EPA'S DATA ATTRIBUTE RATING SYSTEM

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ABSTRACT

The U.S. Environmental Protection Agency (EPA) has developed the Data Attribute Rating System (DARS) to assist in evaluating data associated with emission inventories. The system disaggregates emission inventories into emission factors and activity rate, then assigns a numerical score to each of these two components. Each score is based on what is known about the factor and activity parameters, such as the specificity to the source category, the spatial (geographical) congruity, the measurement or estimation techniques employed, and the temporal congruity. The resulting emission factor and activity rate scores are combined to arrive at an overall confidence rating for the inventory. Though numerical values are generated, the system is only semiquantitative. However, DARS is believed to be a useful tool and may provide more information about inventories than the usual qualitative grading procedures (e.g., A through E) used to characterize data (e.g., in EPA's Compilation of Air Pollutant Emission Factors). The individual rating components are presented, and the attribute evaluation techniques are discussed. The development rationale and history are described, and recent enhancements such as DARS software are presented.

BACKGROUND

Emission inventories are developed and used by policy makers and scientists to study emission trends. Because of the great variety of data and range of techniques used, the inventories vary considerably in their reliability and accuracy. Because of this, there is a need to compare emission estimates for different sources where widely different methodologies have been employed in their development. An inventory rating system can help to compare and evaluate inventories. This paper outlines an emission inventory rating concept--the Data Attribute Rating System (DARS)--that has been developed by the Air Pollution Prevention and Control Division (formerly the Air and Energy Engineering Research Laboratory) of the U.S. Environmental Protection Agency (EPA) Office of Research and Development. The DARS methodology was reviewed by EPA's Office of Air Quality Planning and Standards, and found to be of interest for further analysis to determine applicability for Agency emission inventory assessment. The subsequent evaluation was performed largely within the program called the Emission Inventory Improvement Program (EIIP). The EIIP is a jointly sponsored effort of the State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officials (STAPPA/ALAPCO) and EPA, and is an outgrowth of the Standing Air Emissions Work Group (SAEWG). Funding is provided by state/local agencies through the federal 105 grant programs. The first paper on the DARS concept was presented at the Air and Waste Management Association conference on “The Emissions Inventory: Applications and Improvement” in 1994 (Beck et al., 1994). The concept met with considerable interest, and the EIIP committed to further development of DARS. A DARS workshop was held on July 12, 1995, in Raleigh, NC, and included participants from

Massachusetts, Virginia, North Carolina, South Carolina, and Texas. A second workshop was held on November 16, 1995, in Sacramento, CA, for West Coast participants. Based on the workshops, the suggestion was made that the methodology could further be facilitated by developing computer software to guide the user in the use of DARS. Computerization also offers the advantages of automating most calculations, preparing printed reports, and presenting an electronic record of the results. Additional information on the workshops and the DARS software is presented later in this paper.

INTRODUCTION

Data attributes or data quality indicators can never be absolute or totally quantitative. This is because of the subjective nature of the relative importance of the respective components of emission factors and activity rates. For instance, is it more important to have multiple measurements at one site or fewer measurements at more sites? How many measurements with state-of-the-art techniques does it take to equal a larger number of measurements taken using questionable methodology?

The DARS defines certain classifying attributes that are believed to influence the accuracy, appropriateness, and reliability of an emission factor or activity and derived emission estimates. The approach is semi-quantitative in that it uses numeric scores; however, scoring is based on qualitative and often subjective assessments. The DARS also disaggregates specific attributes of the data and methods utilized in the development of the inventory, thus providing perspective on the reason for the overall rating.

The approach described herein, when applied systematically by inventory analysts, can be used to provide a measure of the merits of one emission estimate relative to another. The DARS also provides the means for determining the comparability and transparency of rated inventories. The DARS rating system cannot guarantee that an emission inventory with a higher overall rating is of better quality, or more accurate, or closer to the true value. The inventory with the higher overall rating is **likely** to be a better estimate given the techniques and methodologies employed in its development. The DARS rating system not only provides data classifications according to **likelihood** of accuracy, but also disaggregates the approximations used in the development of the inventory into "attributes."

Given the dependence of major policy and regulatory decisions on emissions inventories, the paucity of quality determination mechanisms is surprising. The most commonly used quality ranking of emission factors is the "A" through "E" grading system used by the EPA in the publication "Compilation of Air Pollutant Emission Factors" (AP-42). The AP-42 ranking process is based on the quality and amount of data on which the factors are based (EPA, 1995). While this system has served its purpose well, it only addresses one facet of the many that determine overall inventory quality. Other attempts at addressing inventory quality tend to be similar to the AP-42 method, except that numbers are used (Middleton, 1993), or they concentrate on statistical uncertainty (Khalil, 1992). The methodology described by Middleton has advantages in that it allows for numerical treatment of data, but no guidance or method for determining the reliability designation is specified; therefore, the basis for the designation may not always be apparent to the user. The methodology published by Khalil is most useful when a range or standard deviation or other quantitative measure of emissions variability is available. For many inventories, these data are not available, so this method has limited usefulness.

Uncertainty is not always synonymous with quality for several reasons. The term is often used to denote variability; however, if the true variability of emissions is known, the certainty about the range of emissions is increased. Uncertainty is often impossible to quantify since the estimates may be based more on models and assumptions than on hard data. This is particularly true for inventories that encompass large spatial scales and that treat sources in aggregate rather than as individual point sources. Thus, the potential for introducing error increases due to the use of incorrect assumptions, improper models, or poorly correlated surrogates. Therefore, uncertainty analysis of inventories needs to consider both the quantitative aspects--which is more properly called variability and may be expressed in statistical terms--and the qualitative aspects.

THE DARS METHODOLOGY

A basic objective of the DARS methodology is to break down an emissions inventory into its components, and then evaluate the attributes separately. The two basic components of all emissions inventory data are the emissions factor, which addresses the amount of pollutant from a given operation, and the activity rate, which quantifies the number of operations addressed by the emission factor. The product of the emission factor and activity rate produces an inventory of emissions from a certain population of sources (which is defined by the activity rate). The emission factor and activity rate can be broken down further for analysis. Each component has individual measurement, specificity, spatial, and temporal attributes. By assigning numerical ratings to these attributes, the DARS not only enables an analysis of the overall inventory quality, but also identifies individual components of the inventory which are weak or strong. Additional detail and examples of application of the DARS were reported in the earlier paper (Beck et al., 1994).

Comparison of the methodology described in the earlier work with the DARS described in this paper will show that the number of attributes has evolved from five to four. The earlier "pollutant" attribute was not applicable for the activity rate and was closely related to the measurement and specificity (formerly called source definition) attributes for the emission factor. Consequently, pollutant specificity is now a component of the measurement and specificity attributes. The following discussion describes the current DARS attributes and the methodology for scoring an inventory.

Measurement Attribute

The measurement attribute is related to the type, quantity, and coverage of the measurements that were used to develop the value of the rate. For example, an emission factor that is based on repeated measurements of a large number of sources covering the range of typical operating conditions is of higher reliability than an emission factor that is based on a single measurement of one source when the factor is applied universally to all sources in a given emissions category. Similarly, an emission factor based on a mass balance analysis would typically be considered less reliable than one based on measurement data, and an emission factor based on an engineering assessment would normally be considered even less reliable.

The highest score (10) applies to emission estimates based on continuous monitors. Surrogate monitoring of the type specified for enhanced compliance monitoring may rate a 10 if it meets the same standards as a continuous emission monitor. If the "continuous" data set has many data gaps, however, its rank drops. The greater the gaps, the closer the data set comes to a "sample" of emissions data, which would be given a lower rating.

A similar analysis can be completed for the activity rate used to develop an emissions estimate. Activity rate, such as raw material feed or fuel consumed, for a specific source that is based on continuous measurement would be of higher quality than an activity estimate based on a related surrogate. For example, a measurement of the amount of fuel consumed in a boiler over a given period of time would be scored higher than a fuel consumption estimate based on a prediction of load demand for a certain process. Another example would be an estimate of mobile source activity based on a measurement of vehicle miles traveled on specific road segments. This has higher reliability than an estimate based on fuel sales and average miles per gallon or kilometers per liter in the fleet.

The lowest score applies if the estimated factor or activity rate (or emission estimate) is based on engineering or expert judgement. The inventory scorer will have to use some subjectivity for factors/rates falling between these two extremes. For example, first principles models are ranked lower than measurements of any kind. However, a model developed using first principles but calibrated or refined using measurement data might rank higher than estimates based on only one of these methods. The relative ranking is highly dependent on the nature of the source category; in general, the more that emissions are affected by the actual site conditions, the less representative laboratory measurements will be.

Finally, the scores for the emission factors and activity rates will generally be independent of each other for all attributes. For example, if nitrogen oxides (NO_x) emissions from industrial boilers in a region are estimated using an emission factor based on a representative sample of measurements from the boiler population, the emission factor rating might be high. If the activity rate (annual coal used) had to be estimated from a surrogate, the rating would be lower if the surrogate is not demonstrated to be well-correlated with the activity rate.

Specificity Attribute

The more specific the relationship between the factor or activity and the defined source category, the more likely the representativeness of the emission estimate. For example, a methane (CH_4) emission factor for enteric fermentation in dairy cattle could receive a 10 when applied to dairy cattle, a 9 or 8 if applied to all cattle, and a 6 or 5 if applied to all ruminants. Similarly, if the dairy cattle population is estimated from a surrogate such as number of dairy farms, it would receive a score in the 4 to 5 range. If emissions are estimated directly (e.g., CH_4 measurements from a feedlot containing 500 head of cattle), both the emission factor and the activity rate are given scores of 10 if the inventory is for the measured feedlot.

The lowest score is reserved for approximations based on analogy to similar sources with little or no statistical or other quantitative methods to support the estimate. For example, the assertion that CH_4 emissions from municipal wastewater are “roughly the same as from landfills” would be given a 1.

Note that this attribute is very different from the measurement attribute. Here the methods used to develop the factor itself are not in question. This attribute measures the appropriateness of using a particular factor for the defined source category. A factor could be rated very high for the first attribute, but receive a very low score here.

Spatial Attribute

Both emission factors and activity rates sometimes need to be scaled to match the spatial scale of the inventory. This is more important for some categories than others. For example, a sulfuric acid production plant in India would be expected to have the same emission characteristics as one operated in Louisiana, if the same operating practices are used. Rice production, however, would be expected to have different emission characteristics (e.g., of CH_4) because of different soils and agricultural practices.

Spatial scale incongruities are more critical for source categories that are affected by climate, terrain, or sociocultural variations. Consider for example, volatile organic compound (VOC) emissions from temperate hardwood forests on a global scale. An emission factor derived from field measurements of hardwoods in a small plot within the geographic region would receive a score in the 3 to 5 range for this attribute; if the emission factor were derived from samples throughout the range, the score would be in the 7 to 9 range. Note that the spatial attribute scores are independent of the method attribute score. If the sample sizes and methods were equivalent, both factors might receive high scores for the method attribute. The lowest score is given when a generic emission factor or activity rate is applied to all countries or regions. This generally occurs when no information is available to adjust or adapt the data for specific circumstances.

Temporal Attribute

Incongruities in time periods are also a source of inventory errors. Emission factors based on source testing may encompass a relatively short time period (hours or days). If used to estimate annual emissions, any temporal variability needs to be considered.

Emission factors and activity rate can be affected by seasonal influences and by changes between day and night. Activity rate can also be dependent on operations for the typical weekday and weekend day. The specific conditions that can affect the temporal variability of emissions data include but are not necessarily limited to temperature, wind speed, solar radiation, humidity, snow and ice ground cover, and soil moisture content. Biogenic sources are also dependent on the stage of the growth cycle. Any factors or activity rates that are developed for an average condition or a very specific condition will introduce uncertainty when applied to problems covering different time scales.

The scoring for this attribute reflects decreasing confidence as temporal incongruity increases. Some judgment is needed, however. A factor or rate based on daily data may give reasonable annual numbers if the process does not vary much. Sources with little temporal variability (e.g., industrial stacks) may rank a 10 for three samples in 1 week; highly variable sources (e.g., VOCs from trees) may rank in the 1 to 3 range for the same scenario.

As with spatial congruity, neither scaling-up nor scaling-down can be ranked higher. Either method can give good results if the underlying variability is included in the adjustment. For example, annual emissions in the State Implementation Plan (SIP) inventories are adjusted to give seasonal estimates using seasonal throughputs that account for fluctuations in activity. This approach would receive a higher score than simply dividing an annual estimate by the number of operating days per year.

Composite Scores and Quality Confidence Rating

The collective attribute scores provide an evaluation of overall uncertainty of inventory quality. Several methods for determining and combining the individual scores were evaluated.

<u>Totaling the Emission Factor and Activity Rate Scores</u>

After the individual scores are determined, they must be combined in some fashion to arrive at an overall score for the emission factor and the activity rate. This can be done separately for the emission factor and the activity rate by simply adding the scores of the individual attributes and dividing by the maximum total. This is the **additive** method. A more conservative approach is to multiply the quotients (of the individual scores divided by each maximum total). This **multiplicative** approach will always yield a smaller number than the additive approach (unless all the individual scores are 1.0), and the lower value(s) will have a greater impact on lowering the overall score than the additive approach. An argument for using the multiplicative approach is this: if one of the ranking components (e.g., the measurement technique) is of poor quality then the confidence rating (CR) should be downgraded beyond a simple averaging of the low number because of its detrimental effect on the overall inventory. Carrying this argument further, scores were evaluated using only the lowest scored attribute to represent the emission factor or activity rate CR. This would reflect the notion that the CR should be indicative of its **"weakest link."** For instance, if the emission factor is known to be of high quality except for one of its components, then the overall ranking should not be high or moderate regardless of the high-quality components.

The multiplicative and weakest-link approaches are believed to have merit for some attributes (e.g., measurement, specificity), but not necessarily others (e.g., temporal, spatial). To keep the DARS methodology as simple, free from subjectivity, and widely applicable as possible, the additive method is used to total the individual attributes to arrive at CRs for the emission factor and activity rate.

<u>Determining Combined Emission Factor and Activity Rate Scores</u>

For each attribute, the multiplication rule for probabilities is applied. Thus, the composite attribute CR is:

$$\frac{\sum_{i=1}^{4} (e_i * a_i)}{4}$$

where:

e_i = emission factor score for attribute i, and
a_i = activity rate score for attribute i.

By multiplying the two proportions, the composite confidence rating will always be lower than either of the individual values (unless both are 1.0). As noted earlier, this is more conservative than simply averaging the two.

TESTING OF THE METHODOLOGY

As discussed previously, the DARS was evaluated through the EIIP, and pilot studies of the DARS were conducted with state agency personnel to evaluate the usefulness of DARS for evaluating SIP and other regional inventories, and to determine if DARS can be applied consistently by different people. In the pilot studies, state agency personnel were trained in a 1-day workshop, and were asked to apply DARS to their 1990 base year SIP inventories (for point, area, and nonroad and onroad mobile sources). Workshop attendees were asked to provide the results of their DARS scoring exercises as well as comments on how the system could be improved.

As a result of these pilot studies, a number of improvements were made to the DARS. One area that was suggested for improvement concerned the difficulties that DARS users had in distinguishing between the measurement and specificity attributes. As a result of this feedback, additional guidance was provided in the DARS background information to clarify how the measurement and specificity activity attributes should be scored. The guidance clarified that the activity specificity attribute applies to the original activity variable that was used when the emission factor was developed. For example, using "pounds of coating" as the activity for architectural surface coating emissions would receive a higher specificity activity score than using "population." The activity measurement attribute applies to the actual data used to estimate emissions in the inventory being scored; if population is required by the emission method chosen, and if population is measured directly, a score of 10 is possible.

Another recommendation and revision concerned the rating of the mass balance approach to estimating emissions. It was recommended that the DARS take into account that mass balance may be given a fairly high score when used to develop emission factors if all endpoints are accounted for by the methodology, and if the process is evaporative or something similar so that mass balance is clearly a reliable alternative to direct measurement. It was also suggested that the spatial scale considerations include instances where emissions or activity from the same scale are adapted for use in another region. For example, the application of nonroad mobile studies for a specific metropolitan area to other areas.

DEVELOPMENT OF DARS SOFTWARE

One outcome of the workshops was a realization that software would facilitate the use of DARS. First, DARS software would serve to automate many of the data entry and processing needs. Software could reduce the labor involved, decrease transposition errors (by allowing electronic import), standardize procedural routines, and minimize calculation errors. Consequently, software was developed and tested by the potential user community (state and local control agencies).

The DARS software rates the four attributes described above for each emission factor and activity rate comprising an emission inventory, and computes a composite rating for the overall inventory. The DARS software also provides ratings for subsets of the inventory to provide a quality perspective on these subsets.

To work with an inventory imported into DARS or to enter a new inventory element into an existing DARS inventory, the user characterizes the session using the "Define Session" choice from the DARS main menu. Within the DARS software, an Inventory Element is any unique combination of the data that are shown in the Define Rating Session window. For example, an Inventory Element for an area source might be a 1997 VOC emission from a dry cleaner in Johnston County, NC. Or an Inventory Element for a point source might be a 1997 sulfur oxides (SO_x) emission from coal-fired utility boilers in Johnston County, NC.

Point sources are often too numerous to be entered and rated in DARS individually. To solve this problem, the software user's guide recommends grouping point sources into sets of similarly estimated sources and rating the point source sets as a single DARS element. Readers should refer to Appendix F of the EIIP guidance documents (EIIP, 1997) for more information on point source groupings. A copy of the EIIP guidance documents and appendices can be viewed on the Internet at http://www.epa.gov/oar/oaqps/eiip/qachaps.html.

After the desired emission inventory elements have been selected, the other menu functions at the top of the screen become active, allowing the selection of one of the following functions:

- Rate Factor Attributes - rates the emission factor attributes of the defined emission inventory element,
- Rate Activity Attributes - rates the activity attributes of the defined emission inventory element,
- Session Summary - shows a summary of the factor and activity ratings stored in DARS, and
- Reports - compiles reports on the emission inventory element and on the area of the emission inventory from which the element was derived.

These menu functions are discussed in greater detail in the user's guide, which can be viewed at http://www.epa.gov/docs/crb/apb/llbpage/dars.htm.

DARS is not preloaded with any source category codes or names at this time. Types of codes that may be entered include Source Category Codes (SCCs), Standard Industrial Classification (SIC) codes, and Area and Mobile Source (AMS) codes. To enter a SCC and name, the user will simply click on the ADD button and then enter the SCC and name. To see the list of stored source categories, the user clicks on the ADD button, followed by the LOOKUP button. The user then selects from the list of source categories and presses ENTER. Pollutants (the current DARS version is loaded with only the criteria pollutants) are entered and viewed similarly.

Once the information in each tab is completed, the user clicks the ACCEPT button. The remainder of the menu bar will become active, and the user will be able to rate the defined Inventory Element.

As mentioned above, large sets of inventory data can also be imported using an external spreadsheet, greatly facilitating the process of entering inventory elements. To import data from a spreadsheet, the user first must prepare the Import File in Excel 5.0. The import file may also be prepared in a more advanced version of Excel and saved as an Excel 5.0 file.

Once the user completes the spreadsheet and places it in the DARS directory, the spreadsheet is ready for importing into the DARS software for rating. To import an inventory, the user pulls down the "File" menu and selects "Import Inventory." The "DARS Source Category List Import Spreadsheet" window will appear. From this window, there are three options: Convert, Preview, and Import. The Preview option allows the user to verify data using the DARS Spreadsheet Data Browser prior to executing the actual import.

Conducting a DARS Rating Session

The DARS Rating Session is used to rate the emission factors and activity rate comprising an emission inventory element. To begin a rating session, the emission inventory element must first be selected. When the ACCEPT button is selected, the "Rate Factor Attributes" and "Rate Activity Attributes" choices become active at the top of the main menu, and the user can begin rating these attributes. Figure 1a shows "Rate Factor Attributes / Rate Using DARS Logic" selected.

For both "Rate Factor Attributes" and "Rate Activity Attributes," the user can choose to proceed through the DARS logic provided by the software or to bypass the questions and use a direct entry form. Until the user is well versed in the DARS rating process, it is recommended that the flow provided by the software be followed. The direct entry option is provided as a shortcut for the expert user who is familiar with the DARS logic scheme.

Rating the Attributes Using DARS Logic

When the user selects an attribute for rating, such as the "Measurement Rating" attribute under the "Rate Factor Attributes" menu, the software will bring up a screen similar to the one shown in Figure 1b. DARS then will present the first question in the appropriate DARS logic tree. The user then clicks on the most appropriate answer to the question among the options presented on the screen, and then "Accepts" the answer. The ACCEPT button advances the user to another question until the end of one of the flow chart branches is reached. The Q1, Q2, Q3, etc. buttons allow the user to move forward or back to previous questions.

The response to a question determines the flow chart branch for the subsequent questions. As the user reviews the questions, the user toggles between YES and NO depending on the response. Pressing ACCEPT on a YES response takes the user down one branch of the flow chart, while pressing ACCEPT on a NO response takes the user down another branch. The number of questions the user encounters varies for each flow chart and branch selected.

Pressing the ACCEPT button of the standard DARS rating completes the rating of this attribute. The user selects another attribute and repeats the process until all four of the emission factor attributes have been rated. The activity rate attributes are rated similarly.

Following the rating session the user may select the "Reports" menu which offers five options for reporting: Session, Inventory Element Summary, Geographic Summary, Source Category Summary, and Inventory Summary. The Session reporting option presents most of the information the user can see from the "Current Session Summary**"** window, as well as all of the values associated with the rated Inventory Element. These are the values that were imported or entered in the "Define Session**"** window. An example of the DARS Single Inventory Element Rating Session Report is shown in Figure 2.

Clicking on PRINT (shown as a printer icon) will print the report. Using the EXPORT function (shown as a suitcase icon) allows the report to be exported to commercial spreadsheet, database, or wordprocessing software for further analysis. The ZOOM icon allows the user to adjust the size of the report on the window (zoom in or out). Other utilities can be examined by reviewing the user's guide at the aforementioned Internet web site.

Testing of the Software

A first test of the DARS software by potential users (called a "Beta test") was completed in August 1997. The procedure was to provide the software and draft User's Guide to emission inventory specialists at state pollution control agencies. Many of the state agency personnel who participated in the pilot studies discussed above were asked to participate in the Beta Test program. The reviewers were contacted prior to the test period to assure that they were willing to participate in the test and could respond within the allotted time period.

For the most part the comments concerned how to make the software and user's guide more user-friendly and useful to state agency personnel. Some of the suggested improvements are discussed below:

<u>Provide More Specific DARS Methodology</u>

One of the most significant comments received was that the rating methodology should be tailored for evaluating point, area, mobile, and biogenic inventories separately. Several reviewers made this suggestion because the methods used to evaluate the quality of each type of inventory can vary significantly.

<u>Provide Additional On-line Help</u>

Some examples of comments provided to make the program more user-friendly pertain to the need for lookup screens for information such as SCC, SIC, and AMS codes with their descriptions. It was also suggested that a library of default or example ratings be developed and provided with the system, and that the software include some type of on-line help or on-line demonstration program.

<u>Expand the Import Utility</u>

A number of comments were received on the "Import Spreadsheet" function of the software. The DARS software was originally designed to import Excel spreadsheets; commenters requested that the program be able to import files in other spreadsheet and database formats, including formats such as the California Emission Inventory Development and Reporting System **(**CEIDARS).

<u>Increase Visibility of Rating Scheme</u>

In the rating sessions, several reviewers indicated that they would prefer a rating system based on flow charts such as those presented in the EIIP QA Procedures document (EIIP, 1997) rather than stepping through the rating logic in a series of questions. If the flow charts are not used, those working through a rating session would somehow like to see all of the subsequent questions as they move through the rating session.

<u>Provide Additional Reports</u>

After the rating sessions are complete, the user moves into the "Reports" menu option. A very good suggestion was provided that the user have a report for summarizing scores for a particular range (e.g., flag all scores below 0.3), pollutant, or attribute.

In addition, it was suggested that the user be able to more clearly identify the source, emission factor, or activity rate shown on the screen, as well as the inventory name. Some options suggested for solving this problem were to allow the defined data elements to remain displayed on the screen, or let the users rate the defined elements within the "Define Session" menu selection. One reviewer suggested that the program should allow the user to perform quality assurance (QA) and quality control (QC) checks to identify assigned scores that are different from those suggested in the EIIP QA Procedures document (EIIP, 1997).

DISCUSSION AND CONCLUSIONS

The DARS has undergone extensive examination following the first publication of the methodology in 1994. The most significant activities resulting from the reviews are the combination of the pollutant and specificity attributes and the development of DARS software. Though it is still a work in progress, no significant changes in methodology are anticipated. Version 1.0 of the software is expected to be available for general distribution by the end of 1997.

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Figure 1a. DARS software main menu with "Rate Factor Attributes / Rate Using DARS Logic" selected

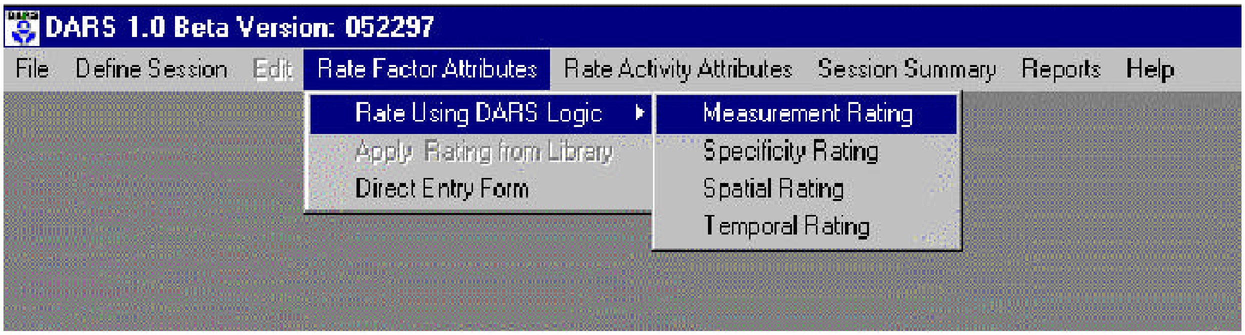

Figure 1b. DARS Emission Factor Measurement Attribute Rating screen.

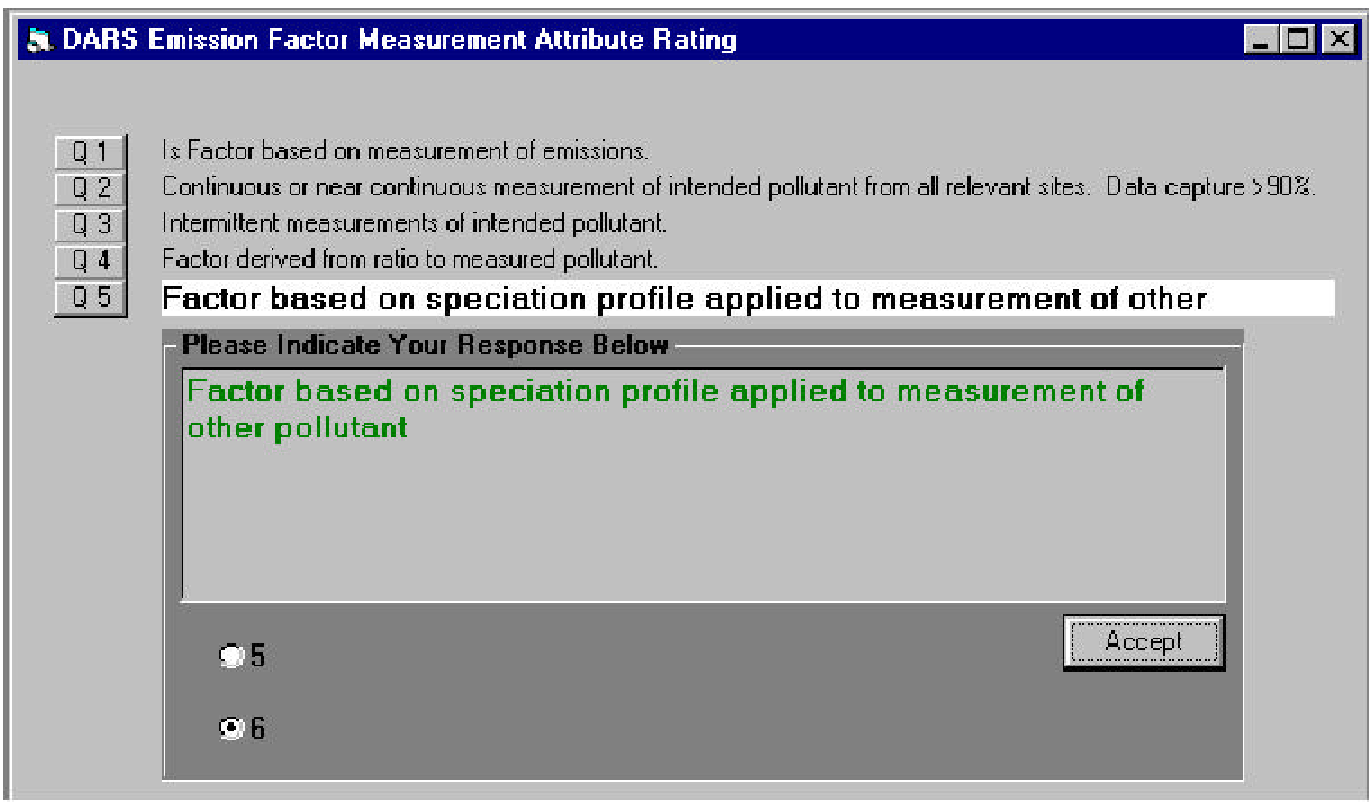

Figure 2. DARS single inventory element rating session report.

DARS SINGLE INVENTORY ELEMENT RATING SESSION REPORT

1995 Air-Criteria

PM-10

N/A
NC
COUNTY Johnson county

Source Type: Point
Source Category Code: 234324
Source Category Name: Boilers
Source Category Coding System:
Subcategory: 21
Emission Rate: 1.00

ATTRIBUTE	EMISSION FACTOR RATING	ACTIVITY RATING	EMISSIONS RATING
Measurement	0.60	0.30	0.18
Source Specificity	0.70	0.90	0.63
Spatial	0.70	0.80	0.56
Temporal	0.70	0.80	0.56
COMPOSITE	0.68	0.70	0.48