12 MODER

The MODER module is used to convert ENDF, PENDF, and GENDF tapes from the NJOY blocked-binary mode to formatted mode (ASCII on modern computers), and *vice versa*. It can also be used to copy data from one logical unit to another without change of mode, or to make a new tape containing selected materials from one or more ENDF, PENDF, or GENDF tapes. MODER handles ENDF-4 through ENDF-6 formats, plus special-purpose formats developed for NJOY, such as the GROUPR and ERRORR output formats.

This chapter describes the MODER module in NJOY2016.0.

12.1 Code Description

The main subroutine `moder` is exported by the module `modem`. At the beginning of execution, MODER rewinds the output tape `nout`. Additionally, each time a new input tape `nin` is specified, that unit is rewound. MODER then processes `nin` one file at a time, either for all materials on `nin`, or optionally (see following section) for a single specified material. As each file is identified, the main program calls a subroutine dedicated to that file. Each subroutine makes the series of calls to `contio`, `listio`, etc., that is appropriate to that file.

If `nin` and `nout` are of opposite sign, then mode conversion is performed automatically by the utility I/O subroutines. If `nin` and `nout` have the same sign, then no mode conversion is performed; runs of this type can be used simply to make an extra copy of the input tape or to retrieve selected materials without mode change. Only a little more than one page of scratch storage is needed, so there are no limitations on which tapes can be processed.

12.2 Input Instructions

As an aid to discussions of the user input to MODER, the input instructions that appear as comment cards at the beginning of the current version of this module are listed below. Since code changes are possible, it is always advisable to consult the comment-card instructions contained in the version of the code actually being used before proceeding with an actual calculation.

```
!---input specifications (free format)---------------------------
!
! card 1        unit numbers
!      nin      input unit
!      nout     output unit
!
!  a positive unit is coded (mode 3).
!  a negative unit is blocked binary (njoy mode).
!
!  note: abs(nin) ge 1 and le 19 is a flag to select various
!        materials from one or more input tapes, with or
!        without mode conversion.  the kind of data to be
!        processed is keyed to nin as follows:
!              nin=1, for endf or pendf input and output,
!                  2, for gendf input and output,
!                  3, for errorr-format input and output.
!
!      cards 2 and 3 for abs (nin) ge 1 and le 19 only.
!
! card 2
!      tpid     tapeid for nout.  66 characters allowed
!               (delimited with ', ended with /)
! card 3
!      nin      input unit
!               terminate moder by setting nin=0
!      matd     material on this tape to add to nout
!------------------------------------------------------------------
```

The contents of `nin` and `nout` are positive or negative logical unit numbers, with absolute magnitudes normally in the range 20-99, inclusive. Positive unit numbers refer to formatted tapes, and negative unit numbers refer to blocked-binary tapes. No other input is required to copy or convert the entire contents of the data file on unit `nin`, writing the results to unit `nout`.

A positive value of `nin` in the range 1-3 is used as a trigger to specify that the data to be copied or converted are not the contents of a single tape, but, instead, they are selected materials from one or more input tapes. The type of data to be processed (ENDF/PENDF *vs.* GENDF *vs.* ERRORR-format) is keyed to the value of `nin`, as detailed in the instructions above. If `nin` is in the

range 1-3, and only in this case, additional input is supplied to specify (on card 2) the tape-identification information to be written on the first record of the output tape and to specify (on card 3) both the `mat`-numbers of the materials to be included and the logical units where each of the desired materials are to be found. Note that the slash terminating the Hollerith information on card 2 is required. In the case of GENDF processing of a material `matd`, which is present on the specified input tape at a series of temperatures, a single card 3 causes the retrieval of all temperatures. Card 3 is repeated as many times as needed, and input is terminated with a card containing 0/.

12.3   Sample Input

It is good practice to convert the mode of the ENDF/B tape before proceding with any NJOY run. The time spent in MODER is normally much less than the time saved by the subsequent modules. The required input for this is extremely simple. In this first example, an ENDF-formatted file, designated "tape20" is copied to a binary-formatted file designated "tape21". This file is subsequently used as input to RECONR.

```
moder
20 -21/
reconr
-21 -22/
...
```

For older versions of ENDF/B, the released "tapes" usually contained multiple materials. In the following example we specify that a single material, 1305, be extracted from "tape20" and written to "tape21". Subsequent use of "tape21" will be more efficient since only the material of interest is on that tape.

```
moder
1 -21/
'B-10'/
20 1305/
0/
reconr
-21 -22/
```

```
...
```

The final example (taken from one of the standard sample problems) shows the use of MODER to prepare a special multimaterial ENDF tape for a co-variance calculation involving the 5 primary fissionable isotopes. Since, in this particular example problem, the resonance region is of no interest, a copy of the ENDF serves as the PENDF for later modules. Mount ENDF Tape 515, 516, and 555 on units 20, 21, and 22.

```
moder
1 -23/
'endf/b-v nubar covariance materials'/
20 1380/
20 1381/
21 1390/
22 1395/
22 1398/
20 1399/
0/
moder
-23 -24/
group
-23 -24 0 25/
...
```

The second moder run copies the ENDF file to use as a PENDF file for GROUPR.

12.4   Error Messages

`error in moder***endf materials must be in ascending order`
    This is a problem with the material ordering for the input tape.

`message from moder--mat nnnn not found on gendf tape`
    Check the `matd` value on input card 3 and make sure that the correct input tape was mounted.

`error in moder***this material is not a gendf material`
    Input file contains an illegal mixture of data, namely, an initial GENDF material, followed by the indicated non-GENDF `mat`.

`error in moder***input is not an errorr output tape`

    User has requested ERRORR-format processing, but input data file is not a ERRORR-format tape.

`error in moder***input is not an endf or pendf tape`

    User has specified `nin`=1 on card 1, thereby requesting selective multitape ENDF or PENDF processing, but input data file on the unit `nin` specified on card 3 is not an ENDF/PENDF file.

`error in moder***input is not an endf tape`

    See comments above.

`error in moder***input is not a gendf tape`

    User has requested GENDF processing, but input data file is not a GENDF tape.

`error in moder***conversion not coded for mf=nn`

    There is an illegal or unrecognizable `mf` value on `nin`.

`error in moder***should have found send card`

    MODER expected the end of a section but found actual data. The listed data display the contents of the last card read. Input data file may be bad or may use a format not yet implemented.

`error in moder***illegal covariance mf=nn`

    ERRORR-format file is missing the required `mf`=3. ENDF and PENDF tapes must be `mat` ordered.

`error in file1***bad LFC in mt=458.`

    There is a bad value for the `LFC` value in `mf`=1 `mt`=458. Only 0 or 1 are allowed.

`error in file1***bad LO in mt=460.`

    There is a bad value for the `LO` value in `mf`=1 `mt`=460. Only 0 or 1 are allowed.

`error in file1***illegal mt`

    Only the standard `mt`=451 to 458 and 460 are allowed in File 1.

`error in file2***illegal mt`

    Only the standard `mt`=151 and the NJOY special values of `mt`=152 and 153 are allowed in File 2.

`error in file5***illegal lf`

    The File 5 `lf` value is outside the legal range 1-12.

`error in file6***illegal ltt`

    This message comes from the branch used for ENDF-5 format or for thermal data generated by the THERMR module. Check the format of the File 6 sections.

`error in file6***illegal endf6 law`

> This message comes from the branch used for ENDF-6 tapes. Check the values for the law parameter in the sections of File 6. Only law values 0 to 7 are allowed. In the case of fission, negative law values are also allowed.

`error in file6***illegal endf6 law for mt=nnn`

> This message comes from the branch used for ENDF-6 tapes. Check the values for the law parameter in the corresponding section of File 6. Negative law values are only allowed for fission (mt=18).

`error in file7***bad NS in mt4.`

> The number of non-principal scattering atom types NS cannot be larger than 3.

`error in file7***illegal mt=nnn`

> Only `mt`=2 and `mt`=4 are allowed in File 7 for the ENDF-6 format.

`error in file7***illegal value of lthr=n`

> Only values of 1 or 2 are allowed for `lthr` in ENDF-6.

`error in file12***bad LO in mt=460.`

> There is a bad value for the `LO` value in `mf`=1 `mt`=460. Only 0, 1 or 2 are allowed.

`error in file15***illegal lf`

> Only `lf`=1 and the special lanl format `lf`=2 are allowed

`error in file32***illegal value of ndigit`

> There is a bad value for the `NDIGIT` value in `mf`=32. Only 0 or 2 to 6 are allowed.

`error in file32***illegal value of lcomp`

> There is a bad value for the `LCOMP` value in `mf`=32. Only 0, 1 or 2 are allowed.