Memo 4C-3/94

To: Distribution 20 December 1973

From: H.D. Lemmel and NDS staff Lemmel

Subject: More-dimensional tables
Reply to Memo 4C-2/46

We regret that the discussion on this subject has become rather lengthy. We believe, however, that the table-formats under discussion (and we agree that such tables are badly needed!) imply extensive modifications for all EXFOR programs. Therefore it is vitally important that we be general enough to cover all cases which may arise in the forseeable future so that further extensive modifications are not needed at least not in the near future. The following arguments resulted from discussions among all NDS staff members involved in EXFOR.

We regret that NNCSC and CJD have not commented on Memos 4C-3/88 and 4C-2/46.

We wish to apologize that we were not able to reply earlier to Memo 4C-2/46.

In this memo, we wish to stress two items (among others of less importance):

1. Definitions and use of the pointers should be more flexible than envisaged in 4C-2/46.
2. Decisions about pointers, multiple isoquants, Z and A as variables, and treatment of more than 10 columns should be made simultaneously so that revisions in EXFOR programs need be made only once.

Happy New Year!

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1. Re 4C-2/46 p. 2 item 1:

We agree to the "types of numerical data information"

2. Re 4C-2/46 p. 2 item 2:

We agree that the line (4C-3/88 bottom of page 2) "- a column with Additional Information ..." can be dropped, this list of examples being anyway not comprehensive.

We see no reason to exclude pointers from the general rule of having all common BIB and COMMON information collected in subentry 001. Certainly, in most cases pointers will not show up in subentry 001; but there can well be cases where pointers in subentry 001 may be of advantage (compare flags). We see no complication from having pointers in subentry 001, since this subentry must always be considered, when one of the following subentries is processed.

However, our wording in 4C-3/88, item 2a, lines 3f was not good either, and we suggest the following reformulation:

"A pointer links pieces of EXFOR information together, for example:
- ....
- ....
- ....

In general, a pointer is valid for one subentry only; a pointer used in the first subentry must have a unique meaning throughout the entire entry." Cancel sentence: "A pointer must ..... in subentry 001."

3. Re 4C-2/46 page 3, middle:

We wish to use pointers for general purpose linkage. We do not wish to tie them to isoquants nor to the column sequence. We believe that both ties would lead to unnecessary restrictions or complications.

We do not understand why NDCC prefers to tie pointers to the column-sequence numbers. In particular, it is not explained, whether and how a different use of pointers would create difficulties in the NEUDADA-EXFOR-NEUDADA conversion.

In Appendix A we present some examples showing that the link between pointers and column-sequence number would create difficulties in some cases.

We disagree to the idea of assigning pointers to all columns. Pointers in the DATA table should be present only when they are really used. The presence of a pointer will be used as a signal to computer-programs that there is something linked to the column carrying the pointer. This should be stated explicitly in the Manual.

4. Re 4C-2/46 item 3:

We accept the NDCC proposal of column-heading hierarchies, if NDCC provides us with a listing of dictionary 24, in which the final flags to be entered have been written (similar to 4C-2/42). We believe however that a less complicated system of hierarchy flags may be adequate.

5. Re 4C-2/46 item 6.b; first paragraph:

We wish to revise the paragraph on the limitation in the use of the Multiple Iso-quants. The first paragraph under 6.b on page 7 of 4C-3/88 should be replaced by:

"As a guideline to compilers, this formalism can be used for inter-dependent data that were obtained from a common analysis, such as:

resonance-parameters;
elastic and partial inelastic data;
integral scattering data and Legendre-coefficients;
(n,p) and (n,np) data resulting from an analysis of the p-spectrum;
and similar cases."

Thus, contrary to our previous position (4C-3/88 page 7 item 6.b), we have decided to accept integral cross-section data in the Multiple-Isoquant formalism.

6. Re 4C-2/46 item 6.b, second paragraph:

We agree that the NDCC proposal on "more than one nuclide in the table" (4C-2/41, Section 7.(a)) may be a better way to code example 3c, however the solution shown in example 3c (4C-3/88 page 7) should be an acceptable alternative which may have advantages for certain cases, too. In cases where different alternatives are possible, the choice should be left to the compiler.

We agree that the above-mentioned NDCC proposal having Z and A as variables in the DATA table, should be implemented. In appendix B we present an example where the usefulness of the NDCC proposal becomes obvious. It should however be noted that the variable-Z-A-proposal makes indexing and retrieval programs far more complicated than the Multiple-Isoquant concept. Nevertheless, we recommend that the Multiple-Isoquant concept and the Variable-Z-A concept should be implemented simultaneously so that the affected Exfor-processing programs need be revised only once.

7. Re 4C-2/46 page 7 items 7 and 8:

Agreed.

8. Re 4C-2/46 page 8 item 10:

We agree that the feature of tables with more than 10 columns is important and should be implemented soon. To decide on the best way of implementation, it is however essential to consider not only the ease of compilation (compare item 55 page 12 of the minutes of the Moscow 4C-Meeting), but perhaps even more the economy of later processing of Exfor data. Compilation of an entry is done only once - processing of this entry is done more often, at least once at each receiving center. For our center, a more directly readable format of such tables in Exfor would definitely speed up the implementation. For illustration, see Appendix C. We believe that our arguments presented in 4C-3/88 page 9 are still valid.
We do not know the details determining at NNCSC and NDCC the most economical way of compiling and processing more-than-10-columns tables in Exfor, and we would like to receive the results of their assessment. As a center which has less occurrence of such tables than NDCC and NNCSC, we shall agree to the solution which appears most economical to them.

We appreciate very much that NDCC intends to provide a printing subroutine and we will gratefully accept such a subroutine for any solution that may be adopted. Note however, that each center will have to incorporate this subroutine at least into their own programs for listing and checking of incoming tapes, and into their customers' output programs with appropriate modifications for both cases. These programs would be much simplified if more-than-10-column tables were transmitted in EXFOR in a more directly readable format (compare case c in Appendix C). For the originating center the inconvenience (if any) of producing this more directly readable format would be probably less significant.

9. Re Implementation:

After discussing the pros and cons, we came to the conclusion that we shall accept entries having

* pointers,
* multiple isoquants, and
* Z and A of the target nucleus as independent variables

immediately after the rules have been agreed and entered in the Manual, even before our processing programs are adapted to these new features. Undoubtedly, this will create inconveniences in our operations, but we believe that the necessity and convenience of transmitting such entries at an early date are predominant. Our only condition is that we must be able, at any time, to produce readable outputs of Exfor entries received, which is a trivial problem for the three concepts above. However, entries with

* more than 10 columns

we will be able to accept only after we have the programs to produce a readable output within the processing-routines of incoming

Exfor tapes and within the production-routines of customers' listings. (We have not yet developed suitable methodology and programs for compiling such tables at our center and for checking and correcting them. This will be solved at a later date and need not be discussed here.)

We assume that

* two-dimensional tables with multiple independent variables in the form of examples 9a and 9b page 4 of 4C-3/88

can be transmitted immediately. We would like to have soon a corresponding Manual update with simultaneous cancellation of the TABLE-NR concept.

Appendix A: On the purpose and use of pointers

The following examples show that the NDCC proposal, namely to link pointers and column-sequence numbers, would create difficulties in a number of existing cases.

First Example: EXFOR rules allow that certain DATA columns are split up into DATA and DATA-APPRX, or DATA and DATA-MAX, both columns referring to the same iso-quant. If this case occurs in a multi-isoquant table (for example for resonance-parameters!) this can nicely be solved by:

BIB
ISO-QUANT 1(Z-S-A,$Q_1$)
2(Z-S-A,$Q_2$)

DATA

| EN-RES | DATA | 1DATA-APPRX | 1DATA | 2DATA-MAX | 2 |
|---|---|---|---|---|---|
| . | . | . | . | . | |
| . | . | . | . | . | |
| . | . | . | . | . | |

(Note: Instead of the pointers 1 and 2, any other pointers like 4 and L could be used. Pointers should not be linked to the sequence of the iso-quants nor to the sequence of the columns. Permitted pointers should be all digits and characters, except zero.)

According to the NDCC proposal, the example would probably be coded, by linking the pointers to the column-sequence, as follows:

BIB
ISO-QUANT 2(Z-S-A,$Q_1$)
3(Z-S-A,$Q_1$)
4(Z-S-A,$Q_2$)
5(Z-S-A,$Q_2$)

DATA

| EN-RES | DATA | 2DATA-APPRX | 3DATA | 4DATA-MAX | 5 |
|---|---|---|---|---|---|
| . | . | . | . | . | |
| . | . | . | . | . | |
| . | . | . | . | . | |

Of course, both proposals convey the correct information, which is certainly the most important aspect. But it seems to us that the first version is clearer and simpler and that there are no advantages to the second version, which also brings unnecessary indexing and retrieval complications, when an iso-quant for the same data-type appears repeatedly, although it refers to one data-set only.

Second Example: Consider the case of various resonance-parameters given for various nuclides, one nuclide per subentry within one entry; the subentries may have quite similar structure, but the sequence number of columns may be different due to an inserted column such as a flag, an error, a DATA-APPRX.

For the purpose of clarity and to avoid possible sources of error, the compiler should try to (not: must) use the same pointer for the same purpose throughout an entry. This convenience is not given in the NDCC proposal.

Third Example: The sequence-number of columns in EXFOR may be rather incidental and therefore not suitable to define the pointers:

a.) Relatively frequently we insert an additional error-column as a result of a proof-copy coming back from the author. It would be annoying to have to change all the pointers in such a case when the sequence-numbers of the columns change.

b.) For our computation format we shall have to suppress or re-arrange certain columns; a COMMON value will have to be converted to a column in the DATA section; we shall have to retrieve a single iso-quant from a multiple-iso-quant subentry. All these operations change the sequence-numbers of the columns. We foresee considerable complications for these operations if the pointers are tied to the sequence-number of the columns.

c.) If the compilation format is different from the EXFOR transmission format (and there is no agreement on the contrary), the compiler may not easily know which sequence-number a specific column is going to get in the EXFOR transmission format.

Appendix B: Several possible representations of identical information

1. Resonances of a natural sample with some assignments to isotopes. (Similar formalisms may apply to gamma-spectra of a natural sample with some assignments of lines to isotopes.)

a. Presently possible solution:

```
BIB
ISO-QUANT     (28-NI-0,TOT/WID)
MISC-COL      (MISC) ASSIGNMENT TO ISOTOPE
...
...
DATA
EN-RES        DATA      MISC
...           ...       blank
...           ...       58.
...           ...       blank
...           ...       60.
```

(Note: Units were omitted in all examples.)

Disadvantage: the table is not retrieved when searching for NI-58 or NI-60. If this were to be achieved, this subentry had to be split into three subentries, one each for NI-0, NI-58, NI-60.

b. Multiple-Iso-quant solution:

```
BIB
ISO-QUANT     1(28-NI-0,TOT/WID)
              2(28-NI-58,TOT/WID)
              3(28-NI-60,TOT/WID)
...
DATA
EN-RES        DATA      1 DATA      2 DATA      3
...           ...         blank       blank
...           blank       ...         blank
...           ...         blank       blank
...           blank       blank       ...
```

c. Variable-A solution:

```
BIB
ISO-QUANT     (28-NI-A,TOT/WID)
...
DATA
EN-RES        A         DATA
...           0.        ...
...           58.       ...
...           0.        ...
...           60.       ...
```

Advantage: most compact solution !

d. A-in COMMON solution (not recommended):

```
BIB
ISO-QUANT   (28-NI-A,TOT/WID)'
...
COMMON
A           1A          2A          3
0.          58.         60.
ENDCOMMON
DATA
EN-RES      DATA        1 DATA      2 DATA      3
...         ...           blank       blank
...         blank       ...         blank
...         ...           blank       blank
...         blank         blank       ...
```

Disadvantage: as clumsy as b., but b. is clearer.

e. If in the same example not only TOT/WID is given but also EL/WID and NG/WID, and if also the resonance-energy shall be given as an Iso-quant, then the Variable-A solution seems to be the only possible one (if one does not want to give the Isotope under MISC):

```
BIB
ISO-QUANT   1(28-NI-A,EN,RES)
            2(28-NI-A,TOT/WID)
            3(28-NI-A,EL/WID)
            4(28-NI-A,NG/WID)
...
DATA
A           DATA        1 DATA      2 DATA      3 DATA      4
0.          ...         ...         ...         ...
58.         ...         ...         ...         ...
0.          ...         ...         ...         ...
60.         ...         ...         ...         ...
```

Note that the real independent variable, namely the resonance-energy, has disappeared and is now hidden under the column-heading DATA 1. The secondary independent variable, namely the A-number, cannot be sorted in ascending order. Thus, the better column-sequence would be:

f.
```
DATA
DATA        1 A         DATA        2 DATA      3 DATA      4
...           0.        ...         ...         ...
...           58.       ...         ...         ...
...           0.        ...         ...         ...
...           60.       ...         ...         ...
```

Here, the A-number would show up under a different hierarchy, which will have to be considered in Hans Potters' hierarchy concept.

Summary: f. and c. are the preferred solutions, but b. may be adequate, too, in certain cases.

## APPENDIX C



A rather simple-looking table, as reproduced from literature below, may be used as an illustration showing a most generalized form of coding of Exfor tables. (Note, that partial reactions leading to g or m state are hidden in the published table.)

Table 1

Cross sections of the /n,2n/ reaction

| Target nuclide | Measured half-life | Cross section /mb/ |
|---|---|---|
| $^{14}N$ | 9.89 ± 0.48 min | 8.1 ± 0.7 |
| $^{19}F$ | 108.1 ± 7.13 min | 40.7 ± 3.5 |
| $^{23}Na$ | | 16.5 ± 3.0 |
| $^{31}P$ | 2.49 ± 0.12 min | 12.6 ± 1.2 |
| $^{35}Cl$ | 32.81 ± 1.24 min | 9.0 ± 1.1 |
| $^{39}K$ | 7.61 ± 0.5 min | 5.1 ± 0.6 |
| $^{46}Ti$ | 3.08 ± 0.28 h | 42.8 ± 3.6 |
| $^{50}Cr$ | 42.11 ± 2.35 min | 31.4 ± 2.5 |
| $^{52}Cr$ | 28.10 ± 1.7 d | 143 ± 17 |
| $^{55}Mn$ | | 643 ± 65 |
| $^{54}Fe$ | 8.86 ± 0.95 min | 26.5 ± 2.6 |
| $^{59}Co$ | 71.83 ± 6.12 d | 663 ± 67 |
| $^{58}Ni$ | 42.39 ± 2.34 h | 37.9 ± 3.8 |
| $^{65}Cu$ | 12.58 ± 0.96 h | 975 ± 63 |
| $^{64}Zn$ | 38.40 ± 1.87 min | 161 ± 12 |
| $^{66}Zn$ | | 583 ± 50 |
| $^{69}Ga$ | 68.02 ± 3.43 min | 908 ± 68 |
| $^{70}Ge$ | 40.83 ± 2.70 h | 710 ± 58 |
| $^{76}Ge$ | 81.79 ± 5.24 min | 937 ± 100 |
| $^{75}As$ | 18.54 ± 0.93 d | 835 ± 72 |
| $^{79}Br$ | 6.37 ± 0.28 min | 942 ± 64 |
| $^{85}Rb$ | 34.13 ± 3.02 d | 698 ± 72 |
| $^{87}Rb$ | 19.42 ± 2.11 d | 855 ± 78 |
| $^{86}Sr$ | 65.0 ± 4.86 d | 630 ± 70 |
| $^{89}Y$ | | 572 ± 65 |
| $^{90}Zr$ | 76.28 ± 2.94 h | 588 ± 55 |
| $^{96}Zr$ | 64.4 ± 5.39 d | 1297 ± 145 |
| $^{92}Mo$ | 15.88 ± 0.86 min | 323 ± 27 |
| ... | ... | ... |

A blank half-life means: half-life is longer than 100 days so that it could not be measured.

case a)

It is certainly debatable whether this is a good form to present the given table; however, it is an interesting case to study, since it includes

*several independent variables,
*multiple isoquants,
*pointers,
*Z and A as variables,
*and more than 10 columns.

The presentation given on this page is idealized; having 13 columns, it cannot be printed this way, nor can it be taken into EXFOR this way.

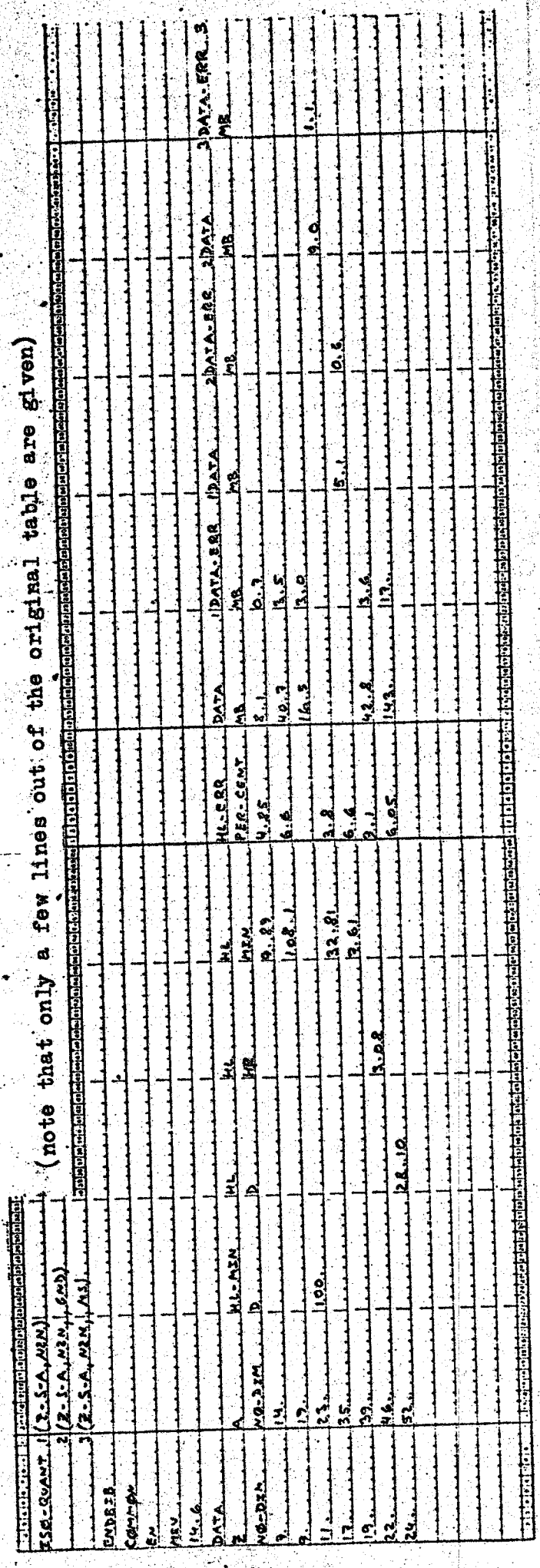
For transmitting this table in EXFOR, one has two possibilities:

1. using the NNCSC proposal as shown in case b) on the next page. For printing this had to be converted into a readable form as shown in case d).

2. using a modified "DATA-CONT" proposal as shown in case c). Here the original DATA-CONT proposal was modified such that space is saved by not repeating the independent variables in the second and third block. For printing, no editing or format conversion is needed, since it is directly readable.

For clarity, in cases b), c) and d) a line-numbering has been added on the left hand margin (as suggested by Hans Potters); this line-numbering is, of course, not on the EXFOR tape but is added by the printing program.

Note, that blanks are required in DATA columns as well as in independent-variables columns.



case b) NNCSC proposal for transmitting more than 10 columns.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | DATA | | | | | | | | | |
| 1 | 2 | A | HL-MIN | HL | HL | HL | | | | |
| | HL-ERR | DATA | 1 DATA-ERR | 1 DATA | 2 | DATA-ERR | 2 | DATA | 3 | |
| | DATA-ERR | 3 | | | | | | | | |
| 2 | NO-DIM | NO-DIM | D | D | HR | MIN | | | | |
| | PER-CENT | MB | MB | MB | MB | MB | | | | |
| | MB | | | | | | | | | |
| 3 | 3. | 14. | | | | 9.89 | | | | |
| | 4.85 | 5.1 | 0.7 | | | | | | | |
| | | | | | | | | | | |
| 4 | 9. | 12. | | | | 108.1 | | | | |
| | 6.6 | 40.7 | 3.5 | | | | | | | |
| | | | | | | | | | | |
| 5 | 11. | 23. | 100. | | | | | | | |
| | | 16.5 | 3.0 | | | | | | | |
| | | | | | | | | | | |
| 6 | 17. | 35. | | | | 32.81 | | | | |
| | 3.8 | | | | | 9.0 | | | | |
| | 1.1 | | | | | | | | | |
| 7 | 19. | 39. | | | | 7.61 | | | | |
| | 6.6 | | | 5.1 | 0.6 | | | | | |
| | | | | | | | | | | |
| 8 | 22. | 46. | | | 3.08 | | | | | |
| | 9.1 | 42.8 | 3.6 | | | | | | | |
| | | | | | | | | | | |
| 9 | 24. | 52. | | 28.10 | | | | | | |
| | 6.05 | 14.3 | 17. | | | | | | | |
| | | | | | | | | | | |
| | ENDDATA | | | | | | | | | |

For producing a better readable printout, this must be converted into a form as shown in case d).

case c) A modified "DATA-CONT" proposal for transmitting more than 10 columns. This is readable as it stands. Independent variables are not repeated, since this would waste too many columns.

A format based on this concept would simplify drastically the editing operations required at all four centers.

| | | | | | | |
|---|---|---|---|---|---|---|
| | DATA | | | | | |
| 1 | 2 | A | HL-MIN | HL | HL | HL |
| 2 | MØ-DIM | MØ-DIM | D | D | HR | MIN |
| 3 | 7. | 14. | | | | 9.89 |
| 4 | 9. | 19. | | | | 108.1 |
| 5 | 11. | 23. | 1.00 | | | |
| 6 | 13. | 35. | | | | 32.81 |
| 7 | 19. | 39. | | | | 3.61 |
| 8 | 22. | 46. | | | 3.08 | |
| 9 | 24. | 52. | | 28.10 | | |
| | DATA-CONT | | | | | |
| 1 | HL-ERR | DATA 1 | DATA-ERR 1 | DATA 2 | DATA-ERR 2 | DATA 3 |
| 2 | PER-CENT | MB | MB | MB | MB | MB |
| 3 | 4.85 | 8.1 | 0.7 | | | |
| 4 | 6.6 | 40.7 | 3.5 | | | |
| 5 | | 16.5 | 3.0 | | | |
| 6 | 3.8 | | | | | 9.0 |
| 7 | 6.6 | | | 5.1 | 6.6 | |
| 8 | 9.1 | 42.8 | 3.6 | | | |
| 9 | 6.05 | 143. | 17. | | | |
| | DATA-CONT | | | | | |
| 1 | DATA-ERR 3 | | | | | |
| 2 | MB | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | 1.1 | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| | ENDDATA | | | | | |

Why not repeat [illegible]?

case d) An output format using the full paper width, that is up to 10 columns (plus identification field).

This is close to the trial printout we received from NDCC.