any estrogenic activity. However, the substitutes may be slightly more expensive. According to another study, a 97% substitution could be achievable at modest net annual cost to the industry (roughly estimated at $770,000 for the industry and an average of $6,500 per mill)[16]. Many mills have already voluntarily eliminated their use of NP and NPEs in the past years.

The toxicity risk management objective for TMEs will play an important role in the management of NP and NPEs. Indeed, this objective will help ensure that the NP and NPE substitutes chosen by the mills are not more toxic than the NP and NPEs currently in use, otherwise the mills will not meet the toxicity risk management objective for TMEs.

[16] Marbek Resource Consultants. *Identification and Evaluation of Best Available Technologies Economically Achievable (BATEA) for Textile Mill Effluents*. Prepared for Environment Canada. September 2001. p.44.

6.2.2 Mills Discharging Directly to the Environment

The NP and NPE risk management objective for mills discharging directly to the environment is the same as for TMEs directly discharged to environment, that is they must comply with the *Fisheries Act* requirements.

Risk management objective for NP and NPEs:

- **For mills discharging to MWWTPs:**
  Reduce use of NP and NPEs by at least 97% on a mass basis relative to the annual use for the 1998 base year. Should there be no NP and NPE use data for the 1998 calendar year, the first year after 1998 for which there is data should be used as the base year. The reduction objective has to be achieved by the 2009 calendar year.
- **For mills discharging directly to the environment:**
  No specific risk management objective other than continued compliance with the *Fisheries Act* requirements.

7. Risk Management Actions

The following sections discuss the risk management instruments for existing mills (mills already in operation at the time the instrument is published in the *Canada Gazette*) and for new mills (mills for which the operation begins after the instrument is published).

7.1 Risk Management Instruments for Existing Mills

Environment Canada conducted a qualitative assessment of relevant risk management instruments. The objective of the qualitative assessment was to identify the most promising risk management instruments to meet the proposed risk management objectives for TMEs, NP and NPEs. The assessment criteria included effectiveness of the instrument, impacts on governments, impacts on the private sector and public acceptability. Both CEPA 1999 and non-CEPA 1999 risk management instruments were assessed.

According to the qualitative assessment, the most promising instruments were:

- Pollution prevention planning
- Regulations (performance standards)
- Technology transfer
- Financial incentives

Two combinations of instruments were then subjected to a full cost-benefit analysis to determine which was best suited to meet the proposed risk management objectives:

<u>Combination 1</u>

- Pollution prevention planning as a core instrument supported by technology transfer, financial incentives and reporting.

<u>Combination 2</u>

- Regulations as a core instrument supported by technology transfer and financial incentives.

The overall preliminary results of the cost-benefit analysis are presented in Appendix A. This analysis reveals that the regulatory combination would generate greater annualized net benefits than the pollution prevention planning combination ($122 million compared to $100 million). This is mainly due to the fact that the regulatory combination is expected to be more effective in meeting the risk management objective which involves implementing pollution prevention technologies that generate net savings for the mills.

However, if the savings incurred by the mills because of pollution prevention technologies are not taken into consideration (equal to zero), the annualized net benefits for the regulatory combination are $9.7 million and $6.7 million for the pollution prevention combination.

Furthermore, it appears that the yield or return-on-investment for government using the pollution prevention planning combination is double compared to the regulatory combination when excluding savings to industry.

Based on the cost-benefit analysis and the inherent strengths and weaknesses of each combination, the pollution prevention planning combination is recommended to efficiently reduce the risk of TMEs, NP and NPEs in the textile sector.

The main benefits of the pollution prevention combination include the following:

- **Requiring the mills to rethink their processes and implement pollution prevention:** The pollution prevention planning notice will oblige mills to prepare and implement a comprehensive pollution prevention plan to address TMEs, NP and NPEs. Although regulations can lead to such planning, it is not expected that most mills would prepare a plan in this context. If the pollution prevention planning experience is profitable to mills, they may also apply it to other pollutants.

- **Providing flexibility:** Pollution prevention planning is designed to provide flexibility to allow for site-specific solutions to managing toxic substances. Reducing the toxicity of TMEs requires such flexibility.

- **Minimizing potential incompatibilities with existing or future provincial or municipal regulations:** Because most textile mills discharge to MWWTPs and are subject to provincial permitting requirements or municipal sewer by-laws, the potential for regulatory incompatibilities is decreased with pollution prevention planning.

- **Allowing for early action:** Because pollution prevention planning notices can be issued rapidly, pollution prevention planning is likely to generate early actions. Pollution prevention planning will also allow mills to meet the proposed risk management objectives without the need for regulations. However, if the risk management objectives are not met, Environment Canada will consider taking steps to regulate the release of TMEs, NP and NPEs.

In addition, it is estimated that regulations will cost government twice as much as pollution prevention planning. These costs include instrument development, consultations, implementation, compliance promotion and enforcement.

The disadvantages of pollution prevention planning include the fact that the risk management objectives are not enforceable (only the submission of preparation and implementation declarations as well as interim reports are mandatory). Nevertheless, if the analysis of the declarations reveals that the results of pollution prevention planning are not satisfactory (by not meeting the risk management objectives), Environment Canada will consider regulating the release of TMEs. Another disadvantage is the fact that pollution prevention planning is a new risk management tool and there is little experience to build on.

It should be noted that the risk management strategy for NP and NPE-containing products requires the reduction or elimination of the NP and NPE content through pollution prevention planning for manufacturers, distributors and importers. NP and NPE-containing products used in textile processing are included in this strategy. Although it will help reduce NP and NPE content in textile mill effluents, pollution prevention planning for NP and NPEs used at textile mills is also needed because the mills can import products containing NP and NPEs directly from the US where they are readily available.

Technology transfer and financial incentives were both part of each combination examined. Since the textile industry includes a significant number of small- and medium-sized companies (SMEs) and because reducing effluent toxicity is not a straightforward task, it was proposed that the pollution prevention planning requirements be complemented by technology transfer, as well as some financial incentives. Technical information and a technical guidance document can be found on the Canadian Center for Pollution Prevention website. Industry Canada is implementing a financial assistance program for the textile industry called CANTEX. Some of the pollution prevention initiatives can be financed by this program. In Quebec, this program is administered by Economic Development Canada.

Finally, because pollution prevention planning requirements come to an end at the date the plan must be implemented, some form of reporting is necessary to enable Environment Canada to assess whether TMEs, NP and NPEs are adequately being managed in Canada. NP and NPEs are already monitored through the *National Pollutant Release Inventory* (NPRI). TMEs, however, are not on the NPRI substances lists and are not likely to be added as they are not a specific chemical substance. NPRI substances which contribute to TMEs toxicity could be examined yearly to identify trends regarding TMEs toxicity. A more comprehensive voluntary reporting mechanism will be discussed with industry and other stakeholders.

7.2 Risk Management Instrument for New Mills

Mills not in operation at the time the pollution prevention notice is published are not required to prepare a pollution prevention plan unless a new notice is published. If they were, Environment Canada would need to be constantly aware of new facilities beginning operations in Canada, which is not a simple task. Also, requiring a pollution prevention plan after the new mill is designed and built is not the most efficient way to prevent pollution. The provinces and municipalities which require permits to operate

these facilities are in a much better position to deal with new facilities and ensure that new mills meet the risk management objectives.

It is therefore proposed that Environment Canada engage the provinces and municipalities in integrating TMEs toxicity and NP and NPE release considerations in their permitting schemes and by-laws. Discussions with the provinces and municipalities will take place to explore this possibility and the means to achieve it through existing forums such as National Advisory Committee of CEPA 1999 (CEPA NAC).

8. Outline of the Implementation Plan

8.1 Pollution Prevention Planning

A pollution prevention planning notice was published on December 4th, 2004 according to Environment Canada Guidelines[17]. Prior to publication, the draft notice was shared with stakeholders and comments were taken into consideration.

In order to make sure that the pollution prevention planning requirements are met by each concerned facility, compliance promotion activities are essential. A large number of textile mills are very small firms (less than 25 employees). Most have minimal experience with environmental management and incomplete knowledge and understanding of environmental legislation, especially federal legislation. Information sessions have thus been carried out. The technical guide for the textile sector and the additional technical information found on the Canadian Center for Pollution Prevention Website were used to support compliance promotion. Environment Canada will also enact an enforcement strategy to ensure that all mills meet their legal obligations.

8.2 Long Term Monitoring

The *National Pollutant Release Inventory* (NPRI) will be used to monitor progress with regard to NP and NPEs.

As TMEs are unlikely to be listed on the NPRI because of their nature, a list of key NPRI substances contributing to TMEs toxicity will be examined yearly to identify trends in TMEs quality. Reporting thresholds will be reviewed if needed.

The examination of the effluent quality data from MWWTPs will also, in some cases, give a good indication of TMEs quality and NP and NPE releases.

A more comprehensive reporting mechanism will be discussed with industry and stakeholders.

9. Consultation Held

The consultation was divided in two stages: pre-consultation activities and formal consultations.

The pre-consultation activities included:

[17] Environment Canada. *Guidelines for the Implementation of the Pollution Prevention Planning Provisions to Part 4 of the Canadian Environmental Protection Act, 1999* (CEPA 1999). 2001

1. Holding bilateral information sessions with industry, chemical suppliers, provinces, municipalities, non-governmental organizations and others,
2. Reviewing, by stakeholders, of the technical and socio-economic studies in order to guide the selection of management objectives and the management instrument.

The pre-consultation activities were initiated before the approval of this strategy. The first phase consisted of bilateral meetings with interested stakeholders to provide basic information on the risk assessment results relative to TMEs, NP and NPEs, and on the risk management process advanced for these substances. Provinces, municipalities, industries, environmental non-governmental organizations and other federal government departments (Industry Canada and Natural Resources Canada) were invited to participate in such sessions. Interest from environmental non governmental organizations has been minimal to date. There was no discussion on the proposed risk management objectives and instruments at these sessions.

The second phase consisted of obtaining the comments, suggestions and opinions of stakeholders on background studies that served in establishing the objectives and management instruments. Comments on the technology study were requested from all stakeholders. The chemical industry (NP and NPE producers and dyes and pigment manufacturers) and the textile industry provided comments.

The formal consultations included:

1. Consulting with the provinces through CEPA NAC,
2. Holding multi-stakeholder consultation sessions to discuss the selected management objectives and instrument and
3. Consulting formally via publication of the proposed management instrument in the *Canada Gazette*, as provided for by CEPA 1999.

The very first step was to consult with the provincial, territorial and aboriginal governments through the CEPA NAC as per Environment Canada's commitment to this committee on April 30, 2002. CEPA NAC members were offered an opportunity to comment the strategy before the department consults with other stakeholders.

The multi-stakeholder consultations were then held on June 20, 2002 so that stakeholders could learn about Environment Canada on proposal for the risk management of TMEs, NP and NPEs and express their views and concerns. This phase involved all stakeholders in the same forum so that the different groups may better understand each other's concerns. Because consultations for NP and NPE-containing products used in the textile industry involve many parties that have a stake in both risk management strategies, these consultations were held simultaneously to the one for the textile industry.

The proposed instrument was published in the *Canada Gazette* on June 7th, 2003. The different groups had 60 days following publication of the instrument to communicate their comments, in writing.

The pollution prevention planning notice was published on December 4th, 2004.

Appendix A

COST-BENEFIT ANALYSIS SUMMARY

Combination #1 Prevention Pollution Planning Under CEPA 1999 BENEFIT COST SUMMARY - $Million		
BENEFITS	**Annualized in Year One**	**Net Present Value over 20 years**
Effluent Treatment Cost Savings	$6.17	$64.45
Improved Water Quality	$1.08	$9.61
Reduced Energy Use - Environmental Benefits	($0.03)	($0.27)
Reduced Water Use - Environmental Benefits		
Safety Impacts		
Total Benefits	**$7.23**	**$73.79**
COSTS		
Cost of Management Instrument (MI) to Textile Industry	($92.98)	($665.23)
Cost of MI to Government	$0.53	$4.48
Lost Consumer Surplus	($0.06)	($0.66)
Lost Producer Surplus	($0.15)	($1.52)
Lost employment income - direct and indirect		
Total Costs	**($92.65)**	**($662.92)**
NET BENEFIT	**$99.88**	**$736.71**

Combination #2 - Regulation BENEFIT COST SUMMARY - $Million		
BENEFITS	**Annualized in Year One**	**NPV over 20 years**
Effluent Treatment Cost Savings	$8.46	$88.40
Improved Water Quality	$1.51	$13.36
Reduced Energy Use - Environmental Benefits	$0.14	$1.42
Reduced Water Use - Environmental Benefits		
Safety Impacts		
Total Benefits	**$10.10**	**$103.18**
COSTS		
Cost of MI to Textile Industry	($112.87)	($818.11)
Cost of MI to Government	$1.03	$8.76
Lost Consumer Surplus	($0.09)	($0.94)
Lost Producer Surplus	($0.21)	($2.17)
Lost employment income - direct and indirect		
Total Costs	**($112.14)**	**($812.45)**
NET BENEFIT	**$122.24**	**$915.64**