April 9, 2003

Mr. Philippe di Pizzo,
Chief Administrative Officer
Nunavut Water Board
P.O. Box 119,
Gjoa Haven, Nunavut, X0B 1J0
E-mail:

RE: NTI Comments on Phase II ESA & HHERA reports submitted by Can Zinco.

Dear Mr. di Pizzo:

In response to your letter to Robert Carreau, and the distribution list dated Feb. 17, 2003, Nunavut Tunngavik Incorporated is please to provide it's commentary on the two above mentioned reports.
In order to present a factual review of these reports, NTI has commissioned a review of the two reports through a prominent environmental engineering consultant firm. Here we present a summary of the most salient point of the review, however, for the sake of completeness, we submit the reports from the consultant as well as a plain language version of these reports. We provide in addition an Inuktitut translation of the plain language report and our submission.

REVIEW OF PHASE II ENVIRONMENTAL SITE ASSESSMENT (ESA)

The review of the ESA found several deficiencies in the report.

1) Document organization:
   The format of the report does not follow the presentation format recommended by the Canadian Standards Association. This leads to difficulty in assessing the report. Details on the organization of the report are found in the review paper.
2) In view of the fact that the 1973 B.C. Research Inc. states that "no soil formation has occurred in the mine area", it is difficult to understand the use of CCME soil quality guidelines derived for soil types common to southern Canada. This may put into question the assessment of potential ecological & human health risk base on soil criteria.

3) Contaminants of Concern (COC):
Chlorinated Ethenes – Volatile Organic Compounds are identified in Table F as one of the Contaminants of Concern. Its source is listed as constituent of Xanthate. Based on the 12^{th} edition Condensed Chemical Dictionary, Chlorinated Ethenes is not a constituent of Xanthate, so the source of these chlorinated Ethenes remains a mystery, yet they are given the same status as a COC as the metals.

4) Areas of environmental concern:
In Table G and H, areas of environmental concern identify the distribution of these areas as "Localized", "small quantities", and "limited". This brings into question whether they are overestimated as being "of concern" or underestimated as being "localized".

Given these shortcomings, the conclusions drawn from the Phase II ESA and the implications for the HHERA needs to be clarified.

REVIEW OF ECOLOGICAL RISK ASSESSMENT (ERA)

The review of the ERA found the report to be well organized. The conclusions are conservative as is common for risk assessment. The review finds no serious fault with the conclusions of the ERA. The issues of concern in the review focus on:

1) Focus on Trace element as the Contaminants of Concern raises the question of why other contaminants, identified in the ESA, are not discussed (Hydrocarbons, etc).
2) Statistical references are mixed in the section on Surface waters, (arithmetic mean vs. log-normal geometric means)
3) Receptor, exposure & hazard assessment:
The effects of snow cover are not assessed or addressed in the exposure discussions.
4) Threshold limits, Assumptions and uncertainties:
It is clear that the details used in calculation of limits (100% bio availability, etc) are used to create a worst-case scenario, though some of these are overestimations, and are not current practice. (See details in report).
5) Chemical Interactions:
The presence of metallothioeins requires at least some mention.

The review of the Ecological Risk Assessment report concludes that, despite the minor concerns above, this does not affect the accuracy of the conclusions reached.

REVIEW OF HUMAN HEALTH RISK ASSESSMENT (HHRA)

The review of the HHRA has identified several items that need clarification. However, overall, the review does not believe that the lack of clarity of the items detracts from the correctness of the conclusions of the HHERA. The issues of concern are identified in the review documents provided as background to this summary.

GENERAL CONCERNS WITH THE PHASE II ESA AND HHERA

The conclusions of the review carried out by NTI has identified several issues with the reports that should be clarified, however, overall these issue do not render the conclusions of the Phase II ESA and HHERA incorrect.

However, several issues and concerns come out of the general review of the reports. These are summarized below:

1) The use of the 1985 Soil Geochemical Survey data as representative of baseline conditions is questionable. These data are presented as representing conditions prior to wind blown dispersion of metals from dry tailings; however, the potential for other sources of metals (Mining activity in general, etc.) is not accounted for.
2) The results of the Phase II ESA & HHERA in determining Soil Quality Remediation Objectives (SQRO) define a threshold of 12,000 mg/kg (ppm) Zinc as acceptable, , for a site that is to have potential Human Habitation (Nanisivik Town Site) as a future use. This is in contrast with a similar evaluation at the Polaris mine were threshold for a region that is expected to have little or no use in the future has thresholds of 10,000 mg/kg Zinc. When comparing the General Mine Area SQRO for Nanisivik with Polaris, the difference is greater (Lead mg/kg 3,500 Nanisivik vs. 2,000 Polaris; Zinc mg/kg, 39,000 Nanisivik vs. 12,000 Polaris). These differences seem inappropriate considering the proposed future uses of the two sites.

GENERAL COMMENTS ON THE EMERGENCY RESPONSE PLAN

Though no outside review of the emergency response plan was undertaken as part of the NTI review, some general observations have been made. These mostly reflect the need to update the plans contact information and chain of command to reflect the current and future manpower availability on site.
These issues were addressed in detail in the technical meeting held in Iqaluit, Nunavut on March 29, 2003.

These general concerns, along with the specific concerns in the review reports, need to be addressed by the authors of the Phase II ESA and HHERA reports. Nunavut Tunngavik Inc. hopes that the board will consider our concerns when deciding on the status of these reports.

Sincerely

Stefan B. Lopatka
Senior Advisor,
Environmental, Water & Marine Management
Lands and Resources Department
NUNAVUT TUNNGAVIK INC.

ᐊᐃᕆᓕ 9, 2003

Mr. Philippe di Pizzo,
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ᐱᓪᔪᑎᖓ: ᓄᓇᕗᑦ ᑐᓐᖓᕕᒃᑯᑦ ᓱᕈᕐᓇᕐᑐᓕᕆᔩᑦ ᑐᓂᔭᐅᓯᒪᔪᑦ ᑳ ᔨᓐᑯᒃᑯᓐᓄᑦ

ᒥᓯᑦ ᑏᐱᑦᔪᒧᑦ:

ᑕᐃᑯᐊ ᑎᑎᕋᓚᐅᕐᑕᑎᑦ ᑕᐃᓱᒧᖓ ᕿᐳᑦ ᑲᓇᐅᒧᑦ, ᐊᒻᒪ ᑕᐃᑯᐊ ᐅᑉᓗᖃᕐᑐᑦ ᕕᕗᐊᓇ 17, 2003, ᓄᓇᕗᑦ ᑐᓐᖓᕕᒃᑯᑦ ᖁᕕᐊᓱᒃᐳᑦ ᑖᒃᑯᓂᖓ ᑕᒪᒃᑮᒃᓂᒃ ᐱᓚᐅᕐᒪᑎᒃ ᖁᓛᓂ ᐅᕙᓂ ᐅᖃᐅᓯᕆᔭᓐᓂᒃ ᑎᑎᕋᕐᑕᐅᓯᒪᔪᓂᒃ. ᑕᒪᒃᑯᐊ ᕿᒥᕈᔭᐅᓯᐊᕐᓂᐊᕐᒪᑕ ᑎᑎᕋᕐᑕᐅᓯᒪᔪᑦ, ᓄᓇᕗᑦ ᑐᓐᖓᕕᒃᑯᑦ ᑎᓕᓯᓯᒪᕗᑦ ᐃᑲᔪᕐᑕᐅᓂᐊᕐᓗᑎᒃ ᑖᒃᑯᐊ ᑎᑎᕋᕐᑕᐅᑎᓪᓗᒋᑦ ᕿᒥᕈᔭᐅᑎᓪᓗᒋᓪᓗ ᐊᕙᑎᓕᕆᓂᕐᒥᒃ ᖃᐅᔨᒪᓪᓯᐊᕐᑐᓄᑦ. ᐅᕙᐅᓇ ᓇᐃᒃᓕᒋᐊᕐᓯᒪᔫᖅ ᕿᒥᕈᕐᖃᓯᐅᔫᖅ, ᑭᓯᐊᓂ, ᐱᔭᕇᕐᓯᒪᓪᓯᐊᕐᑐᒥᒃ ᑕᑯᔫᒪᓂᑎᓐᓄᑦ, ᑕᐃᑯᐊ ᐅᖃᐅᓯᕐᔪᐊᖑᓗᐊᖅᑕᕐᒪᑕ ᑎᑎᕋᕐᑕᐅᓯᒪᔪᑦ ᑕᐃᒪᐃᑐᓄᑦ ᑕᐃᑯᐊ ᐊᐱᕆᓯᒪᔭᕗᑦ ᑐᑭᓯᓐᓇᕐᓂᖅᓴᐅᕆᐊᕐᓗᒍ ᐋᖅᑭᒃᓯᖁᑉᓗᒋᑦ. ᐃᓄᒃᑎᑐᕐᓯᒪᕗᖅ ᑖᓐᓇ ᖃᓪᓗᓈᑎᑐᕐᑐᖓᓗ ᑐᑭᓯᓇᕐᓂᖅᓴᐅᓕᕐᓯᒪᓇᓱᐊᕐᓗᓂ.

ᑕᒪᓐᓴ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᓂᖓᑕ ᐊᐃᐸᖓ ᐊᕙᑎᓕᕆᓂᕐᒧᑦ ᑕᐃᒪᓗ ᑕᒪᓐᓇ ᐃᓚᖓ

ᑖᑦᓱᒪ ᑎᑎᕋᕐᑕᐅᓯᒪᔫᑉ ᑐᑭᓯᒪᓇᓯᐊᕐᓂᐊᕐᑐᒃᓴᐅᖏᑑᒐᓗᐊᖅ.

1) ᐋᖅᑭᒃᓯᒪᓂᖓ:
ᑕᒪᓐᓇ ᖃᓄᐃᓕᖓᓂᖓ ᑎᑎᕋᕐᑕᐅᓯᒪᔫᑉ ᐅᓂᒃᑳᓕᐊᖑᓯᒪᓪᓗᓂ ᒪᓕᒃᓱᓂ ᑲᓇᑕᒥ ᑕᐃᒪᐃᓯᐊᓇᐊᖃᕐᓂᕐᒧᑦ ᑕᒪᑐᒧᖓ ᒪᓕᒐᖓᓂᒃ. ᑕᒪᓐᓇ ᑕᐃᒪ ᐃᓚᖓ ᑐᑭᓯᓇᓱᐊᓇᐊᖓ ᐊᔪᕐᓇᑲᓴᒃᑑᒐᓗᐊᖅ ᑭᓯᐊᓂ ᑕᕙᓂ ᑎᑎᕋᕐᑕᐅᓯᒪᔫᖅ ᑐᓴᐅᑎᓕᐊᖑᓯᒪᓪᓗᓂ ᑕᕙᓂ.

2) ᑕᒪᓐᓇ ᖃᐅᔨᒪᓪᓗᒍ ᑕᐃᓱᒪᓂ 1973ᒥ ᖃᐅᔨᓴᕐᓂᖃᓚᐅᕐᓯᒪᒃᒪᑕ "ᑕᒪᓐᓇ ᓄᓇ ᖃᓄᐃᓕᖓᒃᓯᒪᖏᑦᓴᓇᐊᖓ ᐅᔭᕋᒃᑕᓇᐊᕐᕕᐅᓯᒪᔪᒥ", ᑕᒪᓐᓇ ᑐᑭᓯᓚᓇᒐᓱᐊᕐᓱᒍ ᐊᔪᕐᓇᑲᓴᒃᒪᑦ ᐊᑦᔨᒋᔭᐅᓚᓇᖏᑎᑦᓗᒍ ᑕᒪᓐᓇ ᓄᓇᖓ ᑲᓇᑕᒥᐅᓂ ᓄᓇᐅᕙᑦᑐᓂ. ᑕᒪᓐᓇ ᐊᐱᖁᑎᒃᓴᐅᓇᔾᔪᖅ ᖃᓄᖅ ᑕᒪᓐᓇ ᓄᓇᖓ ᐱᐅᖏᓕᔪᑕᐅᓇᔾᔪᖏᒃᑲᓗᐊᓇᐊᖓᓂᒃ ᐊᑕᓇᖏᒃᑲᓗᐊᓇᐊᖓᓂᒃ ᑎᒥᒧᑦ

3) ᓱᕈᕐᓇᑐᖅᑐᐃᓐᓇᓇᐊᖅᑲᕐᓂᕐᒧᑦ ᐃᓱᒪᒋᔭᐅᓂᖏᑦ:
Chlorinated Ethenes – ᑕᐃᒫᒃ ᑕᒪᒃᑯᐊ ᑕᐃᔭᐅᔪᑦ ᐃᓱᒫᓗᒋᔭᐅᓪᓗᑎᒃ ᓱᕈᕐᓇᑐᖅᑐᐃᓐᓇᓇᐊᖅᑲᕐᓂᖏᓐᓂᒃ. ᑕᐃᒪ ᑕᒪᓐᓇ ᐅᖃᐅᓯᕆᔭᐅᓚᐅᕐᓯᒪᔪᖅ ᖃᓄᐃᑑᓂᖓᓂᒃ ᑕᒪᑐᒪ ᖃᐅᔨᓴᕐᑕᐅᔪᓐᓇᕐᑐᖅ, ᐊᑦᔩᖏᑦᑑᓗᑎᒃ ᑕᒪᒃᑯᐊ ᐊᑎᖅᑲᐅᕐᒪᑕ ᓱᕈᕐᓇᕐᑐᐃᑦ. ᐅᖃᐅᓯᕆᔭᐅᓚᐅᕐᓯᒪᔪᖅ ᒪᓕᒃᓗᒍ 12ᒋᓕᕐᑕᖓᓂᒃ ᑕᒪᓐᓇ ᑎᑎᕋᕐᑕᐅᑎᓪᓗᒍ ᖃᐅᔨᒪᔭᐅᓯᐊᓚᐅᕐᓯᒪᖏᑦᑐᖅ ᓱᓇᐅᓚᓇᒋᐊᖓ ᑕᒪᓐᓇ ᓱᕈᕐᓇᑐᐃᓐᓇᓇᐊᓕᒃ, ᑭᓯᐊᓂᓕ ᐊᑦᔨᒋᔭᐅᑎᑕᐅᓗᓂ ᑕᒪᓐᓇ ᓴᕕᕋᔭᒃᓴᖃᓲᖏᒋᐊᖓᓂᒃ ᖃᐅᔨᒪᔭᐅᑦᓱᓂᓗ

4) ᓯᑕᒪᖓ ᑕᒪᑐᒧᖓ ᐊᕙᑎᒧᑦ ᐃᓱᓖᓗᒋᔭᐅᔪᖅ;
ᑕᕝᕙᓂ G ᐊᒻᒪ H, ᐅᖃᐅᓯᕆᔭᐅᓯᒪᔪᖅ ᑕᒪᒃᑯᐊ "ᓇᓅᓐᓂᖏᓐᓂᒃ", ᐊᒻᒪ "ᐱᑕᖃᕆᐊᖏᓐᓂᒃ, "ᐱᑕᖃᓗᐊᖏᓂᖏᓐᓂᒃ", "ᐱᑕᖃᓚᖀᒋᐊᖓᓂᒃᓗ". ᑕᒪᓐᓇ ᐱᓗᐊᕆᑎᑕᐅᓯᒪᖏᒃᑲᓗᐊᒪᖖᖅᐃᓱᒪᓇᓱᓂ "ᐃᓱᓖᓗᑕᐅᔪᖅ" ᐅᕙᓘᓐᓃᑦ "ᐱᑕᖃᕆᐊᖓᓂᒃ".

ᑕᒪᓐᓇ ᖃᐅᔨᑦᓗᒍ, ᑕᐃᓇ ᐊᑐᕐᓗᒍ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᔪᖅ ᐊᐃᐸᖓᓂᒃ ᐊᒻᒪ ᑕᕝᕙᓂ ᖃᓄᐃᑑᓚᕆᒃᓂᖏᑦ ᐅᖃᐅᑕᐅᓯᒪᕐᓯᐊᕆᐊᖅᑐᑦ.

ᖃᐅᔨᓴᕐᑕᐅᓯᒪᓂᖓ ᐊᑕᕐᓇᑐᐃᓐᓇᕆᐊᖅᕐᓂᖓᓄᑦ

ᑕᒪᓐᓇ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᓂᖓ ᓇᓗᓇᐃᕐᓯᒪᕗᖅ ᐅᓂᒃᑳᐊᕆᓯᒪᔭᐅᔪᖅ ᐋᖅᑭᒃᓯᒪᑎᐊᕐᒪᑦ. ᑕᒪᓐᓇ ᖃᓄᐃᓕᖓᓂᖓ ᑕᐃᒪᓇᓴᐃᓐᓇᕐᑕᐅᖅ ᐊᑕᓇᕐᓂᖃᕐᒪᑦ. ᑭᓯᐊᓂᓕ ᐱᓗᐊᕋᓗᒃᑐᒥᒃ ᐱᑕᖃᖏᑐᖅ ᑕᕝᕙᓂ. ᑕᐃᒪᓕ ᑕᒪᓐᓇ ᐃᓱᓖᓗᒋᔭᐅᓯᒪᓂᖓᓄᑦ ᐃᒪᓐᓇ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᔪᖅ:

1) ᑕᒪᓐᓇ ᕿᒥᕈᓗᒍ ᓱᕈᕐᓇᑐᖃᑐᐃᓐᓇᕆᐊᖅᕐᓂᖓ ᐊᓯᖏᑦ ᑕᒪᒃᑯᐊ ᓱᒧᑦ ᑕᕝᕙᓂ ᐅᖃᐅᑕᐅᓯᒪᖏᑦᓴᕆᐊᖏᑦ ᓱᕈᕈᑕᐅᔪᓐᓇᕐᒥᔪᑦ ᓲᕐᓗ ᒪᑯᐊ ᐆᒃᑑᑎᒋᓗᒋᑦ ᐃᒪᑦᑐᑦ (Hydrocarbons, etc).

2) ᑕᒪᒃᑯᐊ ᖃᐅᔨᔭᐅᓯᒪᔪᑦ ᐃᒪᕐᒧᑦ ᐅᐊᕈᑎᖃᑦᑐᑦ, ᐃᒪᐃᑐᑦ, (arithmetic mean vs. log-normal geometric means)

3) ᐊᑕᕐᓇᑐᐃᓐᓇᕆᐊᖅᑐᑦ ᖃᓄᐃᑐᑐᐃᓐᓇᐃᑦ:
ᑕᒪᓐᓇ ᐊᐳᑦ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᖏᑐᖅ ᓱᓇᑕᖃᕐᒪᖖᑦ ᐊᑦᑕᕐᓇᐅᑕᐅᑐᐃᓐᓇᕆᐊᓕᒃᓂᒃ.

4) ᖃᓄᐃᑑᓂᖏᑦ ᐱᑕᖃᕐᓂᐅᔪᑦ, ᐃᓱᒪᒋᔭᐅᔪᑦᓗ ᖃᐅᔨᒪᔭᐅᖏᑦᑐᑦᓗ:
ᓇᓗᓇᖏᑎᓱᓂ ᑕᒪᓐᓇ ᑲᑎᕐᓱᕐᑕᐅᓯᒪᔪᖅ ᒪᓕᒃᓗᒍ (ᑕᒪᒃᑭᕐᓗᓂ ᖃᓄᐃᓕᖓᓂᖓ) ᑕᒪᓐᓇ ᐱᐅᖏᓕᑐᐃᓐᓇᕆᐊᖅᕐᓂᖓ, ᐅᖓᑕᐅᓯᒪᓗᐊᕐᓱᑎᒃᓗ, ᒫᓐᓇ ᑕᒪᒃᑯᐊᐊᑐᕐᑕᐅᖏᑐᑦ. (ᑕᑯᓗᒍ ᐅᓂᒃᑳᓕᐊᕆᔭᐅᓯᒪᔪᖅ ᑕᒪᑐᒧᖓ).

5) ᖃᓄᐃᑐᕐᑕᖅᕐᓂᖓ:
ᑕᒪᒃᑯᐊᓗ ᐊᓯᖏᑦ ᓱᕈᕐᓇᕐᑐᑦ ᐃᒪᐃᑦᑐᑦ ᐅᖃᐅᓯᕆᔭᐅᓯᒪᔭᕆᐊᖅᒥᔪᑦ

ᑕᒪᓐᓇ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᓂᖓ ᐊᑕᕐᓇᑐᐃᓐᓇᕆᐊᖅᕐᓂᕐᒧᑦ ᐅᓂᒃᑳᓕᐊᖑᓯᒪᔪᖅ

ᐃᒪᓐᓇᐃᓕᖓᒃᒪᑦ, ᐅᑯᐊ ᖁᓚᕇᓂᑦᑐᑦ ᐊᑕᕐᓇᑐᐃᓐᓇᕆᐊᓖᑦ, ᓱᓂᕈᑕᐅᔫᖏᒻᒪᑕ ᑕᒪᑐᒧᖓ.

< ᖃᐅᔨᓴᕐᑕᐅᓯᒪᓂᖓ ᑎᒥᒧᑦ ᐊᑕᕐᓇᑐᐃᓐᓇᕆᐊᖅᑲᕐᓂᖓᓄᑦ (HHRA)

ᑕᒪᓐᓇ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᓂᖓ ᓇᓗᓇᐃᕐᓯᓯᒪᒃᒪᑦ ᑕᒪᓐᓇ ᓱᓕ ᖃᐅᔨᒋᐊᕐᑕᐅᓯᐊᕆᐊᓕᒃ. ᑭᓯᐊᓂᓗ, ᑕᒪᒃᑭᕐᓗᒍ ᑕᒪᓐᓇ, ᖃᐅᔨᓴᕐᑕᐅᓯᒪᓂᖓ ᖃᓄᖅ ᐅᖃᐅᓯᕆᔭᐅᑦᓯᐊᓯᒪᖏᓪᒪᑦ ᐃᓱᓕᕕᐅᔪᓐᓇᕐᓂᖓ ᖃᓄᐃᑑᔭᕆᐊᖓᓂᒃ. ᑕᒪᒃᑯᐊ ᑕᕝᕙᓂ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᔪᑦ ᑕᒪᑐᒧᖓ ᐅᕗᖓ ᐃᓚᐅᒥᑦᓗᑎᒃ ᐅᓂᑳᕐᑕᐅᑦᓯᐊᕐᓯᒪᑦᓱᑎᒃ.

ᐃᓱᒫᓗᒋᔭᐅᔪᑦ ᑕᒪᑐᒧᖓ ᐊᐃᐸᕆᓕᕐᑕᖓᓄᑦ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᓂᖓᓄᑦ

ᖃᐅᔨᓴᕐᑕᐅᓯᒪᓂᖓ ᑕᒪᑐᒧᖓ ᒪᓕᒃᓗᒍ ᓄᓇᕗᑦ ᑐᓐᖓᕕᒃᑯᓐᓄᑦ ᓇᓗᓇᐃᕐᓯᒪᒃᒪᑦ, ᑭᓯᐊᓂᓗ, ᑕᒪᒃᑭᕐᓗᒋᑦ ᑖᒃᑯᐊ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᓂᖏᑦ ᐊᐃᐸᕆᓕᕐᑕᖓᓂ ᑕᒪᕐᓯᒪᓂᖅᑲᕐᒪᑕ ᑕᒪᑐᒧᖓ. ᑭᓯᐊᓂᓗ, ᐃᓱᒫᓗᒋᔭᐅᔪᑦ ᑕᒪᒃᑯᐊ ᑕᒪᑐᒧᖓ ᑐᓴᐅᓯᐊᖑᓯᒪᔪᒧᑦ. ᐅᑯᐊ ᑕᕝᕙ ᖃᓄᐃᓕᐅᕐᓯᒪᓂᖏᑦ ᐅᕝᕙᓂ ᐊᑖᓂ:

1) ᑕᐃᑯᐊ ᐊᑐᕐᑕᐅᑎᑦᓗᒋᑦ 1985ᒥ ᓄᓇᒧᑦ ᐃᒻᒧᐊᓄᑦ ᖃᐅᔨᓴᐅᑕᐅᓂᑯᐃᑦ ᓱᓕ ᖃᐅᔨᒪᔭᐅᓯᐊᖏᓪᒪᑕ ᑕᒪᓐᓇ ᐊᓄᓇᖅᑕᕐᓂᖅ ᐱᑦᔪᑎᒋᑦᓗᒍ ᓴᕕᒃᓴᔭᓂᒃ ᑕᒫᖓᑦ ᑎᒃᑕᐅᕋᕐᑐᖅᑲᖅᑲᑕᕐᑎᑦᓗᒍ ᑕᒪᒃᑯᓇᖓ ᐃᒋᑦᓯᕕᐅᖅᑲᑕᕐᑐᓂᒃ ᐸᓂᕐᑐᓂᒃ; ᑭᓯᐊᓂᓗ ᑕᒪᓐᓇ ᖃᓄᐃᖅᑲᑕᕐᓂᖓ (ᐅᔭᕋᒃᑕᓇᐊᕕᐅᔪᒥ) ᓱᓕ ᖃᐅᔨᒪᔭᐅᖏᓪᒪᑦ.
2) ᑕᒪᓐᓇ ᖃᓄᐃᑑᓂᖓ ᐊᐃᐸᕆᓕᕐᑕᖓᓂᒃ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᓂᒍ ᐃᑦᔪᖓᑕ ᖃᓄᐃᑑᓂᖓᓄᑦ ᓴᕕᒃᓴᖅᑲᕐᓂᖓᓄᑦᓗ, ᑕᒪᒃᑯᐊ ᐃᓄᖅᑲᖅᑲᕐᓂᑯᐃᑦ ᑎᒥᒧᑦ (ᓲᕐᓗ ᓇᓂᓯᕕᒃᒥ) ᓯᕗᓂᒃᓴᒧᑦ ᐊᑐᐃᓂᖅᑲᕈᓐᓇᕐᓂᖓᓄᑦ. ᑕᒪᓐᓇᑕᐅᖅ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᑦᓗᓂ ᑕᐃᑲᓂ ᐸᓕᐊᓇᓐ ᐅᔭᕋᒃᑕᓇᐊᕐᕕᐊᓂ ᑕᒪᓐᓇ ᐊᑐᕐᑕᐅᓂᖅᑲᓂᐊᕈᓐᓇᐃᕐᑐᖅ ᓇᓗᓇᖏᑦᓱᓂ ᓯᕗᓂᒃᓴᒥ ᓴᕕᕋᔭᓕᒃ. ᑕᒪᓐᓇ ᕿᒥᕈᓗᒍ ᐅᔭᕋᒃᑕᓇᐅᕐᕕᐅᖅᑲᕐᓯᒪᔪᖅ ᓇᓂᕕᒃᒥ ᐸᓕᐊᓇᓐᒥᓗ, ᐊᑦᔨᒌᖏᓐᓂᖅᑲᕐᒪᑦ (ᓴᕕᕋᔭᒃᓴᖓ **3,500** ᓇᓂᓯᕕᒃᒥ ᐱᓕᐊᕋᔅᓗ, ᐊᖏᓂᕐᓴᐅᓗᓂ ᑕᒪᓐᓇ 3,500 ᓇᓂᓯᕕᒃ 2,000 ᐅᓐᓗᓂ ᐸᓕᐊᓇᓐᒥ; ᓴᕕᕋᔭᒃᓴᖅᑲᕐᓂᖓᓗ 39,000ᖑᑦᓗᓂ ᓇᓂᓯᕕᒃᒥ 12,000ᖑᑦᓗᓂ ᐸᓕᐊᕋᔅᒥ) ᑕᒪᒃᑯᐊ ᐊᑦᔨᒌᖏᓐᓂᓇᔭᖏᑦ ᐋᖅᑭᓯᐊᕐᓯᒪᖏᑎᑦᓗᒋᑦ ᑕᒪᓐᓇ ᖃᓄᖅ ᐊᑐᕐᑕᐅᔪᓐᓇᖅᑲᔭᕐᓂᖓ ᑖᒃᑯᐊ ᒪᕉᔫᒃ ᕿᓂᕐᕕᐅᖅᑲᕐᓯᒪᔫᒃ.

ᖃᐅᔨᒪᔭᐅᔪᒃᓴᑦ ᑐᐅᕕᕐᓇᑐᖃᕆᕐᑎᑦᓗᒍ ᑕᕙᓴᐃᓐᓇᖅ ᖃᓄᐃᓕᐅᕆᐊᖃᕐᓂᕐᒧᑦ ᐸᕐᓇᐃᖅᔭᕐᑕᐅᓯᒪᔪᖅ

ᑕᒪᓐᓇ ᖃᐅᔨᕆᐊᕐᑕᐅᓯᒪᙱᒃᑲᓗᐊᕐᑎᑦᓗᒍ ᑐᐊᕕᕐᓇᕐᑐᑰᓂᐊᖃᕆᕐᓂᕐᑎᑦᓗᒍ ᖃᐅᔨᓴᕐᑕᐅᔪᓂᐊᖃᕐᓂᓂᔪᖕᒐ ᓄᓇᕗᑦ ᑐᓐᖓᕕᒃᑯᓐᓄᑦ, ᑕᒪᒃᑯᐊ ᐃᓚᖏᑦ ᑕᕙᓂ ᐃᒃᐱᒋᔭᐅᑦᓯᐊᕆᐊᖃᕐᒪᑕ. ᑕᒪᒃᑯᐊ ᑲᑐᕐᖀᒃᓯᒪᖃᑦᑕᕐᓂᐊᕐᓂᕐᒧᑦ ᐸᕐᓇᐃᕐᑕᐅᓯᒪᔪᑦ ᑕᒪᑐᒧᖓ ᒪᓕᐅᑎᑦᓯᐊᕆᐊᖃᕐᒪᑕ ᖃᓄᖅ ᐃᒃᐱᓇᓂᖃᖅᕿᔪᕐᒪᖕᒐᑕ ᓴᓇᕕᐅᓯᑲᓐᓂᕐᓂᕈᑎᒃ ᐃᓄᖃᓗᕐᓗᑎᒃ ᐊᑐᐃᓐᓇᐅᓕᕐᓂᕐᐸᑦ. ᑕᒪᒃᑯᐊ ᐅᖃᐅᓯᕆᔭᐅᓚᐅᕐᑐᑦ ᑲᑎᒪᓂᖃᕐᑎᑦᓗᒋᑦ ᐃᖃᓗᒃᓂ, ᓄᓇᕗᑦ ᒫᔨ 29, 2003.

ᑕᒪᒃᑯᐊ ᐃᓱᒫᓗᒋᔭᐅᔪᑦ, ᑖᒃᑯᐊᓗ ᑐᓴᐅᓯᐊᖑᓯᒪᓕᕐᑐᑦ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ, ᓯᕗᓂᒃᓴᒥ ᓱᓕ ᑲᒪᒋᔭᐅᔭᕆᐊᖃᓂᐊᕐᒪᑕ ᐅᓂᑳᓕᐅᕐᑐᕕᓂᕐᓄᑦ ᐊᐃᐸᕆᓕᕐᑕᖓᓂ. ᓄᓇᕗᑦ ᑐᓐᖓᕕᒃᑯᑦ ᓂᕆᐅᒃᐳᑦ ᑖᒃᑯᐊ ᐃᓱᒪᒋᔭᐅᑦᓯᐊᕐᑯᑉᓗᒋᑦ ᑲᑎᒪᔩᓄᑦ ᑖᒃᑯᐊ ᐅᓂᑳᓕᐊᖑᓯᒪᔪᑦ ᑕᒪᑐᒧᖓ ᖃᓄᐃᓕᐅᕐᓯᒪᓂᖏᓐᓂᒃ.

ᐅᓇ ᑎᑎᕋᕐᑐᖅ,

ᓯᑕᕚᓐ ᓗᑉᑕᑲ
ᑯᑦᓯᓂᒃᓴᒧᑦ ᖃᐅᔨᒪᔨᕆᔪᖅ
ᐊᕙᑎᓕᕆᓂᕐᒧᑦ, ᐃᒪᕐᒧᑦ ᐃᒪᕐᒥᐅᑕᐅᑦᓗ ᐊᐅᓚᑕᐅᓂᖏᓐᓄᑦ
ᓄᓇᓕᕆᔩᒃᑯᖏᓐᓄᑦ
ᓄᓇᕗᑦ ᑐᓐᖓᕕᒃᑯᑦ

PLAIN LANGUAGE VERSION

A REVIEW OF THE PHASE II ENVIRONMENTAL SITE ASSESSMENT AND THE HUMAN HEALTH & ECOLOGICAL RISK ASSESSMENT OF THE NANISIVIK MINE

1.0 INTRODUCTION

Almost all routine human activities in today's world can be shown to create unnatural substances or enhance the presence of naturally occurring substances to the point where they become a threat to human and environmental health. These natural and unnatural substances are then called "contaminants." Some routine human activities, such as driving a snowmobile or truck, produce such small amounts of contaminants that human and environmental health is not a major concern. Other human activities, especially those large-scale activities such as mining, produce many more contaminants. When a mine shuts down after several years of operation, the question is usually asked as to whether the total amount of contamination released over the period of mine operation was large enough to cause problems of human health or adverse ecological effects, or both.

To determine the answer to this question for Nanisivik, three different studies were conducted. These studies included the land occupied by the Nanisivik Mine area, the town of Nanisivik and the associated facilities, such as the dock area. The first study identifies and quantifies the contaminants present and determines their pervasiveness. This study (called a Phase II Environmental Site Assessment) reviews historical data and collected new data at the site. Once the ESA is completed, two additional studies were conducted to determine if the contaminants found in the Nanisivik area pose a threat to humans living in the area and to the animal and plant life of the area. These studies are called the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA), respectively, and were combined in a single document identified as the Human Health and Ecological Risk Assessment (HHERA).

2.0 REVIEW OF THE PHASE II ENVIRONMENTAL SITE ASSESSMENT

The purpose of the Phase II Environmental Site Assessment (ESA) was to identify and delineate the surface area, depth and severity of environmental contamination related to mine activities. The ESA was to also include an evaluation of the chemical data in relation to federal regulatory guidelines for environmental quality. A review of the ESA found several problems with the document.

The first problem was the way in which the document was organized and the manner in which the information and data collected was presented.

The main sections of the ESA were:

1. Introduction
    - 1.1 Project Objectives
    - 1.2 Background on Closure and Reclamation Plan
    - 1.3 Overview of Nanisivik Mine, Town and Related Facilities
    - 1.4 Regulatory Setting/Framework
    - 1.5 Scope of Work
2. Pre-mining Environmental Setting
    - 2.1 Climate

2.2 Permafrost
2.3 Geology
2.4 Topography
2.5 Hydrology
2.6 Vegetation
2.7 Soil
2.8 Mammals
2.9 Birds

3. Environmental Site Assessment Setting
    3.1 Marine Sediments
    3.2 Air Quality / Dust Monitoring
    3.3 Surface Water Quality
    3.4 Acid-Rock Drainage Testing
    3.5 Possible Contaminants of Potential Concern
4. Site Development and Operations
    4.1 Description of Facilities and Mining Activities
    4.2 Development Sequence
5. Phase II Environmental Site Assessment
    5.1 Methodology
    5.2 Observations
    5.3 Results
6. Contaminants and Areas of Environmental Concern
    6.1 Contaminants of Environmental Concern
    6.2 Areas of Environmental Concern

By contrast, the form of presentation recommended by the Canadian Standards Association (CSA) is indicated as follows:

- Introduction (this would include sections 1.1, 1.2 of the ESA)
- Background (this would include all information and data collected prior to the start of the Phase II ESA in July, 2002, such as found in sections 1.3, 1.4, 2.1 to 2.9, 3.1 to 3.4, 4.1 and 4.2)
- Site Investigation Methodology (this would include sections 1.5 and 5.1)
- Findings (this would include all information collected specifically for the ESA in July 2002 such as found in sections 5.2 and 5.3)
- Evaluation of Findings (this would include information from sections 3.5, 5.3, 6.1, and 6.2 and be a synthesis of information during July 2002 with those data previously collected.
- Conclusions (this section does not exist in the ESA as currently presented)
- Qualifications of Assessor (this section does not exist in the ESA as currently presented)
- References and supporting documentation
- Appendices

Another problem with the ESA was that the ESA described the surface materials in the Nanisivik area as “soil” and then cited a report by B.C. Research that soil formation did not occur in the Nanisivik area. If “soil formation” does not occur, should the surface material at Nanisivik be called soil? Several definitions of the word “soil” were examined from soil science textbooks and a federal government soil science glossary. The surface material at Nanisivik did not meet the strict definitions of soil that were provided by the references.

This raised another question. The environmental quality guidelines used to judge whether or not contamination was present in surface material at Nanisivik were based on "soil" as described in the soil science textbooks and by the federal department of agriculture (that is, soils such as those found in southern Canada). The intended future land use of the mine was identified as "Arctic wild land." However, there are no guidelines for the contamination of Arctic wild lands. Thus, the guideline for soils in parkland/residential areas in southern Canada was used to judge the amount of contamination in surface material in the high Arctic at Nanisivik. The review of the ESA concluded that this was not a reasonable approach for the determination of "contamination" at Nanisivik.

The ESA identified several contaminants of concern that were supposedly associated with the mining activity that had taken place over previous 25 years. These were grouped into categories identified as:

- Volatile Petroleum Hydrocarbons
- Extractable Petroleum Hydrocarbons (including the specific hydrocarbon Naphthalene)
- Chlorinated Ethenes; and
- Trace Elements (specifically cadmium, copper, zinc and lead).

A reason for the identification of chlorinated ethenes as a contaminant of concern was not provided in the text of the ESA. In fact, no reference to chlorinated ethenes could be found anywhere in the text. In addition, laboratory analytical reports for these compounds could not be found. The source of the chlorinated ethenes was stated to be xanthate. However, this could not be verified in a chemical dictionary or other sources of chemical information. Thus, there does not appear to be any supporting evidence for the identification of chlorinated ethenes as contaminants of concern.

While specific areas of the town of Nanisivik were determined to be contaminated with petroleum hydrocarbons, almost all of these areas were restricted to the surface material beneath aboveground diesel or heating oil storage tanks. This contamination was often characterized as "localized." The presence of metallic trace elements was also determined, in many cases, to be "localized" or present in small amounts.

Although explicit conclusions as to the nature of the overall contamination at the mine, in the town and at the dock area were not provided in the ESA, it was implied that environmental contamination which had occurred as a result of mining activities had not been extensive or severe. The corresponded with the conclusion of a 1992 report concerning trace element contamination at Nanisivik in which the "scale" of contamination was characterized as "minor."

3.0 REVIEW OF THE HUMAN HEALTH RISK ASSESSMENT

A Human Health and Ecology Risk Assessment (HHERA) was prepared to predict if exposures to surface soil contamination found at the Nanisivik Mine may lead to harmful health effects on people or the environment. AMEC Earth & Environmental Limited (AMEC) was asked to review the HHERA determine if the HHERA adequately identifies the health risks. The human health component of the HHERA is a scientific tool that is intended to evaluate health risks objectively. HHERAs are regularly used by various government agencies for numerous applications including food and drug testing and contaminated site remediation. The current HHERA was designed to evaluate the risks associated with current and future exposures, not historical exposures. The risks were primarily evaluated by comparison of the surface soil concentrations of the contaminants of concern with the calculated Soil Quality Remediation Objectives.

The HHERA evaluates the risk of the former mine by looking at three study areas based on future uses of the land *i.e.,* Town Area, Dock Area, and General Mine Area. The HHERA indicates that the future land use may involve the ongoing use of the dock area as a storage facility for marine environmental response equipment and refuelling, use of area as a regional training centre for equipment operation, trades, and jobs and use of area as a military training base. As for the town facilities, there are two possibilities: demolition of all facilities within the town or transfer ownership of the town facilities to other organizations for ongoing use.

Since the data used in the HHERA came from a number of previous reports, it is important to cross check the data between those presented in the reports and those used in the HHERA. JWEL checked only 20% of the data. However, AMEC would recommend that 100% of the data be cross checked in order to ensure that the results are complete.

In the review of the HHERA, AMEC identified several items that needed clarification. They included the following:

- Explanation of the statistics used;
- Description of how the HHERA deals with concentrations that were less than the ability of the laboratory to measure;
- Explanation why arsenic was not included in the assessment;
- Explanation why lead and zinc were not evaluated from an inhalation perspective for the toddler;
- Explanation for a lower rate of eating soil in a toddler than recommended by CCME;
- Explanation of how chemical concentrations were calculated in wild game and subsequently determining the chemical intake in people;
- Explanation of why an inhalation exposure limit was not available for cadmium;
- Provide an example of the calculations done in the HHERA to ensure that the right values were substituted in the equations;
- Explanation of why the cancer assessment focused on a composite person (*i.e.,* adding up intakes from each life stage), rather than an adult as recommended by the regulatory agencies;

The primary criticism of the HHERA was the use of data from other regions of Canada to support the HHERA when conditions in the high arctic may be completely different.

Based on the review of the HHERA, AMEC is of the opinion that the assessment adequately addresses the potential risks to human receptors at the Nanisivik Mine. The issues identified above, once addressed, are not considered significant to the point that the HHERA would be considered wrong.

4.0 REVIEW OF THE ECOLOGICAL RISK ASSESSMENT

An ecological risk assessment is an attempt to establish the threat posed by specific levels of contamination to the animals and plants in a specific area. It has been known for several decades that animals and plants living in areas of contaminated soil tend to have these same contaminants in their tissues to various degrees due to exposure to the contaminated soils. In animals, this exposure to contaminated soils may be directly though inadvertent ingestion of soils with their food or from other portions of the environment that have become contaminated due to the migration of the soil contaminants. For example, surface water could be contaminated as a result of snowmelt runoff coming in contact with the soil. Plants growing on the contaminated soil could also become contaminated and pass the contaminants along to animals that eat plants. The contamination of animals that eat plants could ultimately result in the contamination of animals that eat other animals.

An ecological risk assessment (ERA) examines all the possible ways that the contaminants in soil can be transferred to other portions of the ecosystem and to organisms in that ecosystem. An ERA also examines the organisms that have the greatest value to the ecosystem or for other reasons are of special importance. These organisms are called “valued ecosystem components” or VECs. Depending on their relative importance and their life cycle characteristics that bring them in contact with the contaminated soil or with other organisms potentially contaminated by contact with the contaminated soil, specific organisms are selected to represent all animal or plant species at the site where the ERA is conducted. Individual animal species are chosen to represent all other animals at a given food level in the ecosystem (i.e. plant eating animals and animals which eat other animals). The chose is usually based on the economic-social attributes of the animal as well as their species-specific habits that result in the greatest exposure of the animal to the contaminates in the soil. The assumption behind this is that if the level of contaminant in the soil does not endanger the selected animal, then other animals receiving less exposure will, likewise, be protected from adverse effects of the soil contaminants.

Once selected for the ERA, an animal species is intensively examined for its species-specific characteristics. Information concerning body weight, food habits, amount of food ingested per unit of body weight, water consumption, amount of air passed through lungs as well as any other characteristics that would potentially influence the amount of contaminated soil coming in contact with the animal is identified and documented. The information collected for plant species is generally related to the ability to absorb the contaminants that have been identified as of being of concern.

The ability of the contaminants to leave the soil environment and be transferred to other parts of the environment must also be investigated. This requires the examination of the physical-chemical characteristics of the specific contaminants of concern as well as their environmental fate and toxicology.

Once all this information is compiled, estimates are made of the amount of contaminant absorbed by the VECs. The fate and toxicology information previously compiled for the specific contaminant of concern is then used to interpret the effect on the organism of the amount of contaminant absorbed. These effects could range from no effect to the death of the animal or plant over either a short or long time span.

Jacques Whitford Environmental Limited, Fredericton, New Brunswick conducted the Nanisivik mine ERA. The ERA was well organized and presented issues associated with the potential for trace element concentrations to cause problems in the area wildlife in a format that was easy to follow. There was no mention of the hydrocarbon contamination identified in the Phase II ESA, and it was assumed that the hydrocarbons did not constitute a threat to wildlife. As with the ESA, the authors of the ERA referred to the surface material at Nanisivik as "soil." This terminology should probably have been examined in light of the statement in the ESA that no soil formation occurred at Nanisivik. However, this in a minor matter as the main focus of the ERA document was an attempt to quantify the amount of trace elements that passed from the soil directly to plants, from the plants to the animals

Generally, the ERA satisfied the standard protocols for this type of investigation and came to the conclusion that there is little or no potential for adverse effects on the Nanisivik ecosystem from the trace elements in the area due to naturally occurring concentrations or the higher concentrations present as the result of mining activity. The individual criticisms of this ERA are concerned with relatively small details and assumptions of the assessment and do not alter the general conclusions. These individual criticisms, other than typographical errors, concerned:

- The use of an arithmetic mean for calculating the exposure point concentrations instead of using the 95% upper confidence limit of the geometric mean of the log transformed data;

- The absence of a pathway in the conceptual model of contaminant movement involving a connection between contaminated surface material and surface water via surface runoff water;

- The absence of a pathway whereby the tailing pond releases contaminants to the marine environment via the creek;

- The effect of snow cover and frozen surface material on the transfer of contaminants to the lemming for eight months of the year;

- The very conservative assumption of 100% bioavailability of the ingested trace elements; and

- The lack of a discussion of metallothioeins in mammals as a counteractive and migrating issue in trace element uptake, metabolism and toxicity. Metallothioeins are proteins produced primarily by the liver for the purpose of combining with excessive amounts of trace elements entering the body, thus preventing cellular damage that would otherwise result from the presence of the trace elements.

ᕿᒥᕈᔭᐅᓂᐊ ᕿᖕᒍᓕᕐᒥ II ᖃᐅᔨᓴᖅᑕᐅᔪᔪᑦ ᐊᕙᓗᙵᑕ ᖃᓄᐃᓕᕐᓂᙵᓄᑦ ᐊᒻᒪᓗ ᐃᓅᓯᕐᒧᑦ ᐋᓐᓂᐊᕐᓇᖅᑐᖅᑕᐃᓕᕐᑯᓪᓗᒍ ᐱᕈᖅᑐᓄᑦ ᐆᒪᔪᓄᓪᓗ ᐊᑦᑕᕐᓇᖅᑐᖅᑕᐃᓕᕐᑯᓪᓗᒍ ᓇᓂᓯᕕᖕᒥ

1.0 ᐱᒋᐊᙵᓚᐅᕈᓯᐊ

ᑕᒪᐃᑕᑦᓕᒫᑲᓴᒃ ᐃᓄᓕᒫᓄᑦ ᐱᓕᕆᐊᕆᔭᐅᔪᑦ ᓄᓇᒥ ᐅᓪᓗᒥ ᓄᓇᐅᑉ ᒪᓂᕋᙵᓄᑦ ᐊᓯᔾᔨᔪᑕᐅᓃᙳᙵᒪᑕ ᓄᓇᒥ ᕿᒪᒃᑕᐅᔪᕕᓂᕐᓂᒃ ᐱᑦᖃᓕᓃᙳᙵᒪᑦ ᑕᒫᓂᒃᑲᔭᙱᑦᑑᓚᓗᐊᓂᒃ ᐃᓚᙱᑦ ᐱᓗᐊᖅᐸᑕ ᖃᙵᑐᐃᓐᓇᖅ ᐃᓅᓯᕐᒧᑦ ᐊᑦᑕᕐᓇᓕᕈᑕᐅᒍᓐᓇᖅᑐᑦ ᐊᕙᓗᑦᑕᓗ ᐱᖅᑯᓯᑐᖃᙵᓄᑦ ᐊᓯᔾᔩᔪᑕᐅᔫᓐᓇᖅᓗᑎᒃ ᐋᓐᓂᐊᕐᓇᖅᑐᖃᑐᐃᓐᓇᓇᐊᖃᕐᓂᙱᓪᓗ ᐃᓱᒫᓗᒋᔭᐅᓃᙳᓪᓗᑎᒃ. ᑖᒃᑯᐊ ᓄᓇᒥᑦ ᐲᖅᑕᐅᔪᑦ ᐅᕙᓗ ᓄᓇᒧᑦ ᐃᓕᔭᐅᔪᑦ ᓴᓇᖅᑯᑎᕕᓐᓃᑦ "ᓱᕈᔪᐃᒍᓐᓇᕐᒪᑕ". ᑕᐃᒪᙵᓄᑦ ᐃᓄᙵᓄᑦ ᒪᒃᑯᐊ ᓂᒪᕈᑕᐅᓃᑦ ᖃᒧᑕᐅᔭᐃᑦ ᓄᓇᒃᑰᔫᓪᓗ, ᒥᑭᔪᒻᒪᓇᙵᓂᒃ ᓱᕈᔫᕐᓇᖅᑐᓂᒃ ᓄᓇᒧᑦ ᐃᓕᐅᖅᑲᐃᓃᙳᙵᒪᑕ ᑕᐃᒫᒃ ᐊᑦᑕᕐᓇᙱᓐᓂᖅᑕᐅᓃᑦ ᐃᓅᓯᕐᒧᑦ ᐱᕈᖅᑐᓄᓗ ᐆᒪᔪᓄᓗ ᐃᓱᒫᓗᒋᔭᐅᓃᙳᙱᑦᑐᑦ. ᑭᓯᐊᓂᓕ ᐊᓯᙱᑦ ᐃᓄᙵᓄᑦ ᓄᓇᒥ ᐱᓕᕆᐊᑦ, ᐊᙱᔪᒃᓕᒥᒃ ᐃᒻᒪᖅ ᐅᔭᕋᙵᓂᐊᖅᑐᓂᒃ, ᓱᕈᔫᙵᖅᑐᓂᒃ ᓴᓇᖅᑯᑎᓂᒃ ᐊᙱᓂᖅᓴᓂᒃ ᐊᑐᕈᑕᐅᖃᑦᑕᕐᒪᑕ. ᖃᙵᑐᐃᓐᓇᖅ ᐅᔭᕋᙵᓂᐊᕐᕕᒃ ᒪᑐᓛᙵᓚᑦ ᐊᒥᓱᓂᒃ ᐅᑭᐅᓂᒃ ᐱᓕᕆᐸᐃᓚᐅᖅᓗᓂ, ᐊᐱᖅᑯᑕᐅᓕᓃᖅ ᓄᓇᒧᑦ ᓴᓇᖅᑯᑎᕈᔪᐃᑦ ᑲᑕᒃᑲᕐᓂᑯᐃᑦ ᑲᑎᓪᓗᒋᑦ ᓯᕕᑐᔪᒥᒃ ᑲᑕᖅᑕᐅᓂᑯᐃᑦ ᓄᓇᒥ ᐊᙱᒡᓕᕙᓪᓕᐊᓃᙳᙵᒪᑕ ᐊᑦᑕᕐᓇᕈᑕᐅᓕᓇᐊᙱᑦ ᐊᐱᖅᑯᑕᐅᓕᓃᙳᙵᒪᑕ ᑎᒥᒧᑦ ᐋᓐᓂᐊᖃᓕᕐᓇᖅᑐᒥᒃ ᐱᑦᖃᙱᒃᑲᓗᐊᕐᒪᙶᑕ ᑕᒫᓂᕐᒥᐅᓄᑦ ᓄᓇᙵᓂᓗ ᐆᒪᔪᓄᑦ ᐱᕈᖅᑐᓄᑦ, ᑕᒪᐃᓐᓄᓕᒫᕐᓗ.

ᑐᑭᓕᐅᕋᓱᐊᖅᓗᒍ ᖃᓄᖅ ᐊᐱᖅᑯᑕᐅᓯᒪᔪᖅ ᑭᐅᓚᓱᐊᕆᐊᖅ ᓇᓂᓯᕕᖕᒥ ᐅᔭᕋᒃᑕᕐᓂᐊᕐᕕᕕᓂᕐᒧᑦ, ᐱᙵᓱᐃᖅᓱᖅᓗᑎᒃ ᐊᕙᓗᙵᓂᒃ ᖃᐅᔨᓴᖅᓯᒪᓕᕐᒪᑕ. ᖃᐅᔨᓴᕈᑕᐅᓪᓗᑎᒃ ᐃᓱᒪᓕᐅᕈᑕᐅᓚᐅᖅᑐᑦ ᓇᓂᓯᕕᒃᒥ ᐅᔭᕋᒃᑕᕐᓂᐊᕐᕕᓕᐅᕐᕕᕕᓂᖅ, ᓄᓇᓕᙵᓗ ᑕᒫᓂᑦᑐᓪᓗ ᓴᓇᕕᑦ, ᒪᒃᑯᐊ ᑐᓚᒃᑕᕐᕕᑦ. ᓯᕗᓪᓕᖅᐹᒥᒃ ᖃᐅᔨᓴᕈᑕᐅᑎᓪᓗᒍ ᓇᓗᓇᐃᔭᐃᓚᐅᕐᒪᑕ ᖃᓄᑎᒋ ᐊᒃᑎᕆᙳᙵᑕ ᓱᕈᔪᐃᔫᓇᖅᑐᑦ ᑕᒫᓂ ᐊᒻᒪᓗ ᖃᓄᑎᒋ ᐊᑦᑕᕐᓂᕐᓂᖃᕐᒪᙵᑕ. ᒫᓐᓇᓕ ᖃᐅᔨᓴᕈᑕᐅᔪᑦ (ᑭᖑᓂᙵᓂ II ᐊᕙᓗᐊᓂᒃ ᖃᐅᔨᓴᕈᑕᐅᔪᑦ) ᕿᒥᕈᓚᐅᖅᑐᑦ ᑕᐃᓱᒪᙵᓂᓂᑦ ᑲᑎᖅᓱᖅᑕᐅᓯᒪᔪᓂᒃ ᐊᒻᒪᓗ ᓄᑖᓂᒃ ᑲᑎᖅᓱᐃᓪᓗᑎᒃ ᓈᓴᖅᑕᐅᒋᐊᓕᙵᓂᒃ ᑕᒪᙵᑦ. ᑕᐃᒪ ᐊᕙᓗᙵᓂᒃ ᖃᐅᔨᓴᕈᑎᑦ ᐱᐊᓂᒃᑕᐅᙵᒪᑕ, ᑭᖑᓂᙵᒍᑦ ᒪᕈᐊᖅᑎᒃᑲᓐᓂᖅᓗᑎᒃ ᖃᐅᔨᓴᕈᑕᐅᓕᓚᐅᕐᒥᔪᑦ ᓱᕈᔫᓇᖅᑐᖅᑕᕆᐊᙵᓂᒃ ᓇᓂᓯᕕᖕᒥ ᐃᓅᓯᕐᒧᑦ ᐱᕈᖅᑐᓄᓗ ᐆᒪᔪᓄᓗ ᑕᒫᓂ ᐊᑦᑕᕐᓇᓕᕈᑕᐅᒍᓐᓇᖅᑐᓂᒃ. ᑖᒃᑯᐊ ᖃᐅᔨᓴᕈᑕᐅᔪᔪᑦ ᑕᐃᔭᐅᙵᑕ ᐃᓅᓯᕐᒧᑦ ᐋᓐᓂᐊᕐᓇᖅᑐᖅᑕᐃᓕᕐᑯᓪᓗᒍ ᖃᐅᔨᓴᕈᑕᐅᔪᑦ (HHRA) ᐱᕈᖅᑐᓄᓗ ᐆᒪᔪᓄᓗ ᐊᑦᑕᕐᓇᓕᕈᑕᐅᒍᓐᓇᖅᑐᑦ ᖃᐅᔨᓴᖅᑕᐅᔪᑦ (ERA), ᐃᓪᓗᐊᒍᙳᖅ, ᐅᓂᒃᑳᙱᑦ ᑲᑎᑕᐅᓗᑎᒃ ᑕᐃᔭᐅᓕᖅᑐᑦ ᐃᓅᓯᕐᒧᑦ ᐋᓐᓂᐊᕐᓇᖅᑐᖅᑕᐃᓕᕐᑯᓪᓗᒍ ᐱᕈᖅᑐᓄᑦ ᐆᒪᔪᓄᓗ ᐊᑦᑕᕐᓇᖅᑐᖅᑕᐃᓕᕐᑯᓪᓗᒍ ᖃᐅᔨᓴᕈᑕᐅᔪᑦ (HHERA).

2.0 ᑭᖑᓕᙵᓂ ᖃᐅᔨᓴᕈᑕᐅᔪᑦ ᐊᕙᓗᙵᓄᑦ ᓱᕈᔪᐃᔭᑦᑐᑦ

ᑭᖑᓕᙵᓂ ᖃᐅᔨᓴᕈᑕᐅᓚᐅᖅᑐᑦ ᐊᕙᓗᙵᓄᑦ ᓱᕈᔪᐃᔭᑦᑐᓂᒃ ᓱᓕ ᐱᑦᖃᕐᒪᙶᑦ (ESA) ᓇᓗᓇᐃᔭᐃᓇᓱᐊᖅᓗᑎᒃ ᖃᓄᐃᑦᑑᕆᐊᙱᓐᓂᒃ ᐊᒻᒪᓗ ᐅᔭᕋᒃᑕᕐᓂᐊᕐᕕᒃᕐᓂᙵᓄᑦ ᓱᕈᔫᒃᑕᐅᓪᓗᑎᒃ ᐊᓯᔾᔨᖅᑕᐅᔪᕕᓂᕐᓂᒃ ᓴᓄᓪᒪᖅᓴᐃᓪᓗᑎᒃ ᓱᕚᓕᐅᑕᐅᓗᐊᔫᙱᓪᒪᑕ ᐅᔭᕋᒃᑕᕐᓂᐊᕐᕕᖕᒥ ᐲᔭᖅᑕᐅᓪᓗᑎᒃ ᓴᓇᖅᑯᑎᕕᓃᑦ. ᐊᕙᓗᙵᓄᑦ ᖃᐅᔨᓴᕈᑕᐅᔪᔪᑦ ᐃᓗᓕᖃᓚᐅᖅᑐᑦ ᓴᓇᖅᑯᑎᕐᓗᑯᓂᒃ ᓱᕈᔪᐃᔭᑦᑐᓂᒃ ᓈᓴᐃᓪᓗᑎᒃ ᓚᕙᒪᑎᑐᖃᒃᑯᑦ ᒪᓕᓚᙱᑦ ᐆᒃᑐᕋᐅᑕᐅᓪᓗᑎᒃ ᐊᕙᓗᙵ ᖃᓄᐃᑦᑐᓕᓇᐊᙵᓄᑦ ᐃᓱᒪᓕᐅᕈᑕᐅᓪᓗᑎᒃ. ᐊᕙᓗᙵᓄᑦ ᖃᐅᔨᓴᕈᑕᐅᔪᑦ ᐅᓂᒃᑳᙵ ᐃᓄᖅᓴᕐᓂᖃᓚᐅᕐᒪᑦ.

ᓯᕗᓪᓕᖅᐹᖅ ᓈᓪᒪᙱᔾᔪᑕᐅᓚᐅᖅᑐᖅ ᐅᓂᒃᑳᑉ ᐋᕿᒃᓱᖅᓯᒪᓂᙵ ᐊᒻᒪᓗ ᖃᐅᔨᓴᖅᑎᓄᑦ ᓯᕗᓂᙵᓂ ᑲᑎᖅᓱᖅᑕᐅᔪᕕᓃᑦ ᐅᓂᒃᑲᐅᓯᐅᓂᙱᑦ.

ᐅᑯᐊ ᑕᕙ ᖃᐅᔨᓴᖅᑏᑦ ᐅᓂᒃᑳᙵᑕ ᐃᓗᓕᙵᓃᓚᐅᖅᑐᑦ:

1. ᐱᒋᐊᙵᓚᐅᕈᓯᐊ
   1.1 ᑐᕌᖅᑕᐅᔪᑦ

1.2 ᐃᓕᖅᑯᓯᑐᖃᖏᓐᓄᑦ ᒪᑐᔭᐅᓕᖅᑎᓪᓗᒍ ᐅᑎᖅᑎᑕᐅᒋᐊᓖᓪᓗ ᐸᕐᓇᐃᔭᑕᐅᓯᒪᓂᖏᑦ
1.3 ᑕᒪᐃᑕ ᑕᑯᓪᓗᒋᑦ ᓇᓂᓯᕕᖕᒥ ᐅᔭᕋᒃᑕᕐᓂᐊᕐᕕᒃ, ᓄᓇᓕᖓᓗ ᐊᓯᖏᓪᓗ ᓴᓇᕝᕖᑦ
1.4 ᒪᓕᒋᑎᒍᑦ ᐊᑐᐊᖅᑕᐅᒋᐊᓖᑦ/ᓴᓇᒪᓂᕆᔭᐅᔪᑦ ᑭᓱᑐᐃᓐᓇᓄᑦ

2. ᐅᔭᕋᒃᑕᕐᓂᐊᕐᕕᖃᓚᐅᕐᓇᓂ ᐊᕙᓗᖓᑕ ᖃᓄᐃᓕᖓᓚᐅᕆᓯᐊ
   2.1 ᓯᓚᖓᑕ
   2.2 ᓯᕐᒥᐊᓗᐃᑦ
   2.3 ᑕᒪᑐᒪ ᐅᔭᕋ
   2.4 ᓄᓇᖓᑕ ᐋᕿᒃᓱᖅᓯᒪᓂᐊ
   2.5 ᐃᒪᖓᑕ ᑰᖏᑕᓗ
   2.6 ᐱᕈᖅᑐᖏᑕᓗ
   2.7 ᐃᔾᔪᐃᓪᓗ ᓅᓇᐃᑦ
   2.8 ᐆᒪᔪᐃᑦ ᑕᒫᓂ
   2.9 ᑎᖕᒥᐊᑦ

3. ᐊᕙᓗᖓᑕ ᖃᓄᐃᓕᖓᓂᖓ ᖃᐅᔨᓴᖅᑕᐅᑎᓪᓗᒍ
   3.1 ᐃᒪᐅᑉ ᐃᖅᑲᖓᓄᑦ ᑲᑕᖕᓂᕐᓗᑯᐃᑦ
   3.2 ᓯᓚᖓᑕ ᖃᓄᐃᓐᓂᖓ/ᐳᔫᖃᑦᑕᖅᑐᓂᒃ ᑎᒃᑕᐅᓂᑯᓂᒃ ᐅᔾᔨᖅᓱᕈᑏᑦ
   3.3 ᒪᓂᕋᖓᓂ ᑰᒐᓚᐃᑦ ᐃᒪᕐᓗᐃᑦ ᑕᓯᕐᓗᐃᓪᓗ ᖃᓄᐃᓐᓂᖏᑦ
   3.4 ᐅᔭᕋᖕᓂᒃ ᐊᐅᒃᓯᔭᑦᑐᑦ ᐃᓗᓕᖏᑦ ᓇᒧᖓ ᑰᓲᖑᒪᖕᖓᑕ ᐆᒃᑐᕋᖅᑕᐅᓪᓗᑎᒃ
   3.5 ᓱᕈᔪᐃᔪᓐᓇᖅᑐᓂᒃ ᑯᕕᔪᖃᑐᐃᓐᓇᓇᐊᖃᕐᓂᖓᓄᑦ ᐃᓱᒫᓗᒋᔭᐅᔪᑦ

4. ᐅᔭᕋᒃᑕᕐᓂᐊᕐᕕᖕᒥ ᓴᓇᔭᐅᔪᑦ ᐱᕙᓪᓕᐊᑎᑕᐅᔪᓪᓗ ᐊᐅᓚᑕᐅᔪᓪᓗ
   4.1 ᐅᓂᒃᑲᐅᓯᐅᔪᑦ ᓴᓇᕐᕕᓕᐊᖑᓯᒪᔪᑦ ᐅᔭᕋᒃᑕᕐᓂᐊᕐᕕᖕᒥ ᐱᓕᕆᕖᑦ
   4.2 ᐱᕙᓪᓕᐊᑎᑕᐅᔪᑦ ᖃᖓ ᐱᒋᐊᖅᑎᑕᐅᓚᐅᕐᒪᖔᑕ

5. ᑭᖑᓂᖓᓂ II ᐊᕙᓗᐊ ᖃᐅᔨᓴᖅᑕᐅᔪᖅ
   5.1 ᖃᓄᖅ ᓱᕈᔪᖃᕐᕕᐅᔪᑦ ᖃᐅᔨᓴᖅᑕᐅᖃᑦᑕᕐᓗᑎᒃ ᐅᔾᔨᖅᓱᖅᑕᐅᓂᐊᕐᒪᖔᑕ
   5.2 ᐅᔾᔨᖅᓱᖅᑕᐅᓗᑎᒃ ᕿᒥᕈᔭᐅᖃᑦᑕᕆᐊᓖᑦ ᑕᑯᔭᒃᑐᖅᑕᐅᖃᑦᑕᕆᐊᓖᑦ
   5.3 ᖃᓄᐃᓕᕚᓪᓕᐅᑕᐅᖕᒪᖔᑕ

6. ᓱᕈᔫᒃᑕᐅᓯᒪᔪᑦ ᐊᒻᒪᓗ ᐊᕙᓗᖓᓄᑦ ᐊᒃᑐᐊᓂᖃᖅᑐᑦ ᐃᓱᒫᓗᒋᔭᐅᔪᑦ
   6.1 ᓱᕈᔪᐃᔭᑦᑐᑦ ᐊᕙᓗᖓᓄᑦ ᐃᓱᒫᓗᒋᔭᐅᔪᑦ
   6.2 ᓄᓇᐃᑦ ᐊᑦᑕᕐᓇᖅᑐᖃᓕᕆᐊᖏᓐᓂᒃ ᐃᓱᒫᓗᒋᔭᐅᔪᑦ

ᐃᓪᓗᐊᒍᖖᖅ ᑕᑯᓪᓗᒋᑦ, ᖃᐅᓕᓴᖅᑎᓄᑦ ᐅᓂᒃᑳᓕᐅᖅᑕᐅᓲᑦ ᐊᑐᐊᒐᖏᑦ ᒪᓕᒃᑕᐅᒐᓗᐊᕐᒪᖔᑕ ᑲᓇᑕᒥ ᒥᑭᓐᓂᖅᑳᒥᒃ ᒪᓕᒐᓂᒃ ᐊᑐᖅᑕᐅᑎᑦᑎᔩᑦ ᑲᑐᔾᔨᖃᑎᒌᖏᓐᓄᑦ (CSA) ᐅᖃᐅᓯᐅᔪᔪᑦ ᐅᑯᐊᖑᔪᑦ:

- ᐱᒋᐊᖓᓚᐅᕆᓯᐊᓂᒃ ᐅᓂᒃᑳᑦ (ᐃᓗᓕᖏᑦ ᐅᑯᐊ 1.1, 1.2 ᐊᕙᓗᖓᑕ ᖃᓄᐃᓕᕐᓂᖓᓄᑦ ᖃᐅᔨᓴᕈᑏᑦ ESA ᐃᓗᐊᓂ)
- ᖃᓄᐃᓕᐅᓚᐅᕆᓯᖏᑦ (ᐅᑯᐊ ᐃᓚᐅᓪᓗᑎᒃ ᑐᓴᐅᒪᔭᐅᒋᐊᓖᑦ ᑲᑎᖅᓱᖅᑕᐅᓯᒪᔪᓪᓗ ᖃᐅᔨᓴᖅᑎᓄᑦ ᓈᓴᖅᑕᐅᓯᒪᔪᑦ ᖃᓄᐃᓐᓂᖓᓄᑦ ᐆᒃᑐᕋᐅᑏᑦ ᑭᖑᓂᖓᓂ II ᐊᕙᓗᓕᓇᔪᑎᓄᑦ ᖃᐅᔨᓴᕈᑏᑦ ᔪᓚᐃ, 2002, ᑕᑯᔭᐅᔪᓐᓇᖅᑐᑦ ᐃᓚᖓ 1.3, 1.4, 2.1 2.9-ᒧᑦ 3.4, ᐊᒻᒪᓗ 4.1 4.2)
- ᒪᓂᕋᖓᓂᒃ ᖃᐅᔨᓴᕈᑏᑦ ᖃᓄᐃᓕᐅᕈᑕᐅᓚᐅᕐᒪᖔᑕ (ᐅᑯᓇᓃᑦᑐᑦ 1.5 ᐊᒻᒪᓗ 5.1)
- ᖃᐅᔨᔭᐅᔪᔪᑦ (ᐅᑯᐊ ᐃᓚᐅᔪᑦ ᑲᑎᖅᓱᖅᑕᐅᔪᕕᓃᑦ ᖃᐅᔨᓴᖅᑎᓄᑦ ᐊᕙᓗᓕᓇᔪᑎᓂᒃ ᐅᓂᒃᑳᓕᐅᕐᓂᐊᖅᓱᑎᒃ ᔪᓚᐃ 2002-ᒥ ᑕᑯᔭᐅᔪᓐᓇᖅᑐᑦ ᐃᓚᖓ 5.2 ᐊᒻᒪᓗ 5.3-ᒥ)
- ᖃᐅᔨᓴᕈᑕᐅᔪᕕᓃᑦ ᐃᓱᒪᓕᐅᕈᑕᐅᓪᓗᑎᒃ ᑐᑭᑖᕈᑕᐅᓪᓗᑎᓪᓗ (ᐃᓗᓕᐊᓃᑦᑐᑦ 3.5, 5.3, 6.1 ᐊᒻᒪᓗ 6.2 ᐊᒻᒪᓗ ᑲᑎᖅᓱᖅᑕᐅᔪᕕᓃᑦ ᓈᓴᖅᑕᐅᔪᕕᓃᓪᓗ ᑐᑭᓕᐅᖅᑕᐅᓪᓗᑎᒃ ᑐᓴᖅᑎᑦᑎᔪᑕᐅᔪᔪᑦ ᔪᓚᐃ 2002-ᒥ ᐅᖃᐅᓯᖃᕐᒪᑕ ᓯᕗᓂᖓᓂ ᑲᑎᖅᓱᖅᑕᐅᔪᕕᓂᕐᓂᒃ.

- ᐃᓱᒪᓕᐅᕈᑕᐅᔪᑦ ᑐᑭᑖᕈᑕᐅᔪᓪᓗ (ᑖᓐᓇ ᐅᓂᒃᑳᖓᓂ ᐱᑕᖃᕐᒥᒪᑦ ᑕᐃᒫᒃ ᒫᓐᓇ ᐊᕙᑐᓕᕆᔪᑎᓂᒃ ᖃᐅᔨᓴᕈᑏᑦ ᐋᖅᑭᒃᓱᖅᓯᒪᑎᓪᓗᒍ)
- ᐊᔪᖏᓐᓂᖏᑦ ᖃᐅᔨᓴᖅᑏᑦ ᐅᔾᔨᖅᓱᖅᑎᐅᕆᐊᖅ ᑕᒪᒃᑯᓂᖓ (ᑖᓐᓇᑦᑕᐅᖅ ᐱᑕᖃᕐᒥᒪᑦ ᒫᓐᓇ ᐊᕙᑐᓕᕆᔪᑎᓂᒃ ᖃᐅᔨᓴᕈᑏᑦ ᐅᓂᒃᑳᖓᓂ)
- ᖃᐅᔨᒪᓂᖏᓐᓄᑦ ᓱᓕᓂᕋᐅᑕᐅᓲᑦ ᐅᓂᒃᑳᑦ ᐃᓕᓴᖅᓯᒪᓂᖏᓐᓄᑦ ᓇᑐᓇᐃᒃᑯᑕᐃᑦ
- ᐃᓚᒋᐊᕈᑏᑦ

ᓈᒻᒪᓈᖅᓯᓚᐅᖏᒻᒥᔪᖅ ᐅᓂᒃᑳᖓᓂ ᐊᑲᐅᖏᒻᒪᑦ ᑕᐃᔭᐅᔪᓯᐊ ᓇᑐᓇᐃᔭᐃᓪᓗᑎᒃ ᓄᓇᑕᖓᑕ ᒪᓂᕋᖓᓂ ᓄᓇᑐᐃᓐᓇᐅᓂᕋᐃᓚᐅᕐᒪᑕ ᓇᓂᓯᕕᖕᒥ "ᐃᔾᔪᖃᐅᕐᓂᖓᓂᒃ" ᑭᖑᒻᒧᑦ ᖃᐅᔨᓴᖅᑎᕙᓂᕐᒥᒃ ᑕᐃᓯᓪᓗᑎᒃ ᐱ.ᓯᒥ ᖃᐅᔨᓴᖅᑎᒥᒃ ᐃᔾᔫᓂᖃᐅᕐᓂᕋᐃᖏᒻᒪᑕ ᓇᓂᓯᕕᖕᒥ ᒪᓂᕋᖓᓂ. ᑕᒪᑐᒪ ᒪᓂᕋ "ᐃᔾᔫᓂᖃᖏᑉᐸᑦ" ᑕᐃᒪ ᓄᓇᐅᓂᕋᖅᑕᐅᔪᓐᓇᖅᐹ? ᐅᓄᖅᑐᓂ ᑐᑭᓕᐅᖅᑕᐅᓯᒪᔪᓂᒃ ᕿᓂᓚᐅᕋᑦᑕ "ᐃᔾᔪᐃᑦ" ᖃᓄᖅ ᑐᑭᖃᖅᑎᑕᐅᖕᒪᖔᑦ ᐅᖃᓕᒫᓗᓂ ᐃᓕᓴᐃᔪᑎᓂᒍ ᕿᓂᖅᓱᑕ ᓚᕙᒪᑎᑐᖃᒃᑯᑦ ᑐᑭᓕᐅᖅᓯᒪᔭᖏᓐᓂᒃ ᖃᐅᔨᓴᖅᑎᓄᑦ ᐆᒃᑐᕋᐅᑕᐅᓪᓗᑎᒃ ᐊᑐᖅᑕᐅᖃᑦᑕᖅᑐᓂ ᐅᖃᐅᓯᕐᓂᒃ. ᒪᓂᕋᖓ ᓇᓂᓯᕕᖕᒥ ᑐᑭᓕᐅᖅᑕᐅᓯᒪᔪᓂ ᖃᓪᓗᓈᓂ ᓄᓇᖓᓂᒃ ᐅᓂᒃᑳᖅᑐᓂᒃ ᐊᔾᔨᒋᖏᒻᒪᔪ.

ᑕᒪᓐᓇ ᓄᐃᑦᑐᖃᕈᑕᐅᓕᓚᐅᕐᒥᖕᒪᑦ ᐊᐱᖅᑯᑕᐅᔪᓐᓇᖅᑐᒥᒃ. ᐊᕙᑐᕗᑦ ᓱᕈᔪᑉᑕᐅᑦᑕᐃᓕᖅᑯᓪᓗᒍ ᐊᑐᐊᒐᐃᑦ ᐃᓱᒪᓕᐅᕈᑕᓚᐅᖅᑐᑦ ᓯᕗᓂᖓᓂ ᖃᓄᐃᓕᐅᕈᓯᖓᓂᒃ ᐃᖅᑲᖅᑐᐃᔾᔪᑎᖃᕐᓗᑎᒃ ᓱᕈᔫᑕᐅᓯᒪᔪᓂᒃ ᒪᓂᕋᖓᓂ ᓇᓂᓯᕕᖕᒥ "ᐃᔾᔪᖅᑐᓂᒃ" ᓇᑐᓇᐃᔭᐃᓪᓗᑎᒃ ᖃᐅᔨᓴᖅᑏᑦ ᐅᓂᒃᑳᖓᓂ ᓄᓇᐃᑦ ᖃᓄᐃᑦᑑᓲᖑᓂᖏᓐᓂᒃ ᓚᕙᒪᑎᑐᖃᒃᑯᓪᓗ ᓂᕿᒃᓴᓄᑦ ᐱᕈᖅᓰᕙᐅᓰᓂ ᓄᓇᓄᑦ ᒪᓕᒐᓕᐊᓇᓯᒪᔭᖏᓐᓂᒃ ᐆᒃᑐᕋᐅᑎᖃᐅᕐᒥᔪᑦ (ᖃᓪᓗᓈᑦ ᓄᓇᖓᓂ ᐃᔾᔪᕐᓂᐅᓲᓄᑦ ᐊᑐᐊᒐᖏᓐᓂᒃ ᐆᒃᑐᕋᐅᑎᖃᐅᕐᒪᑕ). ᐅᔭᕋᑦᑕᕐᓂᐊᕐᕕᐅᑉ ᑭᖑᓂᖓᒍᑦ ᓄᓇ ᐊᑐᖅᑕᐅᓕᕋᔭᖅᑐᖅ ᐅᑎᖅᑎᑕᐅᕐᑯᓪᓗᒍ "ᐅᑭᐅᖅᑕᖅᑐᒥ ᐃᓄᐃᓕᕐᒥ ᓄᓇᑐᑦ." ᑭᓯᐊᓂᓕ, ᑲᓇᑕᒥ ᐊᑐᐊᒐᖃᕐᒪᑕ ᖃᓄᖅ ᓱᕈᔪᐃᔭᑦᑐᑦ ᓄᓇᒥᒃ ᐅᑭᐅᖅᑕᖅᑐᒥ ᑲᒪᒋᔭᐅᕆᐊᖃᕐᒪᖔᑕ. ᑕᐃᒪᐃᓐᓂᖓᓄᑦ ᑕᕝᕙ, ᐊᑐᐊᒐᓇᔭᐅᔪᑦ ᓄᓇᖓᑕ ᐃᔾᔫᓂᖃᕐᓂᖓᓂ ᖃᓄᐃᑦᑑᓂᓂᑐᑦ ᐱᕈᖅᓰᕕᑦ ᓄᓇᐃᑦ ᐊᑐᐊᒐᖏᓐᓂᒃ ᑕᒫᓂ ᐱᑕᖃᕐᒥᒪᑦ ᐊᓯᐃᓛᒃ ᐊᑐᐊᒐᖃᓕᓚᐅᖅᑐᑦ ᒥᓐᖑᐃᖅᓯᕙᓕᓇᔪᑏᑦ ᐊᑐᐊᒐᖏᓐᓂᒃ/ᐃᒡᓗᖃᕐᕕᐅᔪᓪᓗ ᓄᓇᐃᑦ ᐊᑐᐊᒐᖏᓐᓂᒃ ᓯᕗᓂᖓᓂ ᐃᓕᖅᑯᓯᑐᖃᕐᓂᖓᓄᑦ ᐅᑎᖅᑎᑕᐅᕆᐊᓕᖕᓂᒃ ᐃᖅᑲᖅᑐᐃᔾᔪᑕᐅᔪᔪᑦ ᖃᐅᑎᒋ ᓱᕈᔪᒃᑕᐅᓂᑰᖕᒪᖔᑦ ᐃᓱᒪᓕᐅᕈᑕᐅᓇᓱᐊᖅᑎᓪᓗᒍ ᖁᑎᒃᑐᒥᐅᑦ ᓄᓇᖓᓂ ᓇᓂᓯᕕᖕᒥ.

ᐊᕙᑐᕗᑦ ᖃᐅᔨᓴᕈᑕᐅᔪᓂ ᓇᑐᓇᐃᖅᓯᓚᐅᖅᑐᑦ ᓱᕈᔪᒃᑕᐅᑐᐃᓐᓇᕐᓇᓚᖓᓂᒃ ᐃᓱᒫᓗᒋᔭᐅᔪᓂᒃ ᑕᐃᒪᐃᓕᖅᑎᑕᐅᓂᖅᑕᐅᔪᓂᒃ ᐅᔭᖅᑕᕐᓂᐊᕐᕕᖅᓚᐅᕐᓂᖓᓄᑦ ᑕᒫᓂ ᐅᑭᐅᓂᒃ 25-ᓂᒃ. ᐅᑯᐊ ᑕᒃᑯ ᓱᕈᔭᐃᔭᖅᑐᑦ ᑕᒪᐅᖓ ᑯᕕᓯᒪᓂᑰᔪᑦ ᑲᑎᖅᓱᖅᑕᓚᐅᖅᑐᑦ ᐊᑐᓂ ᓇᑐᓇᐃᒃᑯᑎᖅᓱᖅᑕᐅᓪᓗᑎᒃ ᐃᒫᒃ:

- ᐃᑭᓴᐃᑦᑐᑦ ᐅᕐᓱᐊᓗᑭᔭᐃᑦ ᐃᑯᒪᓕᐅᕈᑕᐅᓲᑦ
- ᐲᔭᖅᑕᐅᕆᐊᓖᑦ ᐅᐊᕆᑎᓯᒪᔪᑦ ᐅᕐᓱᐊᓗᑭᔭᐃᑦ ᐃᑭᓴᐃᑦᑐᑦ (ᒪᑯᐊ ᕚᓯᑦ ᒪᓂᓴᐅᑉ ᐃᓗᐊᓃᑦᑐᑦ ᐃᑲᒃᓴᐅᑎᓖᑦ)
- ᑕᓇᐅᕐᒧᑦ ᐅᐊᕆᑎᓯᒪᔪᑦ ᐃᑲᒃᓴᐅᑏᑦ ᐅᔭᕐᑦ ᓴᕐᓇᖅᑐᑦ; ᐊᒻᒪᓗ
- ᐃᑎᐅᑎᓯᒪᔪᑦ ᓴᕕᕐᔭᒃᓴᔭᓂᒃ ᐅᔭᕐᑦ (ᐱᓗᐊᖑᐊᖅᑐᒥᒃ ᑳᓂᐊᒻᑳᑦᑐᑦ, ᐅᓗᒃᓴᔭᒥᓗ, ᔾᔮᒃ, ᖃᕐᔭᒃᓴᔮᓪᓗ).

ᓱᖑᒪᑦ ᑕᒪᒃᑯᐊ ᐅᔭᕐᑦ ᓴᕐᓇᖅᑐᑦ ᕚᓯᓂᓗ ᐃᓗᓕᖅᖅᑐᑦ ᐃᓱᒫᓗᕆᔭᐅᕆᐊᖃᕐᒪᖔᑕ ᐅᓂᒃᑳᖅᓯᒪᓕᐅᖏᒻᒪᑦ ᑖᕙᓂ ᐊᕙᑐᓕᕆᔪᑏᑦ ᐅᓂᒃᑳᖅᓯᓂ. ᓱᓕᓪᓗᖓ, ᐅᖃᐅᓯᐅᓯᒪᖏᑦᑎᐊᒻᒪᕆᖓᒪᑦ ᑕᒪᒃᑯᐊ ᑕᓇᐅᕐᒧᑦ ᐅᐊᕆᑎᓯᒪᔪᑦ ᐃᑲᒃᓴᐅᑏᑦ. ᐊᒻᒪᓗᑦᑕᐅᖅ, ᑭᓱᑐᐃᓐᓇᐃᑦ ᖃᓄᐃᑦᑑᑎᒍᑦ ᐃᓗᓕᖅᑲᕆᐊᖏᓐᓂᒃ ᐆᒃᑐᖅᑎᓄᑦ ᓈᓴᖅᑕᐅᓯᒪᔪᓂᒃ ᐱᑕᖃᖏᒻᒪᑦ. ᐅᖃᐅᓯᐅᓯᒪᖏᒪᑦ ᕚᓯᒥᒃ ᐳᔪᖃᑦᑕᕐᓂᖏᑦ ᐃᑲᒃᓴᐅᑎᒥᒃ ᐅᐊᕆᑎᓯᒪᕙᐅᔪᓂᑦ xanthate-ᒥᒃ. ᑭᓯᐊᓂᓕ, ᐊᓯᑎᓐᓂᑦ ᐆᒃᑐᕋᐅᑕᐅᔪᓐᓇᖅᑐᒥᒃ ᐱᔪᕙᓂᕐᒥᒃ ᐊᔾᔨᒋᔭᖃᓚᐅᖏᒻᒪᑦ ᐃᓗᓕᖏᑦ ᓴᓇᒪᓂᖏᓐᓂᒃ ᓴᕕᕐᔭᒃᓴᑦ ᑕᐃᔭᐅᒍᓯᕆᓚᒃᑕᖏᓐᓂ ᑕᐃᒪᐃᑦᑐᒥᒃ ᐱᑕᖃᕐᒪᑕ ᐃᒡᓗᐊᒍᖕᖓᖅ ᑐᓴᐅᒪᕙᕆᔭᐅᓇᖅᑕᑎᓐᓂᒃ. ᑕᐃᒪᐃᓐᓂᖓᓄᑦ ᑕᕝᕙ, ᑕᒪᑐᒥᖓ ᐃᑲᔪᖅᓱᕈᑕᐅᔭᐅᓇᖅᑐᒥᒃ ᐅᓂᒃᑳᖃᕐᓕᖅ ᓇᑐᓇᐃᔭᐃᔭᑕᐅᒐᔭᖅᑐᒥᒃ ᐅᔭᕋᐃ ᕚᓯᒥᒃ ᑕᓇᐅᓕᕐᒥᒃ ᐅᐊᕆᑎᓯᒪᔪᓂᒃ ᐃᑲᒃᓴᐅᑎᓂ ᐊᑦᑕᕐᓇᕈᑕᐅᓇᔭᕐᒪᖔᑕ ᓱᕈᐃᒐᔭᓇᐊᕐᓕᖅᑐ ᑕᒪᑐᒪ ᐊᕙᑐᕗᑦ.

ᐃᓚᒃ ᓇᓗᓇᕐᑐᖁᓗᐊᖅ ᓇᓂᓯᕕᐅᑉ ᓄᓇᖓᓂ ᐅᕐᓱᐊᓗᕈᔭᖕᓂᒃ ᑯᑉᐱᕕᐅᓯᒪᔪᓂ ᐱᑕᖃᐅᕐᒪᑦ ᓱᕈᔫᑕᐅᓯᒪᓕᕐᓂᖓ ᑕᑯᒃᓴᐅᔪᓂ, ᑕᒪᐃᑕᓕᒫᕐᓕ ᒪᓂᕋᖓᓄᑦ ᓱᕈᔭᐃᓯᒪᖕᒪᑕ ᑭᓂᖅᑐᓄᑦ ᐅᕐᓱᐊᓗᖕᓄᒃ ᖃᑦᑕᐅᔦᕐᔭᐊᖃᕐᕕᓂ. ᑖᒃᑯᐊ ᓱᕈᔫᑕᐅᓯᒪᔪᑦ ᑕᒪᑐᒥᖓ ᒪᓂᕋᖓᓂᒃ ᑭᓯᐊᓂ "ᓇᔪᖅᑕᖏᓐᓂ" ᓱᕈᔭᐃᓂᕋᖅᑕᐅᔭᖕᒪᑦ. ᓴᕕᕋᔦᒃᓴᖃᕐᕕᐅᔪᑦᑕᐅᖅ "ᓇᔪᖅᑕᖏᓐᓂ" ᒪᓂᕋᓂ ᑭᓯᐊᓂᑐᐊᖅ ᒥᑭᔪᒥᒃ ᓱᕈᔭᐃᓂᕋᖅᑕᐅᒋᓪᓗᑎᒃ.

ᐃᓚᖏᓚᒃ ᓇᓗᓇᐃᔭᑦᑎᐊᖅᓯᒪᔪᒥᒃ ᖃᓄᐃᓕᕐᓂᖏᓐᓄᑦ ᐅᓂᒃᑳᖅᑐᖅᖃᖅᓯᒪᓚᐅᖏᓪᒪᑦ ᓱᕈᔫᑕᐅᔪᕕᓂᕐᓂᒃ ᐅᔭᕋᒃᑕᕐᓂᐊᕐᕕᖓᒥ, ᓄᓇᓕᖓᓂ ᓇᓂᓯᕕᐅᑉ ᑐᓚᒃᑖᕕᖓᓂᓗ ᓯᒡᔭᖓᓂ ᐊᕙᓗᓕᕆᔪᑏᑦ ᐅᓂᒃᑳᖓᓂ, ᑭᓯᐊᓂᓕ ᐃᒪᖄᖅ ᐅᖃᐅᓯᐅᓚᐅᕐᒪᑕ ᑕᒪᑐᒪ ᓯᓚᑎᖓᓄᑦ ᓱᕈᔫᑕᐅᔪᑦ ᐊᒃᓱᓗᐊᖑᖏᓐᓂᕋᖅᑕᐅᓪᓗᑎᒃ. ᑖᓐᓇ ᒪᓕᒃᑯᓂ ᑕᐃᓱᒪᓂ ᐅᓂᒃᑳᓕᐊᕕᓂᕐᓂᒃ 1992-ᒥ ᓇᓂᓯᕕᖓᒥ ᖃᓄᑎᒋ ᓴᕕᕋᔦᒃᓴᔭᐃᑦ ᐊᕙᓗᖓᓄᑦ ᐃᑦᑎᑎᖅᓯᒪᓂᖏᓐᓄᑦ ᐅᓂᒃᑳᖓᓂ ᐅᖃᐅᓯᐅᓚᐅᖅᓯᒪᔪᓂᒃ "ᐆᒃᑐᕋᐅᑕᐅᓪᓗᑎᒃ" ᓱᕈᔭᐃᔪᑦ "ᒥᑭᔪᒥᒃ."

3.0 ᕿᒥᕈᔭᐅᓪᓗᑎᒃ ᐃᓅᓯᕐᒧᑦ ᐊᑦᑕᕐᓇᕈᑕᐅᔾᔭᖅᑐᑦ ᖃᐅᔨᓴᖅᑕᐅᔾᔪᑎᖏᑦ

ᐃᓅᓯᕐᒧᑦ ᐊᑦᑕᕐᓇᕈᑕᐅᔭᓇᖅᑐᑦ ᐊᒻᒪᓗ ᐱᕈᖅᑐᓄᑦ ᐆᒪᔪᓄᓪᓗ ᖁᐊᖅᓵᕐᓇᖅᑐᑦ ᖃᐅᔨᓴᖅᑕᐅᔾᔪᑎᖏᑕ ᐅᓂᒃᑳᖓ (HHERA) ᐋᕿᒃᓱᖅᑕᐅᔪᕕᓂᖅ ᓯᕗᓂᖓᓂ ᓇᓚᐅᑦᑖᕈᑕᐅᓇᓱᐊᖅᓗᓂ ᓄᓇᖓ ᓱᕈᔫᑕᐅᒃᐸᑦ ᖃᓄᐃᑎ ᓇᓂᓯᕕᖓᒥ ᐆᒪᔪᓄᑦ ᐃᓅᓯᕐᒧᓪᓗ ᐋᓂᐊᖃᕐᓇᕋᔭᕐᒪᖔᑕ ᓴᓇᖅᑯᑎᕕᓃᑦ ᐃᓄᖕᓄᑦ ᐊᕙᓗᖓᓄᓪᓗ. AMEC-ᑯᑦ ᐊᕙᓗᓕᕆᔩᖏᑦ ᕿᒥᕈᑎᑕᐅᓚᐅᖅᑐᑦ ᐊᕙᓗᓕᕆᔪᑏᑦ ᐅᓂᒃᑳᖓᓂᒃ HHERA ᓇᓚᐅᑦᑖᕈᑕᐅᓯᒪᔪᑦ ᓈᒻᒪᓈᖅᓯᒪᓗᐊᕐᒪᖔᑕ ᑐᑭᓯᓇᓱᐊᕐᑯᔦᐅᓪᓗᑎᒃ ᐊᑦᑕᕐᓇᕈᑕᐅᓇᔭᖅᑐᓂᒃ ᓈᓯᓪᓗᑎᒃ ᑕᒪᐃᓐᓂᒃ ᖃᐅᔨᓴᕈᑎᖃᓚᐅᕋᓗᐊᓇᐊᖏᓐᓂᒃ. ᐃᓅᓯᕐᒧᑦ ᐊᑦᑕᕐᓇᕈᑕᐅᔭᓐᓇᖅᑐᓂᒃ ᖃᐅᔨᓴᖅᑏᑦ ᐆᒃᑐᖅᑎᐅᖕᒪᑕ ᑭᓱᑐᐃᓐᓇᐃᑦ ᑕᒫᓂ ᐱᑕᖃᖅᑐᑦ ᖃᓄᑎᒋ ᖁᐊᖅᓵᓇᔭᐅᒋᐊᖃᕐᒪᖔᑕ ᑐᑭᓕᐅᕐᑯᔦᐅᓪᓗᑎᒃ ᓯᓚᑖᓂᑦ ᑕᐅᑐᒡᓗᒍ ᐃᓱᒪᓕᐅᖅᑎᒋᔭᐅᓚᐅᖅᑐᑦ. HHERA ᐅᓂᒃᑳᖓ ᐊᑐᖅᑕᐅᖃᑦᑕᓚᐅᖅᑐᖅ ᐊᒥᓱᓄᑦ ᑲᕙᒪᑎᒃᑯᓐᓂ ᐆᒃᑐᕋᐅᑕᐅᓪᓗᑎᒃ ᐊᔾᔨᒌᖏᑦᑐᓄᑦ ᒪᑯᓇᓂ ᓂᕿᓄᑦ ᐃᓅᓕᓴᐅᑎᓄᓪᓗ ᖃᓄᑎᒋᓗ ᓱᕈᔫᑕᐅᓯᒪᔪᑦ ᓴᓗᒻᒪᖅᓴᖅᑕᐅᒋᐊᖃᕐᒪᖔᑕ. ᒫᓇ HHERA ᐅᓂᒃᑳᖅᓯᒪᖕᒪᑦ ᖃᓄᑎᒋ ᐊᑐᓂ ᐃᒃᐱᓐᓇᕐᓂᖃᕈᓐᓇᕐᒪᖔᑕ ᓯᕕᑐᐊᔪᑦ, ᐊᑯᓂᓗᐊᖅ ᑕᒫᓂ ᓴᓇᖅᑯᑎᓂᒃ ᐊᒃᑐᐊᔭᕕᓂᕐᓄᑦ, ᑕᐃᓱᒪᖓᓂᓂᑦ ᖃᐅᔨᒪᔭᐅᕙᓕᖅᑐᓂᒃ ᐃᓅᓯᓕᒫᕐᒧᑦ ᐆᒃᑐᕋᐅᑎᓯᒪᔪᓂᒃ ᐱᑕᖃᖏᓪᒪᑦ. ᐊᑦᑕᕐᓂᖏᑦ ᐆᒃᑐᕋᐅᑕᐅᓚᐅᖅᑐᑦ ᒪᓂᕋᒦᑦᑐᑦ ᐊᑐᖅᓱᒋᑦ ᓄᓇᐅᑉ ᐃᔾᔭᖓᑕ ᓴᓇᒪᓂᖓᓄᖓᑦ ᐊᑦᑕᕐᓇᓕᕈᓐᓇᕐᓂᖏᑦ ᐃᓕᖅᑯᓯᑐᖃᕐᓄᑦ ᐅᑎᖅᑎᑕᐅᒍᒪᒍᑎᒃ ᓄᓇᒥ ᓱᕈᔫᒃᓯᒪᔪᑦ.

HHERA-ᒥ ᑐᑭᑖᕈᑕᐅᔪᑦ ᐊᑦᑕᕐᓇᖅᑐᖃᖅᑐᓂᒃ ᐅᔭᕋᒃᑕᕐᓂᐊᕐᕕᕕᓂᒥ ᐆᒃᑐᕋᐅᑎᖃᖅᓗᑎᒃ ᐱᖓᓱᓂᒃ ᖃᐅᔨᓴᕈᑕᐅᔪᕕᓂᕐᓂᒃ ᐃᓱᒪᒋᓪᓗᒍ ᓯᕗᓂᖓᓂ ᑭᓱᒧᑦ ᓄᓇ ᑕᒪᓐᓇ ᐊᑐᖅᑕᐅᒃᑲᓐᓂᕈᒪᓕᓪᒪᖔᑦ ᐃᒻᒪᖄ ᓄᓇᓕᖅᑲᕐᕕᐅᓗᓂ, ᑐᓚᒃᑖᕕᐅᓗᓂ, ᐅᔭᕋᒃᑕᕐᓂᐊᕐᕕᐅᓗᓂᓗ. HHERA ᐅᓂᒃᑳᖓᓂ ᐅᖃᓚᐅᕐᒪᑕ ᐊᑐᖅᑕᐅᒃᑲᓐᓂᕈᓐᓇᕐᓂᖅᓴᐅᓗᓂᔾᔪ ᓄᓇᐃᑦ ᒪᑯᐊ ᑐᓚᒃᑖᕕᒃᑲᖅᕕᒃ ᓯᕐᓗᐊᖃᕐᕕᐅᓗᑎᒃ ᐃᒪᕐᒥ ᐱᓂᕐᓗᒃᑐᖃᕐᓂᖅᐸᑦ ᑐᐊᕕᖅᑐᒥᒃ ᐸᖅᓴᐃᕈᓄᑦ ᐸᕐᓇᐃᔭᖅᑕᐅᓯᒪᔪᓂᒃ ᐅᖅᓴᒃᓴᖅᕕᐅᓗᓂᓗ. ᐊᑐᖅᑕᐅᒃᑲᓐᓂᕈᓐᓇᕐᒪᑦ. ᑕᒪᓐᓇ ᐃᓚᓴᖅᕕᐅᓗᓂ ᐅᖃᐅᔨᑦᑐᓂᒃ ᓴᓇᖅᑯᑎᓂᒃ ᐊᐅᓚᑦᑎᔨᐅᓂᕐᒥᒃ, ᓴᓇᔨᐅᓂᕐᒥᒃ, ᐊᒻᒪᓗ ᐃᖅᑲᓇᐃᔭᓂᒃ ᐊᔾᔨᒌᖏᑦᑐᓂᒃ ᐊᒻᒪᓗ ᐊᑐᖅᑕᐅᒃᑲᓐᓂᕈᓐᓇᕐᒥᔭᖅ ᐅᓇᑦᑐᖅᓴᓄᑦ ᐃᓚᓴᕐᕕᐅᓗᓂ. ᓄᓇᓕᖕᓕ, ᒪᕿᖕᓂᒃ ᖃᓄᖅᑑᕈᑕᐅᓚᐅᕐᒥᔭᖅ ᓱᕐᑎᖅᑕᐅᔭᖕᓇᖅᑐᖅ ᐅᑉᐸᓘᓐᓃᑦ ᓄᒃᑎᖅᑕᐅᔭᖕᓇᖅᑐᑦ ᐊᓯᖓᖏᓐᓄᑦ ᓄᓇᓕᖁᑎᒋᔭᐅᓕᕐᓗᓂ ᑎᒥᖁᑎᒋᔭᐅᔪᓄᑦ ᐊᑐᖅᑕᐅᒃᑲᓐᓂᕈᓐᓇᖅᑐᖅ.

ᑖᓐᓇ HHERA ᐅᓂᒃᑳᓕᐅᖅᑕᐅᓯᒪᑦ ᐊᒥᓱᓂᒃ ᑲᑎᖅᓱᐃᓪᓗᑎᒃ, ᓱᓕᔪᒥᒃ ᐊᑐᕐᓂᖃᕈᓐᓇᖅᑐᑦ ᐃᔭᐊᖅᑕᐅᔪᒥᓇᖅᑐᓂᒃ ᓈᓴᖅᑕᐅᓯᒪᔪᓂᒃ ᑕᐃᓯᓪᓗᑎᒃ HHERA-ᒥᑦ ᐱᔭᐅᓗᑎᒃ. JWEL-ᑯᑦ ᕿᒥᕈᓚᐅᕐᒪᑕ 20%-ᑐᐃᓐᓇᖑᓐᓂᒃ ᓈᓴᖅᑕᐅᓯᒪᔪᑦ. ᑭᓯᐊᓂᓕ, AMEC-ᑯᑦ ᐊᑐᓕᖅᑎᑕᐅᖁᔨᓯᒪᖕᒪᑕ 100% ᕿᒥᕈᔭᐅᓚᐅᖅᑎᓪᓗᒋᑦ ᓈᓴᖅᑕᐅᓯᒪᔪᑦ ᓱᓕᓗᐊᕐᒪᖔᑕ ᑕᐃᒫᒃ ᑐᑭᑖᕈᑕᐅᔪᑦ ᑭᖑᓪᓕᖅᐸᒥ ᓱᓕᔪᓇᔭᐅᔪᓐᓇᕐᓂᐊᕐᒪᑕ.

ᕿᒥᕈᔾᔨᐅᑎᓪᓗᒋᑦ HHERA, AMEC-ᑯᓐᓄᑦ ᓇᓂᓯᓚᐅᕐᒪᑕ ᐊᒥᓱᓂᒃ ᐃᓄᖕᓴᖕᑐᓂᒃ ᓇᓗᓇᐃᔭᖅᑕᐅᒃᑲᓐᓂᕆᐊᓕᖕᓂᒃ. ᐅᑯᐊ ᐃᓚᐅᑎᓪᓗᒋᑦ:

- ᐅᓂᒃᑳᓕᐅᖅᑕᐅᕆᐊᓖᑦ ᓈᓴᖅᑕᐅᓯᒪᔪᑦ ᐊᑐᖅᑕᐅᔪᑦ;
- ᓇᓗᓇᐃᔭᐃᓗᑎᒃ ᑭᓱᓂᒃ HHERA ᐆᒃᑐᕋᐅᑎᖃᓚᐅᕐᒪᖔᑕ ᑕᒫᓂ ᓱᓇᒃᑯᑖᑦ ᐃᓗᓕᖕᒋᓐᓂᒃ ᖃᐅᔨᓴᖅᑏᑦ ᒥᑭᓐᓂᖅᐹᒥᒃ ᐊᑐᐊᖅᑕᐅᕆᐊᓕᖕᖑᑦ ᐆᒃᑐᕋᐅᑎᕆᖃᑦᑕᖅᑕᖕᒋᓐᓂᒃ;
- ᐅᓂᒃᑳᕐᓗᑎᒃ ᓱᖕᒪᑦ ᐋᕐᓯᓂᒃ ᓴᕕᕋᔭᒃᓴᓂᑦ ᐲᔭᖅᑕᐅᓲᖅ ᐊᒃᑕᕐᓗᑯ ᐱᑕᖃᕐᓂᖕᖓ ᐆᒃᑐᖅᑕᐅᓚᐅᖕᒋᒻᒪᖔᑦ;
- ᐅᓂᒃᑳᕐᓗᑎᒃ ᓱᖕᒪᑦ ᓕᑦᐊᖅᑯᑦ ᕗᖕᖃᖅᑐᓪᓗ ᓴᕕᕋᔭᕈᔪᐃᑦ ᐱᕈᖅᓴᔪᓄᑦ ᐊᑦᑕᕐᓇᕐᓂᖃᖅᑐᑦ ᓂᐅᖅᓯᔭᐅᔫᓇᕐᓂᖕᒋᓐᓄᑦ ᓄᑕᕋᓛᓄᑦ ᑕᒫᓂᕐᒥᐅᓄᑦ ᑐᓴᖅᑕᐅᑎᑕᐅᕆᐊᖃᖅᑐᑦ;
- ᐅᓂᒃᑳᕐᓗᑎᒃ ᓱᖕᒪᑦ ᑕᒫᓂ ᓄᑕᕋᓛᑦ ᓄᓇᕋᖅᑐᕐᖃᑦᑕᖕᒋᓐᓂᖅᓴᐅᓂᖕᒋᓐᓄᑦ ᐊᑦᑕᕐᓇᕈᑕᐅᖕᒋᓐᓂᖅᓴᐅᓂᖕᒋᓐᓂᒃ ᐊᑐᐊᒐᖕᒋᑦ CCME ᐆᒃᑐᕋᐅᑎᒋᓪᓗᒋᑦ;
- ᐅᓂᒃᑳᕐᓗᑎᒃ ᖃᓄᑎᒋ ᓴᓇᖅᑯᑎᕐᓗᑯᓂᒃ ᐃᑦᑎᓯᒪᔪᓂᒃ ᓂᕆᖃᑦᑕᕐᓂᕐᒪᖔᑕ ᓄᓇᕋᓂᑦ ᐆᒪᔪᐃᑦ ᑎᖕᒥᐊᑦ ᐊᒻᒪᓗ ᑖᓐᓇ ᐆᒃᑐᕋᐅᑎᒋᓗᒍ ᐆᒪᔪᖅᑐᓲᓄᑦ ᐃᒻᒪᖅ ᐃᓄᖕᓄᑦ;
- ᐅᓂᒃᑳᕐᓗᑎᒃ ᓱᖕᒪᑦ ᓂᐅᖅᓯᔭᐅᖃᑦᑕᖅᐸᑦ ᓴᕕᕋᔭᕈᔪᐃᑦ ᑳᑦᓂᐊᒻᖃᖅᑐᑦ ᑎᒥᒧᑦ ᐋᓐᓂᐊᕐᖃᓕᕈᑕᐅᔪᓐᓇᖅᑐᑦ ᖃᓄᑎᕆᐅᑎᓪᓗᒋᑦ ᐊᑦᑕᕐᓇᓕᕈᑕᐅᓲᖑᖕᒪᖔᑕ ᐃᓅᓯᕐᒧᑦ;
- ᐅᓂᒃᑳᑦᑎᐊᕐᒥᓗᒍ ᓇᓗᓇᐃᔭᑦᑎᐊᖅᓯᒪᔪᓂᒃ ᐆᒃᑐᕋᐅᑎᒋᓚᐅᖅᑕᖕᒋᓐᓂᒃ HHERA ᐅᓂᒃᑳᖕᒐᓂ ᓈᓴᖅᑕᐅᓯᒪᔪᓂᒃ ᐊᑐᖅᑕᐅᔪᕕᓂᕐᓂᒃ ᐊᔾᔨᓕᐅᖅᑕᐅᑦᑎᐊᖅᓯᒪᒐᓗᐊᕐᒪᖔᑕ ᐅᓂᒃᑳᖕᒐᓂ.
- ᐅᓂᒃᑳᕐᓗᑎᒃ ᐆᒃᑐᕋᐅᑕᐅᓚᐅᖅᑐᒥᒃ ᑳᓐᓯᖅᑐᒧᑦ ᐃᓄᖕᒧᑦ (ᐃᒪᓖᒃ, ᖃᓄᑎᒋ ᓂᐅᖅᓯᖃᑦᑕᕐᓂᑰᓂᖕᒐ ᖃᓄᑎᒋ ᐳᔫᕐᕕᐅᔪᒦᓱᓂ ᐊᖕᕆᕋᒥᓂ ᐃᖅᑲᓇᐃᔮᒥᓂᓗ), ᐃᓐᓇᐃᓐᓇᑐᐊᖕᒍᖕᒋᑦᑐᑦ ᐃᓄᒃ ᐱᕈᖅᓴᓂᖕᒐᓂᑦ ᐋᓐᓂᐊᕐᖃᓕᕈᑕᐅᔪᑦ ᖃᓄᑎᒋ ᐊᒃᑐᐊᓯᕐᖃᑦᑕᓚᐅᓇᐊᖕᒋᑦ ᓱᕈᔭᐃᔭᑦᑐᓂᒃ ᐆᒃᑐᕋᐅᑎᒋᓪᓗᒋᑦ.

ᓯᕗᓪᓕᖅᐹᖅ ᐅᓐᓂᕐᓗᒃᓴᐅᑕᐅᕙᔪᖕᓂᖅᐹᖑᓚᐅᖅᑐᖅ HHERA ᐅᓂᒃᑳᖕᒐᓄᑦ ᓈᓴᖅᑕᐅᓯᒪᔪᓂᒃ ᑕᐃᓯᖅᑲᑦᑕᓚᐅᕐᒪᑕ ᐊᓯᖕᒋᓐᓂ ᐅᓂᒃᑳᓂ ᓄᓇᓂ ᑲᓇᑕᒥ ᖃᐅᔨᓴᖅᑎᓄᑦ ᐃᓱᒪᒋᓪᓗᒍ ᖁᑦᑎᒃᑐᒥᐅᑦ ᓄᓇᖕᒐ ᐊᓯᖕᒋᓐᓂᑦ ᓄᓇᓂᑦ ᑲᓇᑕᒥ ᐊᔾᔨᒋᔭᐅᖕᒋᒪᑦ ᑖᒃᑯᓇᓂ ᑕᐃᔭᐅᔪᓂ ᖃᐅᔨᓴᕈᑕᐅᔪᕕᓂᕐᓂ.

HHERA-ᑯᑦ ᐅᓂᒃᑳᖕᒐᓂᒃ ᖃᐅᔨᓴᕈᑕᐅᔪᕕᓃᑦ ᐊᑐᐊᖅᓗᒋᑦ, AMEC-ᑯᑦ ᑐᑭᑖᕈᑎᖃᓚᐅᕐᒪᑕ ᓈᒻᒪᓈᖅᓯᔪᓂᒃ ᐃᓅᓯᕐᒧᑦ ᐊᑦᑕᕐᓇᕈᑕᐅᓇᔭᖅᑐᓂᒃ ᓇᓚᐅᑦᑖᕈᑎᖃᓚᐅᕐᒪᑕ ᑕᒫᓂ ᓇᓂᓯᕕᖕᒥ. ᐃᓱᒫᓗᒋᔭᐅᔪᑦ ᐅᖃᐅᓯᐅᓚᐅᖅᑐᑦ ᑭᐅᔭᐅᑎᐊᓚᐅᕐᒪᑕ, ᐊᒃᓱᓗᐊᖑᔪᓐᓃᕐᓂᕋᖅᑕᐅᒍᓐᓇᖅᓯᔪᑦ HHERA-ᑯᑦ ᐅᓂᒃᑳᖕᒐᓂ ᐋᕿᒃᑕᐅᓯᒪᓕᕐᒪᑕ ᑕᒻᒪᖅᓯᒪᖕᒋᓐᓂᕋᖅᑕᐅᓕᕈᓐᓇᖅᑐᑦ.

4.0 ᕿᒥᕈᔾᔨᐅᑎᓪᓗᒋᑦ ᓄᓇᖕᒐᓄᑦ ᐊᑦᑕᕐᓇᕈᑕᐅᔫᓐᓇᖅᑐᑦ

ᓄᓇᖕᒐᓂ ᐊᑦᑕᕐᓇᓕᕈᑕᐅᔫᓐᓇᖅᑐᑦ ᖃᐅᔨᓴᖅᑕᐅᓚᐅᕐᒥᔪᑦ ᒪᑯᐊ ᖃᓄᐃᓕᖕᒐᓂᖕᒋᑦ ᐱᕆᐊᖕᒐᕐᕕᖕᒐᓂ ᐃᓱᒪᓕᐅᕈᑎᕆᓇᓱᐊᕐᓗᒋᑦ ᐊᑦᑕᕐᓇᕈᑕᐅᓇᔭᖅᑐᑦ ᐆᒪᔪᓄᑦ ᐱᕈᖅᑐᓄᓪᓗ ᑕᒫᓂ. ᖃᐅᔨᒪᔭᐅᐊᑐᖅᑲᐅᓕᕐᒪᑕ ᐊᒥᓱᓂᒃ ᐅᑭᐅᓂᒃ ᐆᒪᔪᐃᑦ ᐱᕈᖅᑐᓪᓗ ᓄᓇᓂ ᓱᕈᔮᒃᑕᐅᔪᕕᓂᕐᓃᑦᑐᑦ ᑎᒥᖕᒋᓐᓃᑦᑐᖃᓕᓅᖕᒍᖕᒪᑕ ᑕᒫᖕᒐᑦ ᓄᓇᒥᑦ ᐱᔪᓂᒃ. ᐆᒪᔪᓂ, ᐃᓚᓕᐅᑎᔭᐅᔫᑦ ᓂᕿᖕᒋᓐᓂᑦ ᐱᔪᑦ ᓱᕈᔮᒃᓯᒪᔪᓂᒃ ᐱᕈᖅᑐᓂᒃ ᓄᓇᒥᑦ ᐅᕝᕙᓗ ᐊᕝᕙᓗᖕᒐᓂᑦ ᐊᓂᖅᑎᓇᐅᓂᑯᐃᑦ ᓱᕈᔮᒃᓯᒪᔪᒥᒃ ᐊᓯᖕᒋᓐᓄᑦ ᑎᒃᑕᐅᕙᖕᒪᑕ ᐳᔫᖅᑕᐅᕙᖕᒪᑕᓗ. ᐃᒫᖕᒐᐃ, ᒪᓂᕋᒥ ᐃᒪᖅ ᓱᕈᔮᒃᓯᒪᓪᓗᓂ ᓇᒧᑐᐃᓐᓇᖅ ᑰᒍᓐᓇᕐᒪᑦ ᓄᓇᒧᑦ. ᓄᓇᕋᐃᑦ ᑕᒫᓂ ᐱᕈᖅᑐᑦ ᓱᕈᔭᖅᑲᕐᓗᑎᒃ ᐱᕈᕈᓐᓇᕐᒪᑕ ᐊᐃᑦᑑᑎᔪᓐᓇᖅᑕᒥᓂᒃ ᐆᒪᔪᓄᑦ ᓂᕆᔪᓄᑦ ᐱᕈᖅᑐᓂᒃ ᑕᐃᒫᒃ ᐆᒪᔪᐃᑦ ᑲᑎᖅᓱᐃᓯᒪᓕᕈᖕᒍᔪᑦ ᐊᓯᒥᓂᑦ ᐆᒪᔪᓂᑦ ᐱᕈᖅᑐᖅᑑᓂᑦ ᓂᕿᖃᖅᑐᑦ.

ᐊᕙᓗᑦᑎᓐᓂ ᐆᒪᔪᓄᑦ ᐱᕈᖅᑐᓄᓪᓗ ᐊᑦᑕᕐᓇᕈᑕᐅᔪᓂᒃ (ERA) ᕿᒥᕈᔫᑦ ᐅᓂᒃᑳᖕᒐ ᖃᓄᑐᐃᓐᓇᖅ ᓇᐅᒃᑯᑐᐃᓐᓇᖅ ᓱᕈᔫᑕᐅᔾᔭᓐᓇᖅᑐᑦ ᓄᓇᒥᑦ ᐊᓯᖕᒋᓐᓄᑦ ᓄᒃᑎᕈᓐᓇᕐᒪᑕ ᓄᓇᒥᐅᑕᓄᑦ ᐆᒪᔪᓄᑦ ᐱᕈᖅᑐᓄᓪᓗ. ᓄᓇᖕᒐᓄᑦ ᐊᑦᑕᕐᓇᕈᑕᐅᔾᔭᓐᓇᖅᑐᓂᒃ ᖃᐅᔨᓴᖅᑏᑦ ᐅᓂᒃᑳᖕᒐ ᖃᐅᔨᓴᓚᐅᕐᒪᑕ ᐊᓯᒥᓄᑦ ᐊᒃᑐᐊᓂᖅᑲᕐᓂᖅᐹᓂᒃ ᐆᒪᔪᓂᒃ ᐱᕈᖅᑐᓂᓗ ᐅᕝᕙᓗ ᖃᓄᑐᐃᓐᓇᖅ ᐃᒻᒥᒃᑰᖕᒐᔪᒥᒃ ᐊᑐᕐᓂᖅᑐᓂᒃ ᑕᒫᓂᒥᐅᓄᑦ. ᑖᒃᑯᐊ ᓄᓇᒥᐅᑕᐃᑦ ᑕᐃᔭᐅᔫᑦ "ᐊᑐᕐᓂᖅᑐᑦ ᓄᓇᒥᐅᑕᓄᑦ ᐊᓯᒥᓄᑦ"

ᐅᑉᐸᓗ VECs. ᐊᒃᓱᒐᓪᓚᒃ ᐱᒻᒪᕆᐅᑎᑕᐅᓂᖏᑦ ᑕᒫᓂᕐᒥᐅᑦ ᐃᓅᔪᑎᖏᓐᓄᑦ ᓄᓇᖓᓄᑦ ᐃᓚᖓᔾᔪᑎᒋᔭᖏᑦ ᐆᒪᔪᖏᓐᓄᓪᓗ ᐊᓯᒥᓄᓪᓗ ᐱᕈᖅᑐᓄᑦ ᐊᐃᑦᑐᐃᔪᓐᓇᕐᓇᐊᖏᑦ ᓱᕈᔪᒃᑕᐅᒍᑎᒃ, ᐃᓚᐃᓐᓇᖏᓐᓂᒃ ᓂᕈᐊᖅᓯᓪᓗᑕ ᐆᑦᑐᕋᐅᑎᖃᓚᐅᕐᑦᑕ ᐊᓯᖏᓐᓂᒃ ᐆᒪᔪᓂᒃ ᑭᒡᒐᖅᑐᕐᓂᐊᖅᑐᓂᒃ ᑕᒫᓂ (ᐃᒫᒃ ᐱᕈᖅᑐᓰᑦ ᐆᒪᔪᑦ ᐊᒻᒪᓗ ᓂᕿᑐᓰᑦ ᐆᒪᔪᑦ). ᓂᕈᐊᖅᑕᐅᓚᐅᖅᑐᑦ ᑕᒪᓂᕐᒥᐅᓄᑦ ᑮᓇᐅᔭᒃᓴᐅᑕᐅᓰᖑᔪᑦ ᐊᓯᖏᓐᓄᓪᓗ ᐆᒪᔪᓄᑦ ᐃᓅᔪᑕᐅᓰᑦ ᖁᐱᕐᕈᐃᑦ ᐊᑐᕐᓂᖃᖅᑐᑦ ᓂᕐᔪᑏᑦ ᐆᒪᔫᖃᑎᒥᓄᑦ ᐊᐃᑦᑐᐃᒍᓐᓇᖅᑐᑦ ᓱᕈᔪᒃᓯᒪᔪᓂᒃ ᓂᕿᖃᕈᑎᒃ ᓄᓇᒥᑦ. ᐃᓱᒪᒋᔭᐅᓚᐅᕐᒪᑕ ᖃᓄᑎᒋ ᐊᒃᑎᒋᔪᒥᒃ ᓄᓇ ᓱᕈᔪᒃᓯᒪᓕᖅᓱᓂ ᐆᒪᔪᓄᑦ ᑕᒫᓂ ᐊᑦᑕᕐᓇᓕᕈᑕᐅᒍᓐᓇᕋᔭᕐᒪᖔᑦ ᓇᓕᐊᑐᐃᓐᓇᖅ ᐊᑦᑕᕐᓇᓕᕈᑕᐅᖏᑉᐸᑦ ᑕᐃᒪᓴᐃᓐᓇᖅ ᐊᓯᖏᑦ ᐆᒪᔪᐃᑦ ᖃᓄᐃᔭᖏᓛᑦ ᓱᕈᔫᖏᑦᑐᓃᑦᑐᑦ ᑕᒪᓐᓇ ᓇᔪᖅᑕᖓ ᓄᓇ ᓱᕈᔪᒃᑕᐅᓯᒪᓕᕋᓗᐊᖅᑎᓪᓗᒍ.

ᓂᕈᐊᖅᑕᐅᓚᐅᖅᑎᓪᓗᒋᑦ ᖃᐅᔨᓴᖅᑕᐅᓂᐊᖅᑐᑦ ᐆᒪᔪᐃᑦ ᐊᐸᓗᓕᕆᔪᑎᓂᒃ ᖃᐅᔨᓴᖅᑎᓄᑦ ᐅᔾᔨᖅᓱᖅᑕᐅᑦᑎᐊᕆᓚᐅᖅᑐᑦ ᐆᒪᔪᐃᑦ ᓱᐸᓪᓕᐊᓂᕐᐸᒃᑕᖏᑦ ᐆᒃᑐᕋᐅᑕᐅᖃᑦᑕᖅᓗᑎᒃ ᐊᓯᖏᓐᓄᑦ ᑭᒡᒐᖅᑐᖅᑎᒋᔭᐅᓗᑎᒃ ᐃᓕᖅᑯᓯᖏᑦ. ᐅᕿᖏᓐᓂᐊᖅᑕᐅᐸᒃᓗᑎᒃ, ᓂᕿᖏᑦ, ᖃᓄᑎᒋ ᓂᕆᓲᖑᓂᖏᑦ ᖃᓄᑎᒋ ᐊᒃᑎᒋᔪᑦ, ᐃᒥᕋᔪᖕᓂᖏᑦ, ᐊᓂᖅᑎᕆᓂᖏᑦ ᐊᓯᖏᓪᓗ ᐊᔾᔨᐅᖏᔾᔪᑕᐅᔪᑦ ᐆᒃᑐᕋᖅᑕᐅᓪᓗᑎᒃ ᓱᕈᔪᒃᓯᒪᔪᒥᒃ ᑎᒥᖓᓃᑦᑐᖃᓕᕐᒪᖔᑦ ᑎᑎᕋᖅᑕᐅᐸᓪᓕᐊᖏᓐᓇᖅᓗᑎᒃ. ᖃᐅᔨᓴᕈᑕᐅᔪᑦ ᓈᓴᖅᑕᐅᓲᖑᒥᔪᑦ ᐱᕈᖅᑐᓂᒃ ᖃᓄᑎᒋ ᒪᓂᕐᒥᑦ ᓂᕆᖃᑦᑕᕐᒪᖔᑦ ᐃᓱᒫᓗᒋᔭᐅᓂᖃᑦᑕᐅᓪᓗᑎᒃ ᐅᖃᐅᓯᐅᓯᒪᔪᓂᒃ ᓄᓇᖃᓂᒃ.

ᐊᔪᖏᒻᒥᖕᒪᑕ ᓱᕈᔪᐃᓲᑦ ᓄᓇᒥᑐᐃᓐᓇᐅᖏᒻᒪᑕ ᐊᓯᖕᒐᖏᓐᓄᑦ ᓄᒃᑎᕈᓐᓇᕐᒪᑕ ᑎᒃᑕᐅᓪᓗᑎᒃ ᑯᕕᔭᐅᓗᑎᒃ ᖃᐅᔨᓴᖅᑕᐅᕆᐊᖃᕐᒥᔪᑦ. ᑕᒪᒃᑯᐊ ᕿᒥᕈᔭᐅᕆᐊᖃᖅᓴᔭᖅᑐᑦ ᓱᕈᔪᐃᔭᑦᑐᑦ ᐃᓗᓕᖏᑦ ᓴᓇᒪᓂᖏᑦ ᐊᒻᒪᓗ ᐊᐸᓗᑦᑎᓐᓅᖅᑕᐅᒑᖕᒐᑕ ᖃᓄᖅ ᐃᓚᓕᐅᑎᓯᒪᖕᒪᖔᑦ ᑎᒥᖓᓂ ᐊᐅᓚᔾᔪᑎᓄᑦ ᖃᓄᖅᒥᓗ ᐃᓅᓯᖓᓐᓂ ᐃᖃᕈᐸᑕᐅᒍᓐᓇᕐᓕᕐᒪᑕ.

ᑕᒪᒃᑯᐊ ᑕᑉᐸ ᑲᑎᖅᓱᖅᑕᐅᒃᐸᑕ, ᓇᓚᐅᑦᑖᕈᑕᐅᒍᓐᓇᖅᓯᓇᔭᖅᑐᑦ ᖃᓄᑎᒋ ᓄᓇᒧᑦ ᐊᑉᐸᓗᑦᑎᓐᓄᑦ ᐃᓚᓕᐅᑎᓯᒪᓕᕐᒪᖔᑦ ᓄᓇᒥ ᐱᕈᖅᑐᓄᑦ VECs. ᓯᕗᓂᓇᓂᐊᖅᑕᑦᑎᓐᓂ ᖃᓄᐃᓕᕈᒫᕐᒪᖔᑦ ᓇᓚᐅᑦᑖᕈᑕᐅᒍᓐᓇᖅᓯᓂᐊᖅᑐᑦ ᐊᓯᒥᓄᑦ ᓱᕈᔪᐃᔪᑕᐅᔪᓐᓇᖅᐸ ᑐᖅᑯᓐᓇᖅᑐᖅᑲᕈᓐᓇᖅᐸᑦ ᑎᑎᕋᖅᑕᐅᓯᒪᓲᖑᖕᒪᑕ ᐊᑐᓂ ᓱᕈᔪᐃᔭᑦᑐᑦ ᑭᓲᓂᖏᑦ ᒪᓕᒃᓗᒋᑦ ᖂᖑᑦ ᓇᓗᓇᐃᒃᑯᑦᑎᖅᑕᐅᓪᓗᑎᒃ ᑕᐃᒫᒃ ᖃᓄᖅ ᐃᒃᐱᖕᓇᕐᓂᖅᓯᕐᓂᐊᕐᒪᖔᑦ ᐊᓯᒥᓄᑦ ᑐᑭᓕᐅᖅᑕᐅᔪᑦ ᐅᔭᖅᓱᖅᑕᐅᕆᐊᓕᑦ ᐊᑦᑕᕐᓇᖅᓯᕐᓂᖅᓴᖅᑐᑦ ᓇᓗᓇᐃᒃᑯᑦᑎᖅᓱᒃᓯᒪᓕᕐᒪᖔᑦ ᓂᕆᔭᐅᒥᐊᒃᖅᓯᕐᑦ. ᐊᑐᓂ ᐆᒪᔪᑦ ᖃᓄᖅ ᐃᒃᐱᒍᓱᖕᒍᓂᖏᑦ ᐊᔾᔨᒌᖏᒻᒪᑕ ᖃᓄᑎᒋ ᓱᕈᔭᒃᑕᐅᓂᖏᑦ ᒪᓕᒃᓗᒋᑦ ᐃᓚᖏᑦ ᖃᓄᐃᖏᑦᑎᐊᓱᑦ ᐃᓚᖏᓪᓗ ᑐᖁᓱᑦ ᐆᒪᔪᑦ ᐱᕈᖅᑐᓪᓗ ᕿᓚᒥ ᓯᕙᑐᔪᒧᓪᓗᐊᓐᓂᑦ ᓱᕈᔭᒃᓯᒪᔪᒥᒃ ᓂᕿᓯᒪᒍᑎᒃ.

ᔮᒃ ᕗᐃᑦᕗᑦ ᐊᐸᓗᓕᕆᔨᖏᑦ, ᕗᕆᑦᑐᕆᒃᑕᓐ, ᓂᐅᐳᕿᔅᕗᐃᒃᒥᐅᖅ ᓇᓂᓯᕕᖕᒥ ᖃᐅᔨᓴᖅᑎᐅᓚᐅᕐᒪᑕ ᐊᐸᓗᓕᕆᔪᑎᓂᒃ. ᐊᐸᓗᓕᕆᔪᑎᓄᑦ ᐅᓂᒃᑳᖓ ᐋᕿᒃᓱᖅᓯᒪᑦᑎᐊᓚᐅᖅᑐᖅ ᐊᒻᒪᓗ ᐃᓱᒫᓗᑭᔭᐅᔭᖅ ᐅᖃᐅᓯᕆᑦᓱᑦᑎᐊᖅᑐᖅ. ᓴᕙᓴᒃᓴᔭᖅᓯᐊᑉ ᐃᓄᓱᒍᑦ ᐆᒪᔪᓄᓪᓗ ᐊᑦᑕᕐᓇᓕᕈᑕᐅᔪᖅ ᐅᓂᒃᑳᖅ ᑐᑭᓯᒋᐊᕐᓂᖅᓴᖅᑐᖅ. ᑭᓯᐊᓂ ᐅᓂᒃᑳᕆᓚᐅᖅᑕᖓ ᐅᓯᐊᓗᖅᑐᐊᓄᑦ ᓴᓇᓂᖏᑦ ᐱᕈᖅᑕᐅᓄᑦ ᐅᓂᒃᑳᕆᒍᓐᓇᖅᓯᓂᐊᖅᑕᖓ ᑭᒍᓯᖅᓯᕐᒥᔪᑦ ᐊᐸᓗᓕᕆᔪᑎᓂᒃ ᐅᓂᒃᑳᖅᓯᐅᖅ, ᑕᒪᓴ ᐅᓯᐊᓗᖅᑐᐊᑦ ᒪᓂᖅᑕᐅᓄᑦ ᐱᕈᖅᑐᓄᑦ ᐆᒪᔪᓄᓪᓗ ᐊᑦᑕᕐᓇᖅᓯᐅᑎᓴᕐᔪᑦ ᐆᒪᔪᓄᑦ ᐊᐸᓗᓕᕆᔪᑎᒃ ᐅᓂᒃᑳᖅᓯᐅᕐᓂᖏᑦ ᐃᓚᓕᐅᑎᔭᐅᕆᓯᒪᖅᐸᓪᓕᐅᑎᓯᒪᓕᖅᑐᑦ. ᑕᒪᓴᐃᓐᓇᖅ ᐊᐸᓗᓕᕆᓂᕐᒃᑯᑦ ᐅᓂᒃᑳᖅᓯᐅᕐᓂᖏᑦ ᓄᓇᖓᓄᑦ ᓱᐃᓪᓕᐅᑕᐅᔪᑦ ᐆᒃᑐᕋᐅᑕᐅᓕᕐᒪᑕ ᒪᓂᖅᓱᖅ ᓇᓂᓯᕕᖕᒥ "ᐃᔾᔪᓂᖅᑕᐅᔪᑦ". ᐅᖃᐅᓯᐅᑉ ᑖᓱᒪ ᑐᑭᖓ ᕿᒥᕈᔭᐅᑎᓇᓱᐊᒃ ᐅᖃᐅᓯᐅᓯᒪᔪᑦ ᐊᐸᓗᓕᕆᓇᕐᒃᑯᑦ ᐅᓂᒃᑳᖓᓂ ᐃᓱᒪᒋᓪᓗᒋᑦ ᑎᑎᕋᖅᓯᒪᔪᒃ ᓇᓂᓯᕕᐅᑉ ᓄᓇᖓ ᐃᔾᔪᒃᓯᒪᖅᑕᖅᓯᕐᑕᐅᔪᖅ. ᑭᓯᐊᓂᓕ, ᑖᓇ ᐱᑕᖅᓯᒪᖕᒪᑦ ᓯᕗᓂᓴᓗᐊᖅᓯᒪᔪᖅ ᐅᓂᒃᑳᖅ ᑭᑭᑕᐅᓗᐊᖅᐳᑦ ᑕᐃᓴᐅᑐᐃᓐᓇᓗᐊᕐᒪᑦ ᑐᑭᓯᑎᑦᓇᓱᐊᕐᓂᑎᓪᓗ ᖃᓄᐃᓐᓂᖅ ᐃᑎᓯᒪᔪᑦ ᓴᕙᓴᒃᓴᔭᖅᓯᓂᒃ ᐱᑕᖃᕐᓯᒪᔪᑦ ᐅᔭᖓᐃᑦ ᐃᔾᔪᐃᑦ ᓄᓇᐃᑦ ᑕᒪᓂ ᓴᕙᓴᒃᓴᖅᑐᖅ ᐱᕈᖅᑐᑦ, ᐆᒪᔪᓗ

ᑕᒪᐃᑎᒍᓪᓗ, ᐊᐸᓗᓕᕆᔪᑎᓂᒃ ᖃᐅᔨᓴᕈᑎ ᐅᓂᒃᑳᖅ ᓈᒻᒪᒋᔭᐅᓕᕐᒪᑦ ᒥᑭᓂᖅᓴᖏᓐᓂᒃ ᐊᑐᖅᑕᐅᕙᓪᓕᐊᖅᓯᒪᓂᖏᑦ ᒪᓕᒃᒪᓪᓗ ᖃᐅᔨᓴᕈᑎᑦ ᐃᓱᒪᓕᐅᕈᑕᐅᓪᓗᑎᒃ ᐊᑐᖅᑕᐅᔪᓐᓇᖅᓯᒪᑦ ᑲᑎᒪᔨᓄᑦ ᖃᓄᐃᓐᓂᖅᓴᓕᕐᑎᐊᖅ ᒥᑭᓂᖅᓴᖏᓐᓂᒃ ᖃᐅᔨᒪᔭᐅᓕᕐᒪᑕ ᐱᑕᖃᕐᒪᑦ ᑭᓯᐊᓂ ᓇᓂᓯᕕᒃ ᓄᓇᖓ ᒥᑭᓂᖅᓴᒃᑎᐅᔭᐊᑦ ᐊᒥᓱᓂᒃ ᐅᑭᐅᓂᒃ ᑲᑎᖅᓱᖅᓯᒪᔪᓂᒃ ᓯᓚᐅᖅᑎᑦᓱᐃᓐᓇᖅᑕᐅᓪᓗ ᐱᕈᖅᓱᓂᒃ ᐆᒪᔪᓄᓪᓗ ᑕᒪᓐᓇ ᓴᕙᓴᒃᓴᔭᑦ ᐱᑕᕐᓂᖏᓐᓄᑦ ᐃᓱᒪᓕᐅᕈᑎ ᑕᒪᓐᓇᓂ ᑖᒃᑯᐊ ᓴᕙᓴᒃᓴᔭᐃᑦ

ᑕᒫᓃᖏᓐᓇᐅᔭᕐᒪᑕ ᐊᒃᓱᓗᐊᖑᓕᖅᐹᓪᓕᕐᓇᑎᒃ ᐅᔭᕋᖕᓂᐊᖅᑕᐅᓕᕐᓂᖏᓐᓄᑦ. ᐃᒻᒥᒃᑰᖅᑐᑦ ᐅᓐᓂᕐᓗᒃᓴᐅᑕᐅᓚᐅᖅᑑᓗᐊᑦ ᑭᓯᐊᓂᓕ ᐊᒥᓲᖏᓚᐅᕐᓂᖏᓐᓄᑦ ᓱᐴᓪᓕᐅᑕᐅᓗᐊᓚᐅᖏᑦᑐᑦ ᑐᑭᑖᕆᑕᐅᔪᓐᓄᑦ. ᐅᑯᐊ ᑕᕝᕙ ᐃᒻᒥᒃᑰᖅᓗᑎᒃ ᐅᓐᓂᕐᓗᒃᓴᐅᑕᐅᓚᐅᖅᑐᑦ, ᓇᕿᑦᑕᖅᓯᒪᔪᓂ ᑕᒻᒪᖅᓯᒪᔪᑦ ᐊᓯᖏᑦ, ᐃᓱᒪᓗᕆᔭᐅᔪᑦ:

- ᓈᓴᐅᓯᓇᔪᑎᓂᒃ ᐆᒃᑐᕋᐅᑎᖃᓚᐅᕐᒪᑕ ᑎᒥᒧᑦ ᐊᒃᑐᐊᓂᖃᖅᑐᓂᒃ ᐃᒃᐱᖕᓇᕐᓂᖃᖅᑐᓂᓗ ᐃᓱᒪᒋᓪᓗᒋᑦ ᖃᓄᑎᒋ ᐊᑯᓂᐅᑎᒋᔪᒥᒃ ᓱᕈᔪᖕᓇᖅᑐᒦᓚᐅᓇᐊᖏᑦ ᐊᓯᖏᓐᓂ ᐆᒃᑐᕋᐅᑕᐅᕙᒃᑐᖅ ᐊᑐᖅᑕᐅᖏᖕᓛᖅᓗᓂ 95% ᐊᒥᓲᓂᖅᓴᓄᑦ ᐃᓱᕆᔭᐅᔪᑦ ᑲᑎᖅᓱᕋᒥᒃ ᐃᒃᐱᖕᓇᕐᓂᖏᑦ ᖁᑉᕙᖅᐸᓪᓖᐊᔪᓐᓇᖅᑐᑦ ᐊᑯᓚᐃᓐᓂᖃᓕᖅᐸᓪᓕᐊᔪᑦ ᖃᑎᖅᓱᖅᓯᒪᓕᕋᒥᒃ ᐅᓄᖅᓯᕙᓪᓕᐊᓲᖑᓂᖏᑦ ᓈᓴᐅᑏᑦ;
- ᐱᑕᖃᖏᒻᒪᑕ ᓯᓚᒃᑯᑦ ᓇᒧᙵᖃᑦᑕᓲᖑᓂᖏᓐᓂᒃ ᐆᒃᑐᕋᐅᑏᑦ ᓱᕋᐃᔭᖅᑎᓪᓗᒍ ᓄᓇᒥᒃ ᐆᒃᑐᕋᖅᑕᐅᕆᐊᓖᑦ ᒪᑯᐊ ᒪᓂᕋᒥ ᓱᕋᔾᑕᐅᔪᑦ ᐊᕙᓗᑦᑎᓐᓂ ᓇᒧᑦ ᑰᓲᖕᖑᒪᖔᑕ;
- ᐱᑕᖃᖏᒻᒪᑕ ᓇᒧᙵᐅᖃᑦᑕᓲᖑᓂᖏᓐᓂᒃ ᐆᒃᑐᕋᐅᑏᑦ ᓴᙱᔭᒃᓴᐃᔭᖅᑕᐅᓂᑯᐃᑦ ᓴᓇᖅᑯᑎᑦ ᐅᐊᕈᑎᖏᑦ ᐊᒃᑕᕐᙱᖕᖑᓂᑦ ᑕᓯᕐᒥᑦ ᑰᒃᑐᑦ ᓱᕋᐃᑦ ᐃᒪᕐᒧᑦ ᓯᒡᔭᒧᓪᓗ ᑰᖕᓂᑯᐃᑦ;
- ᖃᓄᖅ ᐊᐳᑎ ᓱᕋᔪᒃᓯᒪᔪᖅ ᐊᐅᒃᐸᓪᓕᐊᓕᖅᑎᓪᓗᒍ ᐃᖏᕋᓲᖑᓂᖓ ᑰᒃᑯᑦ ᓯᑯᑉ ᖄᖓᓄᑦ ᑎᒃᑕᐅᓂᑯᐃᑦ ᐊᕕᙵᐃᑦ ᑎᒥᖏᓐᓃᓕᓲᖑᓂᖏᑦ ᑕᖅᑭᓂ 8-ᓂ ᐅᑭᐅᓕᒫᒥ;
- ᒥᑭᓐᓂᖅᐹᒥᒃ ᖃᓄᐃᒃᑲᔭᕐᓂᖓᓂᒃ ᐆᒃᑐᕋᐅᑎᖃᖅᓗᑎᒃ ᑕᒪᐃᓐᓄᓕᒫᖅ ᐊᒃᑐᐊᓂᖃᕈᓐᓇᖅᑎᓪᓗᒍ ᓂᕆᔭᐅᓗᓂ ᓱᕉᑦᑕᐅᔪᓐᓇᖅᑐᓂᒃ ᐅᐊᕈᑎᓯᒪᔪᑦ; ᐊᒻᒪᓗ
- ᐅᖃᐅᓯᐅᓯᒪᖏᓗᐊᕐᒪᑕ ᓴᕕᕿᔭᕈᐊᖕᓂ ᐃᓗᓕᖃᓲᑦ ᐆᒪᔪᑦ ᓂᕿᒋᔭᐅᖃᑦᑕᖅᑐᑦ ᐊᓯᖏᓐᓄᑦ ᐆᒪᔪᓄᑦ ᐊᕕᙵᐃᑦ ᑕᒫᓂ ᐅᔭᕐᑲᑦᑕᕐᓂᐊᕐᕕᐅᔪᓂ ᐊᑦᑕᕐᓗᑯᓂᑦ ᐱᒋᐊᕐᕕᙵᓂᑦ ᐃᓱᓕᕝᕕᙵᓄᑦ, ᑎᒥᖓᓃᓕᖅᑎᓪᓗᒍ ᖃᓄᑎᒋ ᐱᑕᖃᓕᖅᐸᑦ ᐊᑦᑕᕐᓇᓕᕈᑕᐅᓇᔭᕐᒪᖔᑦ ᐃᓅᓯᕐᒧᑦ. Metallothioeins ᓴᓇᔭᐅᓲᖑᖕᒪᑕ ᑎᖑᖕᓂ ᓂᕿᒋᔭᐅᔪᑦ ᓴᕕᕿᔭᒃᓴᖃᐅᓗᐊᓕᖀᖓᑕ ᑎᒥᒧᑦ ᓱᕈᔪᐃᔭᐃᒃᑯᑎᓂᒃ ᐊᑐᖅᑕᐅᒍᓐᓇᖅᑐᓂᒃ ᓴᓇᓇᓯᐊᖅᓗᑎᒃ ᓴᓇᔭᐅᓲᑦ ᓱᕈᔪᐃᔭᑦᑐᓂᒃ ᐱᑕᖃᓕᖀᖓᑦ ᑎᖑᖕᒧᑦ ᐲᔭᐃᔪᑕᐅᓇᓯᐊᓲᑦ.

CRITICAL REVIEW OF THE 2002 PHASE II ENVIRONMENTAL SITE ASSESSMENT AND THE ECOLOGICAL RISK ASSESSMENT AND THE QUANTITATIVE RISK ASSESSMENT – OF CANZINCO LTD. NANISIVIK MINE, NUNAVUT

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PART 1: CRITICAL REVIEW OF THE 2002 PHASE II ENVIRONMENTAL SITE ASSESSMENT NANISIVIK MINE, NUNAVUT

1.0 INTRODUCTION

The 2002 Phase II Environmental Site Assessment (ESA) of the Nanisivik Mine was prepared for CanZinco Ltd. by Gartner Lee Limited. The purpose of the ESA was to complete the data collection and interpretation that was initiated by CanZinco Ltd. to identify and delineate areas of environmental contamination related to mine activities.

There is no doubt that this ESA is a comprehensive compilation of data on surface and subsurface material, sediments and surface water in the Nanisivik area. However, conveying the findings and meaning of this information is made somewhat difficult by the report organization and criteria used to delineate "contamination." There are also problems with the nomenclature used to describe the surface material. A specific contaminant is also listed as being of concern in the conclusion of the report, but was not previously identified in any analysis of material from the Nanisivik mine area or discussed in the text. These problems are discussed below.

2.0 ORGANIZATION OF THE PHASE II REPORT

The general format of a Phase II ESA report, according to the Canadian Standards Association (2000) "should present information in ways that follow a logical order and are unambiguous and comprehensive." While the author of this report probably does not have any problem with the "logical order" in which information is presented, this reviewer found the Phase II document somewhat unorganized and not in accordance with the proposed report format detailed by the Canadian Standards Association (CSA). Although the CSA proposed section headings are not required, the presentation of the data in the Phase II document should have attempted better organization. For example, the proposed format for a Phase II assessment by the CSA suggests the following main sections:

- Introduction (including background)
- Site investigation methodology
- Findings (i.e. the nature and extent of contamination)
- Evaluation of Findings (includes contaminant fate and transport, if applicable)
- Conclusions
- Qualifications of Assessor
- References and supporting documentation
- Appendices

In accordance with the above format, the Phase II ESA document begins with an introductory section. Subsections include a background on Closure and Reclamation Plan (Section 1.2) and an overview the Nanisivik Mine, town and related facilities (Section 1.3). The information discussed much later in Section 4 (Site Development and Operations) would appear to be more appropriate in Section 1.2. The information currently in Section 4 seems out of place.

Section 2 (Pre-mining Environmental Setting) would also seem to be more appropriate in the section discussing the background of the facility, rather than a separate section. The title “Pre-Mining Environmental Setting” begs the question as to whether their should be a section entitled “Post-Mining Environmental Setting” that would describe the changes in climate, permafrost, geology, topography, hydrology, vegetation, soil, mammals and birds due to the mining activity.

Section 3 (Environmental Site Assessment Setting) is still related to the discussion of actions and studies carried on before the 2002 Phase II study and as such should be in the section dealing with “background information.” Indeed, it would seem appropriate to have a section entitled “Environmental Setting” which included all the subjects under 2.0 and the sections 3.1, 3.2, 3.3 and 3.4. Sections 3.5 (Possible Contaminants and potential Areas of Concern) does not seem appropriate to the environmental setting section, but should be placed in Section 6 (Contaminants and Areas of Environmental Concern) of the ESA document.

There should be an entirely separate major section for “Methodology”; not as a subheading under Section 5. This methodology section would contain the information from section 1.5 (Scope of Work) as well as all methodologies, regardless of their time scale so as to present them at one location in the document.

A major section heading, such as “Findings - Nature of Extent of Contamination,” should be used for the information currently covered in 5.2 (Observations) and 5.3 (Results). This type of organization would make the document much easier to read and follow along with the discoveries made by the author.

Another section that seems out of place in the Phase II ESA document is Section 1.4.2 “Remedial Guidelines.” The section states that the soil, sediment and water quality will be assessed according to various government guidelines. This section would seem more appropriate to the “evaluation of findings” section such as the existing sections 5.3 or 6.

3. THE SURFACE MATERIALS AND IDENTIFICATION OF CONTAMINATION

In the Introduction section of the ESA, an explanation is provided of the various criteria used for interpreting the data collected. Specifically, the CCME Canadian Environmental Quality Guidelines for soil are identified for land use activities. This section of the ESA goes on to mention that the mine area “is currently being used for residential, commercial and industrial purposes.” The future land use of the mine site appears to be the subject of negotiations, but regardless of this the remediation objective is to restore the land to as close as possible to natural conditions (i.e. arctic wild lands). The ESA document admits that there are no remediation criteria for a land use category identified as arctic wild lands and that parkland land use “objectives” will be used in the interpretation of data even though “these criteria were developed for urban areas in southern Canada.”
The last section of the Introduction (Section 1.5, Scope of Work) identifies the extensive soil sampling program undertaken to attain the objectives of the ESA. A most remarkable statement is made in section 2.7 (Soil) that reports on the 1973 study of the area. This statement is as follows:

> “Soil studies were conducted by B.C. Research Inc. in conjunction with the 1974 vegetation mapping and reported that virtually **no soil formation has occurred in the mine area**. The little soil that has developed was found to be located primarily in alluvial plains where eroded and wind blown material has settled.”

If this is indeed the case, then exactly what was the material collected in place of soil and how does this affect the use of soil quality guidelines derived from soil-types common to southern Canada?

Definitions of “soil” generally follow the examples below. Buckman and Brady (1962) defined soil as:

> “A natural body, synthesized in profile form from a variable mixture of broken and weathered minerals and decaying organic matter…”

Flawn (1970) defined soil as:

> ”mixtures of fragmented or partly or wholly weathered rocks and minerals, organic matter, water and air, in greatly varying proportions, and have more or less distinct layers or horizons developed under the influence of climate and living organisms.”

Clearly, organic matter is an essential component of soil. In fact, all authors of textbooks dealing with soil agree that soil has four major components even though the relative proportions of these components may vary widely. These components are **mineral matter, organic matter, water and air**. Although the surface material collected from the Nanisivikic site for the Phase II Environmental Assessment are analyzed for minerals, there is no analysis of organic matter or water.

Another definition of soil (Russell 1973) states:

> “A soil is a regolith that shows vertical anisotrophy due to biological activity. By this is meant that a soil consists of layers of mineral material whose properties differ from another in some recognizable respects, and these differences are due to biological activity.”.

In addition Russell (1973) goes on to say:

> “However, chemical changes can take place in the rock below the zone of biological activity, giving vertical anisotrophy, or layers in the rock which differ from the rock itself. **This material is usually not considered to be soil, although it is produced from the rock by weathering**.”

The following definition for soil is from the Canada Department of Agriculture (1976).

> “For the purpose of the Canadian taxonomic system, the earth’s surface (the material that is to be classified) is divided into soil and nonsoil. Soil is the naturally occurring, unconsolidated, mineral or organic material at the earth’s surface that is capable of supporting plant growth. It extends from the surface to 15 cm (6 inches) below the depth at which properties produced by **soil-forming process** can be detected.”

Thus, if B.C. Research Inc. reported that virtually **no soil formation has occurred in the mine area**, the surface material in the mine area is not “soil.” If it is not soil, should this material be judged as to its potential for harm by criteria developed for soil?

As an example of the application of generic standards for soil monitoring, Alberta Environmental Protection (1996) Soil Monitoring Directive states:

> "For a given substance or parameter, generic standards shall be applied only at sites having the following characteristics:
>
> a) clay content in soil greater than five percent;
> b) soil pH between 6.0 and 8.5;
> c) seasonal water table no closer than one metre to the soil surface; and
> d) the ambient background concentration of a given substance does not exceed the standard."

Thus, the solid surface material collected at the Nanisivik site does not appear to be "soil" and yet it is collected as such, is analyzed as such and then judged as such for its potential to cause detrimental ecological and human heath effects.

Statements in the Phase II ESA such as:

> "The natural soils at Nanisivik generally displayed elevated metal concentrations when compared to generic CEQG CI and/or PL guidelines." (page 17) and
>
> "The results confirm that the background, or natural, quality of the weathered bedrock does not meet the generic CEQG CL guidelines of 260 µg/g for lead and 360 µg/g for zinc." (page 61)

cause anyone reading this document to question why the Canadian Environmental Quality Guidelines (CEQGs) for soils characteristic of southern Canada would be used for this particular surface material in a high arctic "polar desert" environment. These guidelines seem inappropriate.

An extremely important paragraph begins at the bottom of page 17. This paragraph points out "an area containing a surficial trend of naturally occurring mineralized soil." In order words, what the author of the Phase II ESA appears to be saying is these surface materials should be considered to contain the naturally high background concentrations of metals. The paragraph goes on to state that the lead concentrations in the samples collected from this area ranged from 48 ppm to 2296 ppm, with an average of 662 ppm. In this same area, zinc concentrations ranged from 93 ppm to 1404 ppm with an average concentration of 825 ppm. If 2296 ppm lead and 1404 ppm zinc are considered to be "naturally occurring," why shouldn't these numbers be used to assess "contamination" rather than CEQGs for soils? The document gives no explanation or rationale regarding this question.

4. CONTAMINANTS OF ENVIRONMENTAL CONCERN

Section 6.1 of the ESA contains Table F entitled "Contaminants of Environmental Concern." Under the table column heading "contaminant," in the fourth row of the table are the words "Chlorinated Ethenes – Volatile Organic Compounds." A search of the Phase II ESA text and embedded tables and the tables at the end of the text failed to find any reference to these compounds. The "comment" column in Table F, fourth row states: "Constituents of Xanthate." However, xanthate is defined in the 12th edition of the Condensed Chemical Dictionary (Lewis 1993) as:

> "A salt (usually potassium or sodium) of a xanthic acid. Available as yellow palletized solids having a pungent odor, soluble in water."

There is absolutely no indication that xanthate contains chlorinated ethenes. Yet, as a contaminant, chlorinated ethenes are given the same status of concern as the obviously ever-present metals cadmium, copper, lead and zinc.

5. AREAS OF ENVIRONMENTAL CONCERN

Table G, in Section 6.2 summarizes the areas that are of environmental concern due to the presence of hydrocarbons. There are a total of 12 areas identified. However, in eight of the 12 areas (67% of the areas cited), the contamination is characterized as "localized." For the "Town," hydrocarbon contamination is stated as "confined to shallow areas (less than 0.05 m)…." These comments beg the question as to whether "localized" contamination can be considered an "environmental concern."

Table H, in Section 6.2 summarizes the areas that are of environmental concern due to the presence of metals. Comments related to five of the 14 areas use words such as "small quantities," "limited," and "localized" to describe the presence of these contaminants. This again raises the question: If these areas are characterized as "small" "limited" and "localized" are they necessarily of concern? This is especially relevant when the natural background levels of metals in the surface material generally exceed the CEQGs for parkland soil.

6. SUMMARY

This ESA contains a wealth of data and information from which to draw conclusions. Given the nature of the site and the lack of generic criteria for the protection of "Arctic wild lands", the term "contamination" as related to the specific geographic and geologic conditions of Nanisivik should have been a major topic of discussion. There are, in addition, several errors (e.g. "chlorinated ethenes" in Table F) that should have been easily identified by any reviewer prior to release of the Phase II ESA document.

The words used to describe the presence of contamination (e.g. "small quantities," "limited," and "localized") seem to indicate that the contamination due to mining at Nanisivik is not pervasive. However, the Phase II ESA does not provide an overall quantitative or qualitative assessment regarding the extent of contamination. In a review of Arctic terrestrial ecosystem contamination, Thomas et al. (1992) qualifies the "scale of chemical contamination" at Nanisivik as "minor." This would seem to support the terminology used to describe the presence of contamination by the ESA.

7. REFERENCES

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PART 2: CRITICAL REVIEW OF THE ECOLOGICAL RISK ASSESSMENT CONDUCTED AT THE NANISIVIK MINE

1.0 INTRODUCTION

Jacques Whitford Environment Limited conducted human health and ecological risk assessments at the Nanisivik Mine (Nunavut) to evaluate the potential for detrimental effects based on the existing contaminant concentrations and future use of the property after mine closure. This critical review is limited to the ecological risk assessment (ERA). A separate review will be conducted for the human health risk assessment. In addition, the results of the ERA were used to develop site-specific threshold limits (SSTLs) for contaminants in surface material in and around the mine. Subsequently, these SSTLs for ecological effects were compared with the SSTLs for human health and the lesser of the two values were identified as the “Soil Quality Remedial Objectives.

Overall, the ERA is well-organized and uses a format that is easily followed. This ERA is conservative in its conclusion, as risk assessments usually are, and this review can find no serious fault with the conclusions. There are a few minor errors or omissions that do not influence the conclusions. There are also several questions raised by some of the statements made in the ERA, but again these have no effect on the conclusions.

2.0 ORGANIZATION OF THE ERA

Section 7.0 (Ecological Risk Assessment) seems to jump immediately into the discussion of trace elements as the contaminants of potential concern. A sentence or two regarding the lack significant amounts or the absence of other categories of contaminants (e.g. hydrocarbons) would seem appropriate to get everything else “out of the way” so that the ERA could proceed.

3.0 TERMINOLOGY, CENTRAL TENDENCY AND THE CONCEPTUAL MODEL

Having examined the Phase II Environmental Site Assessment, the authors of the ERA should probably have given some thought to whether they should be referring to the surface material at Nanisivik as “soil” (see the review of the Nanisivik Phase II Environmental Site Assessment).

In section 7.1.5 (Surface Water) the statement is made (on page 53) the “EPCs for each metal were calculated as arithmetic mean total metal concentrations (mg/L), based on 2001 data as shown in Table 7.3.” This seems to conflict with the statement made in the first paragraph of Section 3.6 that states: “All data were found to be log-normally distributed, hence the EPC and BSC were calculated as the 95% UCL on the geometric mean of the log-transformed data.” If the trace element concentrations in water were log-normally distributed, the geometric mean should be a better measure of central tendency than the arithmetic mean.

The conceptual model (Figure 8) appears complete, but shouldn’t there be a connection between “surface soil” and “surface water” to account for surface water runoff? Surface water runoff (from snowmelt water) would seem to be a mechanism whereby trace elements would have the potential to be transferred from the solid surface material to a solute in surface water. Should water associated with the tailings also be identified as a pathway from the solid material to aqueous dissolution in surface water?

4.0 RECEPTOR IDENTIFICATION, EXPOSURE & HAZARD ASSESSMENTS

The discussion of receptor identification, exposure assessment and hazard assessment seem appropriate to the conditions at Nanisivik and the availability of data. One question that might be asked with respect to the section on exposure assessment is the effect of snow cover that occurs approximately eight months of the year. Although, discussion is provided concerning the lemming and its winter habitat in spaces between the snow and surface material, would the fact that the surface material is frozen reduce the exposure of this animal to the trace elements? Would the snow cover reduce the exposure of the Arctic fox to trace elements? If snow cover does reduce, in some fashion, the exposure to trace elements in the surface material, it would seem to reduce the hazard posed by the specific elements identified as contaminants to an even greater degree than currently calculated.

5.0 THRESHOLD LIMITS, ASSUMPTIONS AND UNCERTAINTIES

The discussion and calculation of threshold limits are appropriate to the available data. The evaluation of assumptions and uncertainties is very well accomplished in the tabular format. This review is in agreement with all that is discussed in these sections.

Perhaps, an additional entry concerning the effect of snow cover for eight months would have been appropriate here. The issue of using the 95% upper confidence limit of the geometric mean certainly appears to be a "worse case scenario." One question that is raised regarding this issue is the pervasiveness of the contamination. Can the contamination be characterized as slightly elevated over the entire area or highly elevated at a few so-called "hot spots?"

The bioavailability of ingested trace elements was assumed to be 100% in this risk assessment. However, this has been known not to be the case for over 30 years. Reference to general texts related to trace element metabolism and toxicity such as Venugopal and Luckey (1978) would provide a more realistic, and yet still conservative (and still worse case) value for intestinal absorption. The differences between a non-essential trace element such as lead and an essential trace element (such as zinc) that is homeostatically controlled by mammalian physiology would also help to present a truer picture of the extremes caused by the assumed 100% bioavailability. In ecological risk assessments, there always exists a high probability that the "worse case" scenario becomes the "impossible case" scenario.

6.0 CHEMICAL INTERACTIONS

Section 7.9 (Chemical Interactions) is a good introduction to uncertainties that revolve around the metabolism of trace elements. In hindsight, of course, more is always possible. The presence of metallothioeins in mammals should have been at least mentioned, if only in one sentence.

7.0 SOIL QUALITY REMEDIAL OBJECTIVES

If there is one sentence in this ERA that should be copied and placed much further forward in the text in bold font (e.g. in the introduction), it is the first sentence of the last paragraph in Section 8.0. It gives a perspective that should be realized from the outset.

Note that Table 8.2 contains an error concerning the final SQRO for lead. It would appear to be 4,600 mg/kg rather than 4,500 mg/kg. The 4,500 mg/kg value is repeated again in Table 8.4.

7.0 SUMMARY

The ecological risk assessment conducted for the Nanisivik Mine is a well-written and organized discussion of the potential for adverse ecological effects due to the presence of various trace elements in the Nanisivik area. This review is in complete agreement with the conclusions.

8.0 REFERENCE

Venugopal, B. and T.D. Luckey. 1978. Metal Toxicity in Mammals. Volumes 1 & 2. Plenum Press, New York.

PART 3: Review of Quantitative Risk Assessment – Nanisivik Mine, CanZinco Ltd.

1.0 Introduction

A Human Health and Ecology Risk Assessment (HHERA) was prepared by Jacques Whitford Environmental Limited (JWEL) to address contamination found at the Nanisivik Mine situated on northern Baffin Island, Nunavut (Site)[1]. AMEC Earth and Environmental Limited (AMEC) was retained by Nunavut Tunngavik Inc., Department of Lands and Resources to review the risk assessment.

2.0 Objective

The objective of the review was to determine if the HHERA was conducted in a manner that adequately evaluates the human health risks.

3.0 Scope of Work

The scope of work included:

- Review of the conceptual exposure model and the assumptions used in the HHERA;
- Review exposure models to determine if they are applicable (a detailed checking of the calculations is considered outside the scope of work); and
- Review each phase of the HHERA to ensure that the process was followed correctly and that the conclusions of the HHERA are supported by the data.

To facilitate the review process, AMEC based the review on the Checklist for Reviewers found in the Ontario Ministry of Environment (MOE) "*Guidance on Site-Specific Risk Assessment for Use at Contaminated Sites in Ontario"* (http://www.ene.gov.on.ca/envision/gp/326701e.pdf) which is also a modification of the checklist described by the U.S. EPA in their "*Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part A)*."

4.0 Comments and Issues

4.1 General

The site-specific objectives of the risk assessment were described in Section 1.1 of the HHERA. The objective was to "determine concentrations of potential contaminants of concern (COCs) in surface soil below which no adverse health effects would be expected." The scope of work identified three specific tasks including:

- Review, compile and summarize existing data;
- Qualitative screening of risks to identify scenarios of greatest risk; and
- Quantitative risk analysis to develop Soil Quality Remedial Objectives (SQRO) specific to the scenarios of greatest risk.

The project was designed to evaluate the risks associated with current and future exposures, not historical exposures. The risks were primarily evaluated by comparison of the surface soil concentrations of the COCs with the calculated SQROs.

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[1] Jacques Whitford Environmental Limited. 2003. Report to CanZinco Ltd. on Human Health and Ecological Risk Assessment, Nanisivik Mine, Nunavut.

4.2 Hazard Identification/Problem Formulation

4.2.1 Site Characteristics

Section 2.0 of the HHERA details the characteristics of the Site and divides it into three study areas based on future uses of the land *i.e.,* town area, dock area, and general mine area. Historical activities and facilities on the Site are also described.

Generally, the Site has been heavy industrial, principally as an underground mine, extracting lead and zinc ore. Specifically, however, there should be greater detail provided as to the specific activities within each of the individual areas. Some areas are described in later sections, but others are lacking in their description so that the reader is unclear whether the types and extent of contamination observed are consistent with the site activities.

General maps of the Site location, mine site and study areas are provided in the HHERA.

The HHERA indicates that the future land use may involve the ongoing use of the dock area as a storage facility for marine environmental response equipment and refuelling, use of area as a regional training centre for equipment operation, trades, and jobs and use of area as a military training base. As for the town facilities, there are two possibilities: demolition of all facilities within the town or transfer ownership of the town facilities to other organizations for ongoing use.

A qualitative and quantitative description of the nature of the contaminants is provided in Section 3 of the HHERA. A screening of the data was based on selection of samples within 0.3 m of the surface. Although it is typical site assessments use either 1.0 m or 1.5 m as the depth for surface soils, JWEL demonstrated adequately that the use of 0.3 m would lead to a more conservative assessment.

Since the data was derived from a number of reports, data validation is a necessary step of the risk assessment process to ensure that errors in transcription are minimized. JWEL conducted a Level 2 validation check for quality control purposes where 20% of the data was checked between the original and transcribed data. While such a process may be adequate, for this assessment where public scrutiny and confidence in the data are of paramount importance, it is suggested that the data validation should cover 100% of the data. Therefore, there can be no future criticism that the assessment might have missed something or faulty data was used.

4.2.2 Data Evaluation

The HHERA used the 95% confidence interval for the assessment. However, on page 13, it indicates that the 95% upper confidence limit (UCL) of the geometric mean of the log-transformed data was calculated for the exposure point concentration (EPC). This is different than the 95% UCL of the log-transformed distribution suggested for the EPC on page 15. Clarification should be provided on which is the value used. Typically, the geometric mean is determined by calculating the mean of log-transformed data.

Furthermore, there is no indication of how the confidence interval is derived. There are many ways that the confidence interval can be estimated based on a number of assumptions (*e.g.,* the data is normally distributed). Deviations from the assumptions may require a different approach to calculate the confidence interval. The HHERA does not provide any evidence that the data is either normally or log-normally distributed and that the method used to calculate the 95% confidence interval is applicable.

In addition, there is no indication of what proxy concentration was used for samples that had concentrations below the limit of quantification (LOQ). Typically, previous practices have used proxy concentrations of zero, ½ the LOQ, or the LOQ itself. The selection of a proxy concentration may have significant bearing on the calculation of the 95% confidence interval and the underlying assumptions regarding the data.

4.2.3 Contaminants Selected for Detailed Analysis

Screening of chemicals was conducted by comparison of the maximum concentrations with the generic guidelines. Chemicals were further screened by comparison of the EPC with the background soil concentrations (BSC). This approach is commonly accepted for determining the chemicals to be assessed in a HHERA. However, the use of Ontario Typical Range (OTR_{98}) as the representative BSC may be criticized since it can be argued that the soil conditions of the high arctic may be different than those found in Ontario. This is important in one respect because arsenic was observed to exceed the guideline in 15.6% of the Town Area data and yet was screened out because it did not exceed the OTR_{98}. Cadmium and zinc were included in the assessment with 9.48% and 4.31%, respectively of the Town Area data exceeding criteria. Because arsenic can be considered to have carcinogenic endpoints, it might be worthwhile to also evaluate the chemical, just like lead was screened out but also included in the assessment.

The HHERA compared the soil concentrations to the residential criteria for screening for the Town Area and the General Mine area and to industrial criteria for the dock area.

4.3 Exposure Assessment

The exposure assessment component of the HHERA considered most of the relevant exposure pathways for a receptor in the Town Area, Dock Area or General Mine Area.

Cadmium inhalation exposures were considered for an adult receptor. However, there is no discussion regarding inhalation exposures for lead and zinc for either the adult or toddler receptor. These exposures to lead and zinc should also be evaluated for the inhalation pathways, especially for the toddler who is a very sensitive receptor to lead exposures.

Table 6.4 describes the parameters used to calculate the appropriate SRQOs. However, the exposure duration and averaging time for non-cancer effects for a 6-month to 4-year toddler is 4.5 years. However, this might be argued that the value should be only 3.5 years.

Similarly, the soil ingestion of a toddler is 41 mg/d. Typically, CCME recommends the use of 80 mg/d for a toddler. The difference is the soil ingestion rates was based on the assumption of the period of snow cover associated with the winter months would prevent direct contact with the soil. While this is an important distinction in cancer assessments where exposures would be averaged over a lifetime, non-carcinogenic threshold exposures do not have the luxury of averaging over a lifetime. Therefore, it would be more prudent to suggest that the soil ingestion rate for a toddler should remain as 80 mg/d.

In the estimation of total daily intakes, the determination of background drinking water concentrations is based on the selection of drinking water concentrations from national surveys. The selection of median concentrations from such surveys may not be appropriate given that the area may naturally have elevated concentrations of metals due to the source geochemistry. The background drinking water concentrations should take advantage of any surface water data available from East Twin Lake where the Town sources its drinking water supply.

The exposure assessment indicated that the consumption of wild game would be considered in the HHERA. However, there is no indication in Table 6.8 that the exposure pathway was considered. Furthermore, there was no discussion on how the wildlife consumption pathway would be integrated into the process.

4.4 Toxicity Assessment

In the selection of toxicity values, a noncarcinogenic exposure limit for cadmium via inhalation exposure routes was not available. With zinc, however, the exposure limits for both ingestion and inhalation routes are identical. A review of the reference for the zinc exposure limits indicates that there is no inhalation exposure limit. It is assumed therefore, that the zinc inhalation exposure limit is based on a route extrapolation of the ingestion exposure limit. Given this, there is no indication why a similar route extrapolation was not assumed for cadmium exposures.

The HHERA used a target cancer risk of one in a million for the assessment of cancer effects. This is an extremely conservative target risk and can be considered overly protective given the isolated location of the Site and the population of residents in the area. Typically, acceptable risks in risk assessments may range from one in ten thousand to one in a million.

4.5 Risk Characterization

The risk characterization component of the HHERA focused primarily on the derivation of the safe concentration in the soil (SSTL) for noncarcinogenic chemicals and incremental risks due to carcinogen exposures. Comparisons were then conducted to evaluate the relative contribution of each of the exposure pathways on the total dose of the receptor and the tolerable daily intake of the chemical. For all of the noncarcinogens, the tolerable daily intakes were not exceeded for cadmium, lead or zinc.

However, it was not possible to evaluate these calculated SSTL since there was no worked calculation demonstrating how the SSTL was derived. The generic equation and parameters were provided in Appendix C, but not the worked example. Typically worked examples are given to indicate that the calculations in the HHERA were correctly calculated.

Similarly, it was shown in the risk characterization that wild game consumption was a viable exposure pathway. However, there is no discussion or calculations showing how the predicted intake by this pathway was calculated. It is unclear how the soil concentration was used to determine a tissue concentration in the wild game and eventually a dose into the human receptor. There was insufficient information on this to adequately validate the mathematical models used to evaluate this exposure pathway.

Carcinogenic risks were evaluated using a composite receptor rather than just evaluate the risks for an adult receptor. The CCME approach typically assesses the carcinogenic risks for an adult receptor. There was no discussion regarding the deviation from the CCME protocol, especially since the rest of the HHERA had adopted the CCME approach.

In the Uncertainty Analysis, there was discussion of summing hazard indices between compounds. However, the HHERA did not calculate any hazard indices and therefore, these comments are unnecessary.

5.0 Conclusions

Based on the review of the HHERA, AMEC is of the opinion that the assessment adequately addresses the potential risks to human receptors at the Nanisivik Mine. The issues identified above, once addressed, are not significant enough to invalidate the HHERA.

AMEC Earth & Environmental Limited