

**Report To The Advisory Council  
Of The Minnesota Pollution Control Agency  
Mercury Contamination Reduction Initiative**

**CRITERIA COMMITTEE REPORT ON THE  
STRATEGY EVALUATION PROCESS AND CRITERIA DEFINITIONS  
May 1998**

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## 1.0 Introduction/Background

The Minnesota Pollution Control Agency (MPCA) has undertaken a project called the Mercury Contamination Reduction Initiative aimed at reducing mercury contamination of fish in Minnesota lakes. As part of the initiative, the MPCA formed an Advisory Council to provide the MPCA with recommendations on mercury-reduction strategies for the agency's consideration.

The Advisory Council process has been divided into three phases. The purpose of Phase I is to gather information needed for identifying the actions that have the greatest potential for achieving significant and cost-effective reductions in mercury contamination. During Phase II, strategies for reducing mercury releases and mercury contamination will be evaluated using a set of clearly defined criteria. Under Phase III the Advisory Council will formulate recommendations, using the information collected during the first two phases to support their decisions. The flowchart shown in Figure 1 and described under Part 2.0 below presents the Initiative's phases and schedule.

In October 1997, the Advisory Council formed two committees to collect information in Phase I and to prepare for evaluating strategies in Phase II. The Criteria Committee identified and defined the criteria by which mercury reduction strategies will be evaluated. The Criteria Committee also developed a detailed proposal for evaluating strategies. The other committee, the Source Reduction Feasibility and Reduction Strategies Committee (SRFRS), developed data on the sources of mercury in Minnesota and the sources' options for reducing mercury releases. That committee's report has been provided to the Advisory Council as a separate document.

## 1.2 Committee Goals

The mission of the Criteria Committee, as stated in the proposal for forming subcommittees dated October 22, 1997, was to "very specifically define what is meant by each criterion, and add criteria not currently on the list if warranted. If possible, the definitions will include a component which provides for a quantitative analysis based on that criterion (e.g., "economical" means that implementation of the reduction option will not increase product cost by X%)." )"

At the committee's first meeting on November 4, 1997, co-chair Gail Lewellan, enumerated the committee goals as follows:

- 1) Identify appropriate criteria for evaluating mercury reduction strategies.
- 2) Provide specific definitions of the criteria to ensure they are used with a common understanding of their meaning. Group and prioritize criteria as appropriate.
- 3) Any other activities needed to prepare for conducting the strategy evaluation phase.

### **1.3 Summary of Results and Conclusions**

#### **1.3.1 Goal: Identify appropriate criteria**

The committee has identified a comprehensive list of criteria for evaluating mercury reduction strategies.

#### **1.3.2 Goal: Provide specific definitions of the criteria, and group and prioritize criteria**

The proposed definitions for each criterion are shown in Part 3 of this report. The context within which the criteria will be used is an important part of understanding them. This is shown on Figure 1 (Strategy Development and Evaluation Procedure), as well as under “applicability” for each definition. The procedure and applicability descriptions also provide information regarding priority, e.g., under Phase III, “fairness” is a primary criterion, while “verifiability” and “transferability” are secondary (“extra credit”).

#### **1.3.3 Goal: Other activities needed to prepare for conducting the strategy evaluations**

**1.3.3.1** The committee recommends that the procedure shown in Figure 1 be used to develop and evaluate strategies. The process will produce a set of preferred strategies for the Advisory Council to use as a basis for forming its final recommendations. Results of economic analyses, estimates of reduction potential, and other relevant information regarding each strategy will also be provided to the Council.

**1.3.3.2** The committee recommends that strategies be compared using criteria to rank them relative to each other (e.g., using “high, medium, low”). The committee did not set “thresholds” (e.g., \$xx,xxx/lb for cost effectiveness), although the subject was discussed at length. The Committee ultimately felt that reaching a consensus on threshold levels would be contentious and time consuming. However, the Council may elect to set a threshold for one or more criteria if it determines that this is warranted. As more information becomes available, logical points of division may become apparent that would make setting a threshold easier.

#### **1.3.4 Goal: Inform the Source Reduction Feasibility and Reduction Strategies Committee**

The committee provided recommendations and information to the Council and SRFRS Committee on a regular basis. In particular, the committee worked with SRFRS to develop the Phase I process and criteria definitions.

#### **1.3.5 Conclusion**

The committee work products consisting of the definitions and procedure contained in this report, and the “Methodology for Determining Cost-Effectiveness” (Reference 1), fulfill the committee goals and tasking. As they work through the initiative process, MPCA staff and Advisory Council members will continue to have new insights that may lead the Council or future committees to make changes to the Criteria Committee’s recommendations. The recommended procedure and criteria definitions presented in this report provide a good foundation for the Phase II committee(s) to build on.

## 1.4 Committee Process

The committee began with the attributes of a good mercury reduction strategy as listed on the MPCA's September 1997 fact sheet:

comprehensive	flexible
economical	compatible with pollution prevention
educational	technically supported
effective	transferable
fair	verifiable

Early in the committee process, the Source Reduction Feasibility and Reduction Strategies Committee requested that the Criteria Committee define "cost-effective" because it had become apparent that cost-effectiveness would be an important criterion. That committee needed a standard for calculating the cost-effectiveness of various options ("options" being the methods mercury sources can use to reduce mercury releases). The Criteria Committee responded by developing a paper which discusses calculating cost-effectiveness in detail (Reference 1), as well as a short definition of cost-effectiveness (shown in Part 3.2 below).

It became apparent, as committee work progressed, that some criteria were needed for evaluating the options being developed by the Source Reduction Feasibility Committee, others would be used only to evaluate strategies actions taken by government or others to encourage implementation of options for reducing mercury releases or contamination), and some would be used for both purposes. Therefore much of the Criteria Committee's work to develop the evaluation process included designating which criteria would be used at each stage of the process.

As the committee proceeded the list of criteria became both broader and more refined. "Educational" and "compatible with pollution prevention" were omitted, because they were more appropriately considered strategies than criteria. "Effective" was omitted because it is covered by other criteria.

"Cost-effectiveness" embraces the two concepts "economical" and "effective." "Reduction potential" incorporates the notion of "effectiveness" in terms describing the probable reduction in releases of mercury.

"Feasible" replaced "technically supported" and includes features such as political feasibility, as well. "Permanence" was an added criterion, recognizing that technologies that capture mercury and transfer it to another environmental medium from which it may eventually escape are not as effective as pollution prevention. "Compatible with existing laws," "political and social concerns," and the results of cost/benefit and regional economic impact analyses were also added.

The final list of criteria to be defined for use in developing and evaluating strategies is:

- feasibility (options and strategies)
- cost-effectiveness
- reduction potential (options and strategies)
- permanence
- compatibility with other regulations
- flexibility
- comprehensiveness
  - regional impacts
  - cost/benefit ratio
  - fairness
  - political and social concerns
- transferability
- verifiability

The order in which the committee recommends that criteria be applied to evaluating options or strategies is shown in Figure 1 and under Part 2.0 below.

## **2.0 Strategy Development and Evaluation Process**

It became clear that the Advisory Council needed a “road map” showing the process leading to recommending strategies. The Criteria Committee prepared the flowchart shown in Figure 1 to address this need. The flowchart shows the proposed procedure for developing and evaluating strategies following a logical and rigorous approach. A written description of the information contained in the flowchart is as follows:

The procedure has been divided into three phases. The purpose of Phase I is to gather information needed to identify the actions (“options”) with the most potential for achieving significant and cost-effective reductions in mercury releases. During Phase II, strategies for reducing mercury releases and contamination will be evaluated using a set of defined criteria. Under Phase III the Advisory Council will formulate recommendations, using the information collected during the first two phases to support their decisions.

Under Phase I, “Option Development and Criteria Definition,” two committees were formed to collect information in and to prepare for evaluating strategies in Phase II. One, the Criteria Committee, was asked to define criteria and recommend an evaluation procedure. The other committee, the Source Reduction Feasibility and Reduction Strategies Committee (SRFRS), was asked to a) produce a comprehensive lists of options for each source, b) prioritize options to identify the most feasible options, c) gather data on cost-effectiveness, reduction potential, and permanence of most feasible options; and, d) summarize data in useful format for developing strategies. Although the SRFRS Committee collected data on cost-effectiveness and other criteria, only one criteria, “feasibility,” was used during Phase I. The SRFRS Committee only collected detailed information regarding options which they believe to be most “feasible” as defined under Part 3.0 below. Results of Phase I are provided to the Advisory Council for review and approval.

Phase II is subdivided into three steps. Under Phase II-a, “Strategy Development,” a combined SRFRS and Criteria Committee will describe strategies that encourage implementing the options that are most cost-effective and have the highest reduction potential, considering permanence and commenting on flexibility and compatibility. This “long list” will be provided to the Advisory Council for review and approval.

Under Phase II-b, “Strategy Analysis Stage 1,” a Screening and Evaluation Committee will evaluate strategies, using information provided under Phase II-a, and recommend a “short list,” using the following predominantly qualitative criteria to narrow the list: comprehensiveness; feasibility of strategy (technical, economical, reduction potential, social factors); flexibility; and compatibility with other regulations and initiatives. The SRFRS Committee will provide additional details and revise strategies as needed to allow the Screening and Evaluation Committee to form recommendations to the Advisory Council.

After receiving approval from the Advisory Council regarding the strategies “short list,” Phase II-c, “Strategy Analysis Stage 2,” calls for two subcommittees of the Screening and Evaluation Committee to analyze the contamination reduction potential and the economic impacts for the remaining strategies. (Economic impacts include regional impact analysis and cost-benefit studies.) The Screening and Evaluation Committee will rank strategies based on the results of this more detailed analysis.

The final phase, Phase III, “Final Strategy Selections,” the Advisory Council will select one or more strategies to recommend to MPCA, considering the committee evaluations and recommendations, i.e., the results of all analyses completed under Phase II. In addition, the Council will use the criteria “fairness” at this stage as an additional factor in their decision. Secondly, three additional criteria will be considered as extra credit: political/social concerns; transferability; and verifiability. Other information which that the Council may also wish to consider when making their final decision, such as information on health and wildlife impacts of mercury contamination, will also be provided throughout the process.

**Timeline:**

Phase I	October, 1997 - April, 1998
Phase II-a	May, 1998
Phase II-b	June, 1998
Phase II-c	July-August, 1998
Phase III	September-October, 1998

### 3.0 Criteria Definitions

The Criteria Committee developed a series of definitions for use in evaluating options and strategies. They are listed here in order as shown in the flowchart.

#### 3.1 Feasibility

*Source Reduction Feasibility And Reduction Strategies  
Committee members apply professional judgment  
(qualitative basis) and available information on the  
following criteria:*

- Technical capability ≡ availability of the physical means to reduce mercury releases
- Economical ≡ ability to compete economically
- Reduction potential ≡ the option's likely effect on mercury releases
- Social factors ≡ political acceptability, with "set asides" subject to Advisory Council approval

Applicability: "Feasibility" was used at Phase I-b (see Figure 1) to focus data-collection efforts on a shorter list of reduction options that have the most promise. It is to be used in a similar fashion at Phase II-b to narrow the initial list of reduction strategies.

Examples:

Three of the options initially considered for reducing mercury emissions from utilities were set aside using the feasibility criterion, based on committee members' knowledge of current conditions:

- a) Corona discharge/plasma systems are not technically feasible because these systems are in the very early stages of research and development. They will not be available for many years, if at all.
- b) Replacing coal with nuclear energy was set aside because of political concerns regarding siting new nuclear generating plants.
- c) Replacing coal with solar energy was set aside based on its low reduction potential. Solar sources are not likely, in Minnesota, to replace coal-based generating capacity.

**3.2 Cost-Effectiveness**

$$\frac{\text{Total annualized cost (\$)}}{\text{Total annual reductions (pounds)}}$$

Cost-effectiveness is expressed as dollars per pound of mercury reduced. All other things being equal, an option that costs \$1,000 to reduce one pound of mercury would be preferred to an option that costs \$2,000 per pound.

Applicability:

SRFRS are tasked under Phase II-b with “describing strategies that encourage implementing the options that are *most cost-effective*....” Cost-effectiveness affects which options are preferred over others. Cost-effectiveness data will also likely be used to prepare input data for economic impact models.

Examples:

Control Technology	Cost per lb Removed (\$/lb)	Level Reduced (%)	Total Potential Reductions	Source
Activated carbon injection applied to municipal waste combustors	\$211-870	90% (nationwide)	50 tons/year	EPA June 1996
Process modifications to chlor-alkali plants	\$400-2,600	100% (Wisconsin & nationwide)	6.5 tons/year	Egan 1997; EPA June 1996
Fluorescent lamp recycling	\$2,702-5,405	unknown (Minnesota)	up to 930 lbs/year	MPCA 1994
Activated carbon injection applied to coal-fired power plant boilers	\$5,240-28,000	50-90% (nationwide)	24-44 tons/year	EPA June 1996

**3.3 Reduction Potential**

- *Annual reductions of mercury releases*
- *total reductions over 20 years*
- *potential effects that reductions of mercury releases will have on mercury contamination in fish*

Applicability: Data on the potential for reductions in mercury emissions or use resulting from various options has been collected as part of Phase I data gathering. This data will play an important role when SRFRS develop strategies designed to reduce mercury releases by varying degrees (Phase II-a). A more in-depth look at the expected results of different strategies, focused on *contamination* reduction potential, will occur as part of Phase II-c.

Examples: Evaluations of *contamination* reduction potential will probably not be as precise as are other reduction potential estimates. Narrative discussion can be used to describe the reasons for general classification as “low, medium or high.”

Options	Reduction Potential							
	Annual (lbs.)			20-year (lbs.)			Contamination	
	Air	Water	Land	Air	Water	Land	Class	Discussion
A.	10	2	8	200	40	160	low	
B.	0	5	0	0	100	0	medium	
C.	100	25	75	2,000	500	750	high	
D.	10	2	8	100	20	80	low	

### 3.4 Permanence

*the duration of mercury reduction options, taking into account:*

- *re-emission possibilities*
- *transfer of mercury from one medium to another (e.g., air to water)*

Applicability: SRFRS should give preference to options which are most permanent when developing strategies (under Phase II-a). Facets of this criteria (e.g., re-emission potential) may also be considered as part of the analysis of the contamination reduction potential of strategies under Phase II-c.

Examples: Mercury reduction options vary with respect to long-term effects. Some promise indefinite reductions. Others imply delayed releases over different time periods. A general classification, with discussion, should help evaluators rank options with respect to permanence.

Options	Permanence	
	Rank	Discussion
<b>A. Carbon injection on a coal-fired boiler</b>	low	In the long term, this option transfers mercury from one medium (air) to another (land). It reduces mercury releases for a time, but slow releases of mercury from the ash may occur, depending on how it is managed (e.g., utilized vs. landfilled). Further study and review of available data is needed to estimate how close to “permanent” the option is.
<b>B. Substitute mercury-free products</b>	high	Some options, mostly associated with pollution prevention programs, may yield mercury reductions that will continue indefinitely and will not result in transfer of mercury from one media to another.

**3.5 Compatibility**

*Consistency with other programs and initiatives. A negative measure of compatibility might be the degree to which a mercury reduction strategy conflicts with other programs and initiatives.*

Applicability: Although the SRFRS, in developing strategies, should provide comments regarding concerns they have with compatibility of strategies, the decision regarding whether compatibility is a significant enough issue to cause a strategy to be set aside should be made by the Screening and Evaluation Committee under Phase II-b.

Examples: Evaluators indicate whether there are conflicts with federal, state or other programs (MACT, Binational Strategy, etc.). If conflict is anticipated, evaluators should estimate the strength of the conflict and discuss whether Minnesota may have enough influence to effect a change.

Strategy	Federal	State	Other
A.	Strong conflict. Minnesota is unlikely to have much influence with respect to changes in federal law.		
B.		Relatively low. Program inconsistencies can be negotiated locally.	
C.		Moderate. Changing state law requires more time, but conflict generally remains localized.	

**3.6 Flexibility**

*Flexibility includes two considerations:*

*A. Can the strategy itself be readily changed in the future, i.e., is it responsive to change? and*

*B. Does it allow affected sources to decide site-specific details regarding what actions to take?*

A variety of factors can influence the appropriate mercury reduction or contamination reduction strategies to be implemented – science, technology, economics, political issues. Ease of adjustment to change influences a strategy’s long-term prospects of success.

Applicability: SRRFS, in developing strategies, should provide comments regarding the flexibility of strategies. Under Phase II-b, the Screening and Evaluation Committee will rank strategies to identify those which are most flexible, and consider the results when deciding which strategies to recommend for further analysis.

Examples:

	<b>Flexibility</b>	
<b>Strategy</b>	<b>Rank</b>	<b>Discussion</b>
<b>State-level education</b>	High flex.	Information materials can be edited and distributed rather quickly.
<b>Federal law technology requirement</b>	Low flex.	Significant efforts needed to make changes.
<b>Early reduction credits</b>	Moderate	Some permitted sources can make rapid changes. However, significant effort may be required to make changes in state regulations or policies, which may make change difficult for other permitted sources if permit modifications are required.

### 3.7 Comprehensiveness

*The extent to which a mercury contamination reduction strategy applies to all emission sources*

Broad coverage of mercury release sources is an aspect of fairness that committee members agreed should be used to evaluate strategies. All other things being equal, it is better to maximize the number of sources that contribute to reductions of mercury contamination. This way, no one source is singled out. The committee’s recommendation is consistent with the MPCA’s objectives for the Mercury Contamination Reduction Initiative.

Applicability: The Screening and Evaluation Committee, under Phase II-b, will rank strategies to assess their relative comprehensiveness, and consider the results when deciding which strategies to recommend for further analysis. Applying the “comprehensive” criterion will be a matter of determining how many sources will be affected, or how many will be excluded, under a particular mercury release reduction strategy.

**3.8 Economic Impact**

*The net effects of a strategy on regional jobs, personal income, etc.*

An effective mercury reduction strategy will probably also have some effect on our region's general economy. Reducing or controlling mercury emissions - work that has begun in only some industrial sectors - will require shifting some economic resources (e.g., capital to pay for new equipment, labor to operate and maintain it) from other sectors. The economic impact(s) of a given change can be significant or minor, depending on how the change is designed and scheduled. For example, recent emission fee studies in Minnesota found that using fee proceeds to reduce taxes may yield positive economic results, so long as fee proceeds are spent the right way.

Advisory Council discussions have, at various times, suggested that economic impact analyses should estimate the interrelated effects of policy changes with respect to: individual firms, local businesses, Minnesota's economy, a multi-state region of unspecified extent, the national economy, and international trade. No single model can cover this range. However, current study efforts and available models can address some economic impacts at each recommended level of analysis. SRFRS committee members are now collecting information about the costs of mercury reduction options as they are or would be incurred at individual plants. Basic information about cost is a necessary input for the economic impact model that the MPCA uses. Other firms represented on the Advisory Council have economic data and impact models configured to cover regions that are both smaller and larger than the state. Economic impact models of any scope must be sensitive to interstate and international trade flows because modern economies cannot function without trade. A cooperative effort by Advisory Council members, drawing on the experience and resources of different organizations, should yield economic impact estimates that address most, if not all, of the Advisory Council's economic impact questions.

Applicability: Under Phase II-c, the Economics Subcommittee will conduct economic analyses to assess impacts of the strategies on the "short list." The results of the analyses will be provided to the Advisory Council for use in making their final recommendations.

**3.9 Cost/Benefit Analysis**

*The cost of reducing mercury releases divided by the value of the damage caused by mercury contamination*

A mercury reduction strategy's economic benefits should exceed its economic costs. Reducing mercury releases is expected to lead to physical effects that will yield economic benefits. Lowered mercury releases should reduce mercury concentrations in lakes, leading in turn to reduced mercury concentration in fish tissues. People and animals that eat fish should enjoy improved health as their mercury intake decreases. Health improvements, in both human and animal populations, have value as economic benefits. Some mercury reduction strategies also seem likely to yield significant secondary benefits. Energy conservation strategies, for example, will yield both

direct (for purposes of this analysis) benefits from reduced mercury contamination and indirect (complementary, secondary) benefits from reduced emissions of other pollutants.

Environmental benefit values are generally harder to estimate than direct costs (e.g., control equipment, input substitution), which derive from prices that occur in existing markets. All other things being equal, the preferred alternative should be the one with the lowest cost/benefit ratio.

Applicability: same as for cost-effectiveness.

**3.10 Fairness**

*The distribution of the economic burdens among affected sectors.*

Committee members have agreed that comprehensive coverage is an appropriate element of a fairness criterion. Extensive program scope roughly equals fairness. The more emission and contamination sources covered by a program, the more fair the program is. A second element for the fairness criterion is proportionality of the costs incurred and a sector’s contributions to environmental mercury contamination. For example:

	<b>Strategy 1</b>		<b>Strategy 2</b>	
<b>Sectors:</b>	<b>Contribution</b>	<b>Cost incurred</b>	<b>Contribution</b>	<b>Cost incurred</b>
<b>A</b>	20%	25%	20%	50%
<b>B</b>	80%	75%	80%	50%

Under the proposed criterion, Strategy 1 would be considered more fair than Strategy 2.

Applicability: The Advisory Council will consider fairness, along with results of economic impact analyses and other relevant information, when making final recommendations under Phase III.

**3.11 Political and Social Concerns**

*Qualitative evaluations of political factors and social acceptance such as impacts on sensitive populations and minority communities*

The Advisory Council will evaluate effects on a) pregnant women and other women of child-bearing age, b) communities in which people eat a lot of fish from Minnesota lakes and c) small business impacts. Impacts on personal income should also be taken into account under this criterion.

Applicability: This is an “extra credit” criterion to be considered by the Advisory Council under Phase III, “Fairness,” and the criteria considered in the previous phases take priority. However, all else being equal, a strategy which has fewer political or social downsides should be preferred.

**3.12 Transferability**

*The extent to which a system can be adapted readily in other states.*

Minnesota emission sources contribute less than 10 percent to the total mercury deposition in Minnesota; i.e., most mercury deposited in Minnesota comes from outside sources, while most mercury released in Minnesota is deposited outside the state. Advisory Council members should consider whether a strategy can serve as a model that could help other states/provinces or EPA to adopt mercury reduction strategies, or for other reasons would be likely to lead to reduced mercury releases from sources outside of Minnesota.

Applicability: This is an “extra credit” criterion to be considered by the Advisory Council under Phase III, “Fairness,” and the criteria considered in the previous phases take priority. However, all else being equal, a strategy which is more transferable should be preferred.

**3.13 Verifiability**

*Data availability (cost and timeliness of data collection)*

This criterion relates to program enforcement and evaluation. The MPCA is often asked to provide data (for internal use, for legislators, EPA, and others) which shows how effectively a program is meeting its goals. It would be appropriate to call for regular evaluation of mercury reduction strategies to check their effectiveness. Data availability defines the appropriate measure for this criterion. For example, a system of conventional standards that requires monitoring and reporting would likely rank higher under this criterion than a voluntary recycling system that has no reporting requirements.

Applicability: This is an “extra credit” criterion to be considered by the Advisory Council under Phase III, “Fairness,” and the criteria considered in the previous phases take priority. However, all else being equal, a strategy which is more verifiable should be preferred.

**4.0 Conclusion**

The committee work products, consisting of the definitions and procedure contained in this report, and the “Methodology for Determining Cost-Effectiveness” (Reference 1), fulfill the committee goals and tasking. As they work through the initiative process, MPCA staff and Advisory Council members will continue to have new insights that may lead the Council or future committees to make changes to the Criteria Committee’s recommendations. The recommended procedure and criteria definitions presented in this report provide a good foundation for the Phase II committee(s) to build on.

## 5.0 Committee Membership

Criteria Committee members volunteered to serve on the committee or were solicited by MPCA staff or other committee members. They include some members of the Advisory Council, alternates, and other interested persons.

### Criteria Committee and Subcommittee Members

MPCA staff: John Seltz, Bob McCarron, Carol Andrews

Stacey Davis	Center for Clean Air Policy
Lee Eberley	Northern States Power
Rebecca Flood	Metropolitan Council Environmental Services
Amy Fredregill	Izaak Walton League of America
Ann Glumac*	Iron Mining Association
Keith Hanson	Minnesota Power
Gail Lewellan*	Department of Natural Resources
Clifford Porter	Lignite Energy Council
Mike Robertson	Minnesota Forest Industries
Molly Sigel	Center for Energy and Economic Development

\* Committee co-chairs

## 6.0 References

1. "Methodology for Determining Cost-effectiveness," developed by the Center for Clean Air Policy and the Minnesota Pollution Control Agency for consideration by the Criteria for Reduction Committee, January 1998.
2. "Proposal for Forming Committees" as approved by the Advisory Council on October 22, 1997.

# STRATEGY DEVELOPMENT AND EVALUATION PROCEDURE

