Introduction to AMPX

D. Wiarda

C. Cihangir

M. L. Williams

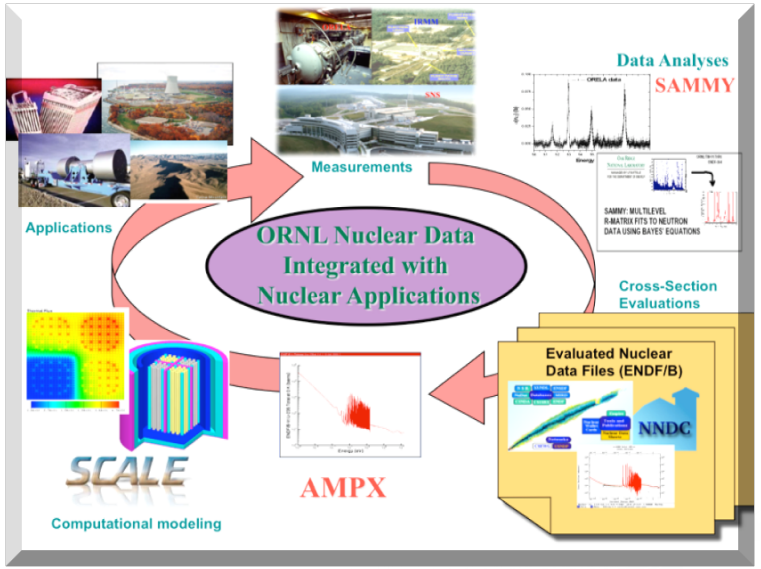
A. Holcomb

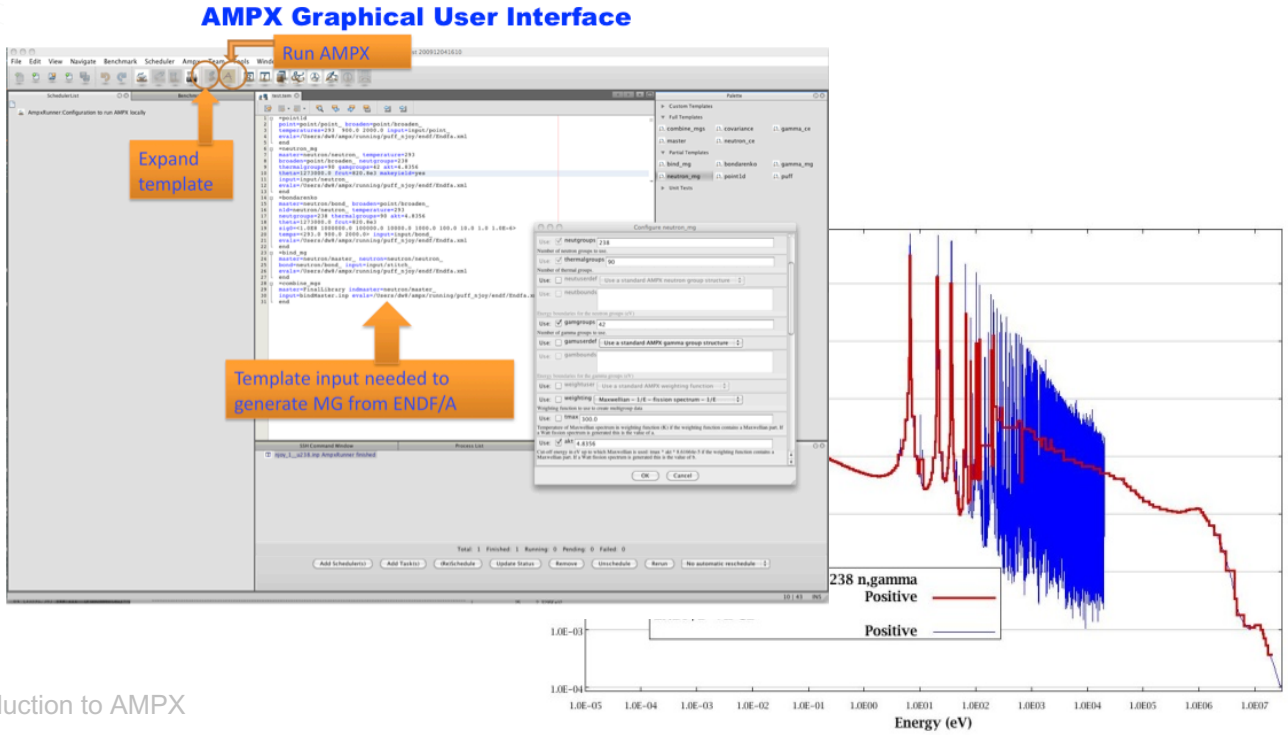
Outline

- Introduction to AMPX
- Content of ENDF files
- Brief overview of AMPX modules
- Overview of ExSite

AMPX processing capabilities vital for SCALE

- SCALE relies upon AMPX for continuous energy (CE), multigroup (MG), and covariance data libraries
  - MG and CE cross section data
  - Cross section uncertainty data to support sensitivity/uncertainty (S/U) methods in SCALE
- AMPX processes ENDF/B-formatted nuclear data evaluations to produce cross section libraries





Data libraries released with SCALE 6.2:

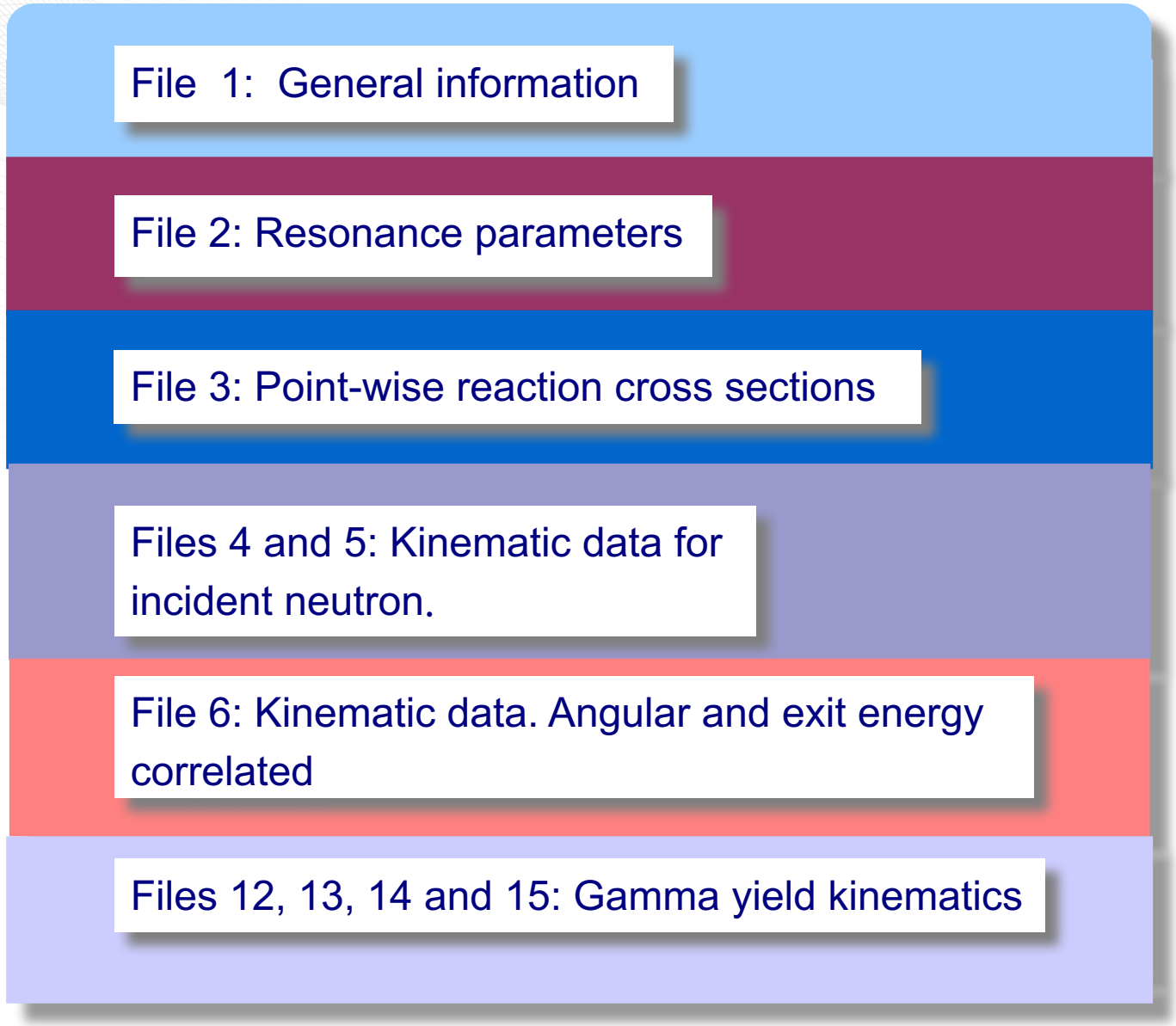
- CE ENDF/B-VII.0 and ENDF/B-VII.1
- 238-group ENDF/B-VII.0
- 252-group ENDF/B-VII.1
- 200n47g ENDF/B-VII.0 and B-VII.1
- 27n19g ENDF/B-VII.0 and B-VII.1
- Recommended covariance data library
  - Evaluated and approximate covariance data
  - Covariance data for all ENDF/B nuclides (neutron)

AMPX nuclear data processing history

- AMPX processes data in evaluated nuclear data files (ENDFs) to provide CE, MG, Covariance, and ORIGEN Data Libraries for SCALE
- AMPX developed and maintained at ORNL for over 40 years
- 1990: ENDF Formats changed significantly with ENDF/B-VI release in 1990—AMPX could no longer process latest ENDF files for SCALE
- 1995—2002: Extensive AMPX upgrade to update AMPX to process latest ENDF/B data
- 2008-2012: AMPX upgrades for generation of continuous-energy shielding libraries
- 2002—2012: AMPX routinely processes latest ENDF/B Formats (e.g., ENDF/B-VI & –VII.0 data libraries in SCALE)
- 2012 – Present: Modernization effort to implement SQA and modern software design/development practices
- Last formal release as stand-alone in 1977
- Current version available with SCALE 6.2

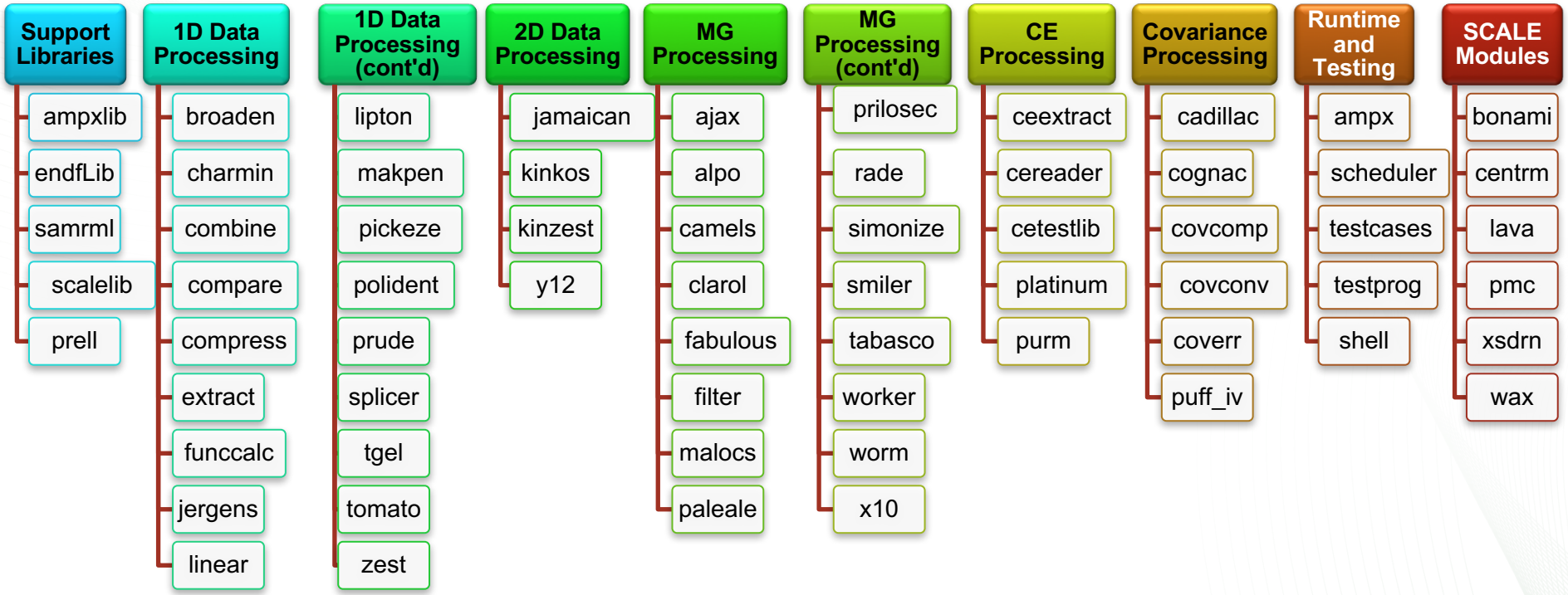
Version	Year	Time between Releases
ENDF/B-I	1968	-
ENDF/B-II	1970	2 years
ENDF/B-III	1972	2 years
ENDF/B-IV	1974	2 years
ENDF/B-V	1978	4 years
ENDF/B-VI	1990	12 years
ENDF/B-VII	2006	16 years
ENDF/B-VII.1	Dec 2011	5 years
ENDF/B-VII.2 or ENDF/B-VIII	TBD	

ENDF structure



- Other information exists in ENDF containing covariance and decay information
- The information listed here is used to generated MG and CE libraries

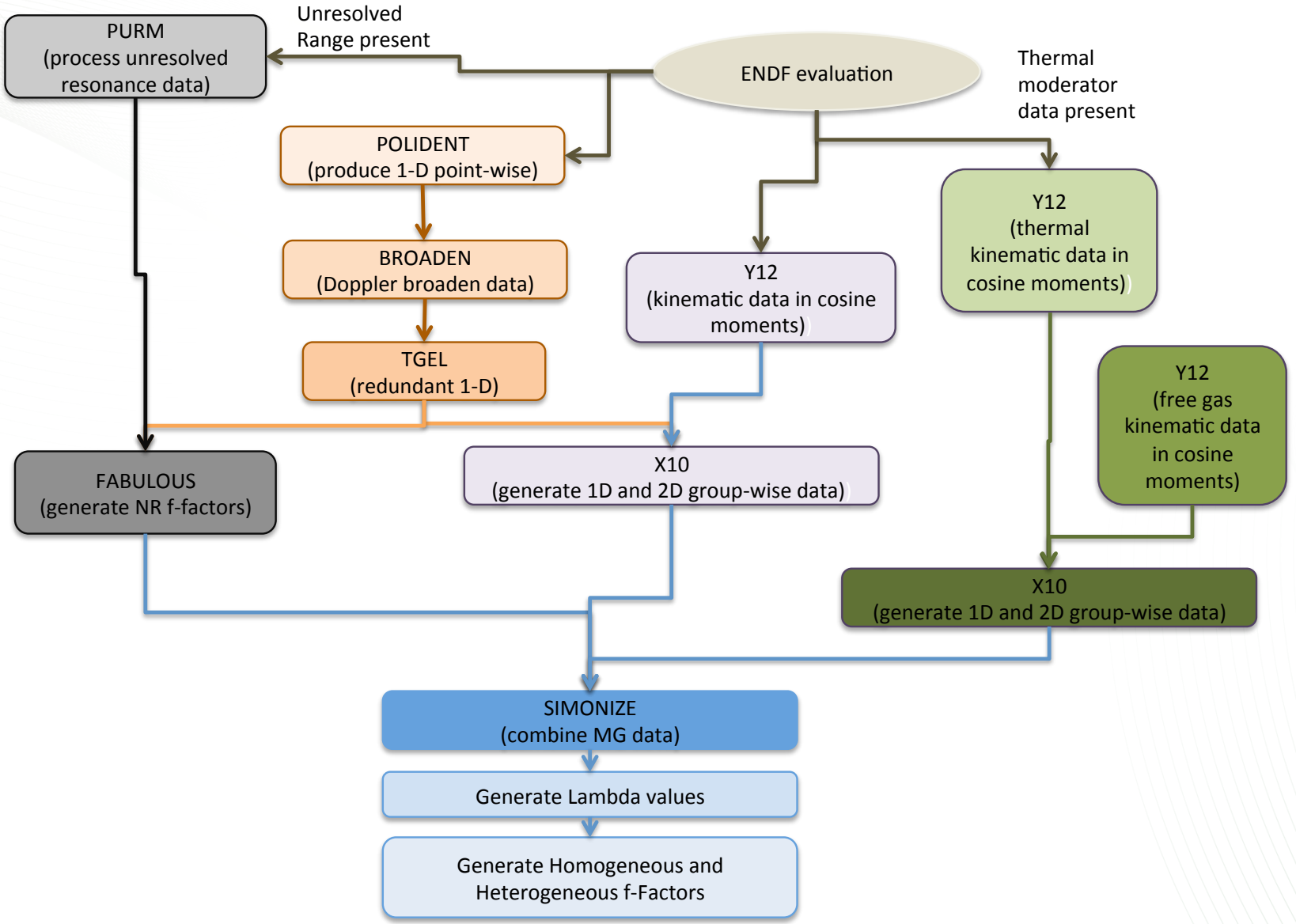
AMPX modular code system



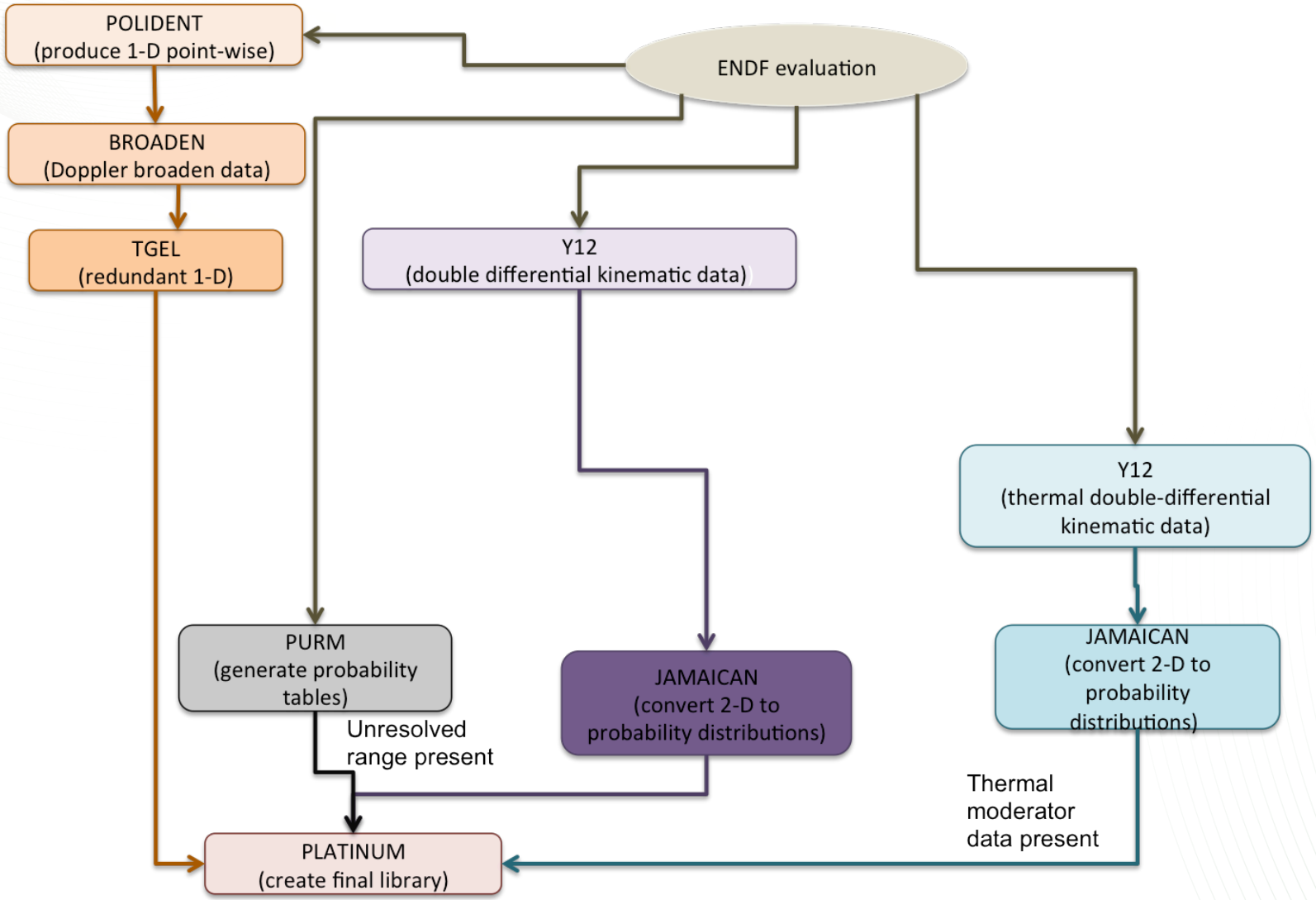
The most important AMPX modules

- Polident:
  - Reads the point-wise data from the ENDF library
  - Reconstruct point-wise cross section data from resonance parameters
- broaden: Doppler broadens the point-wise data
- y12: reads the kinematic data from the ENDF file
- x10: groups average point-wise data and kinematic data
- jamaican and platinum: combine point-wise data and kinematic data into continuous energy libraries
- puff_iv: processes covariance data

Processing MG libraries

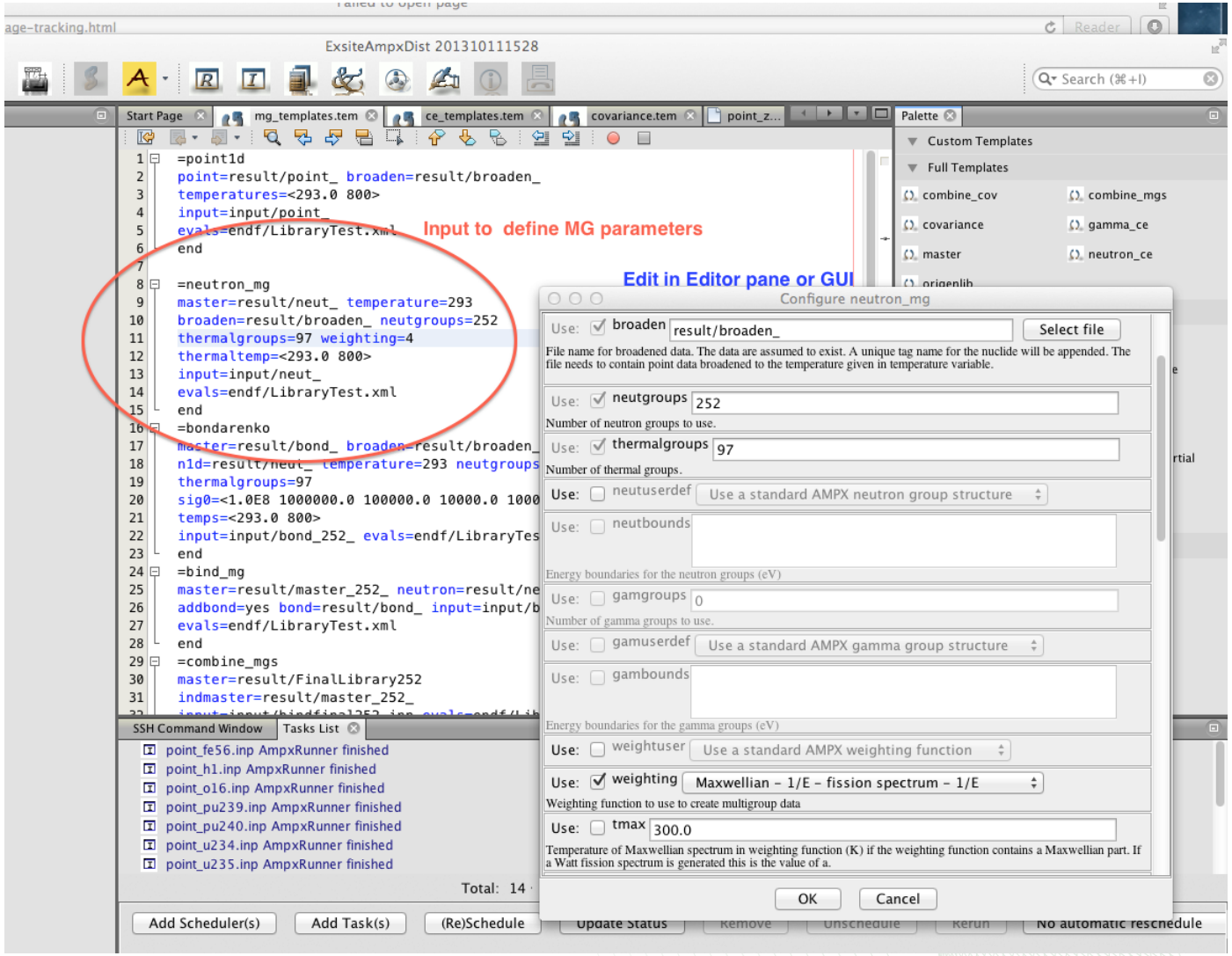


Processing CE libraries



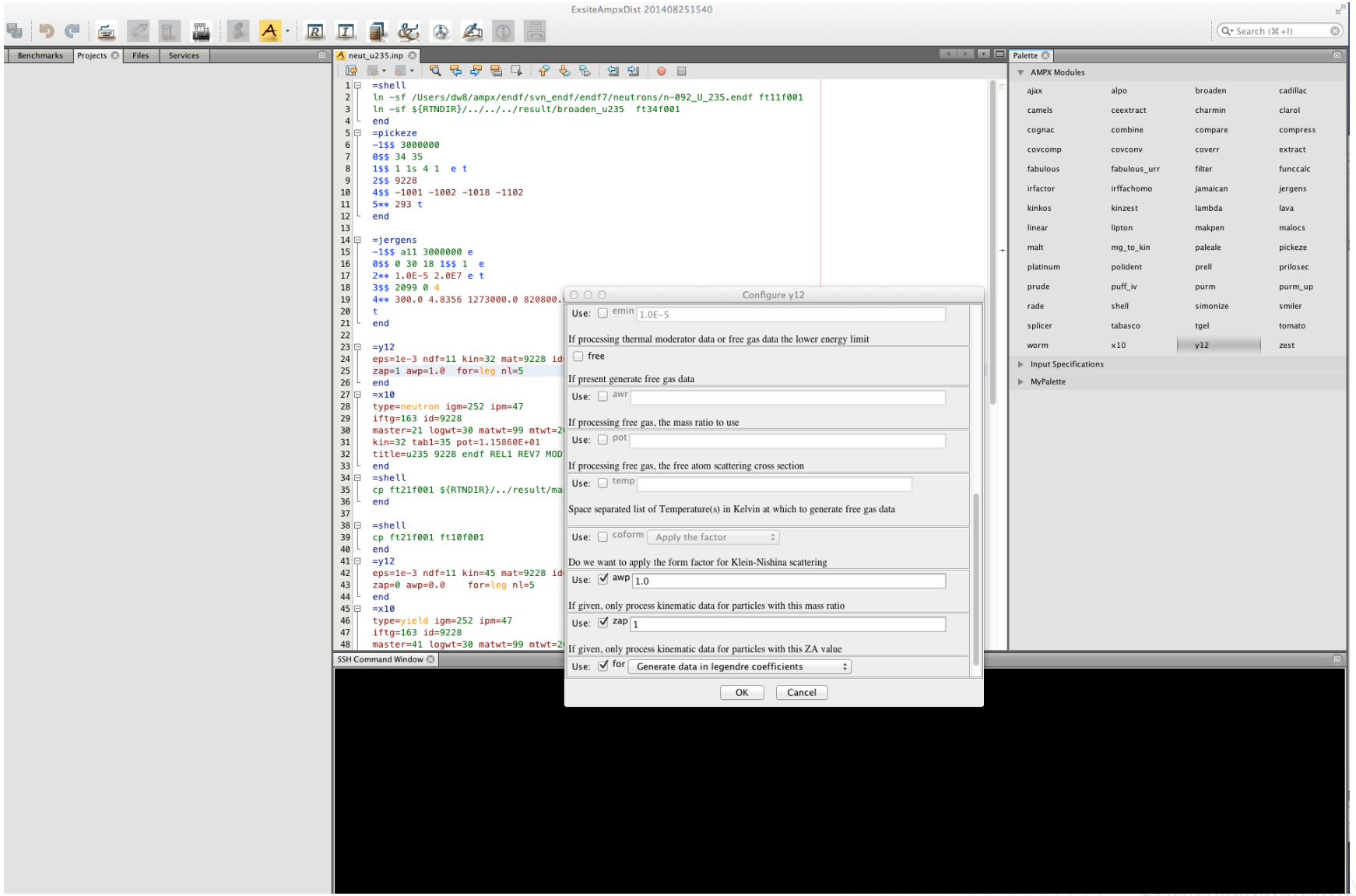
Processing libraries

- Edit templates with relevant parameters
- Expand to generate input files for AMPX
- Available for MG, CE, and covariance library production



Processing CE libraries (continued)

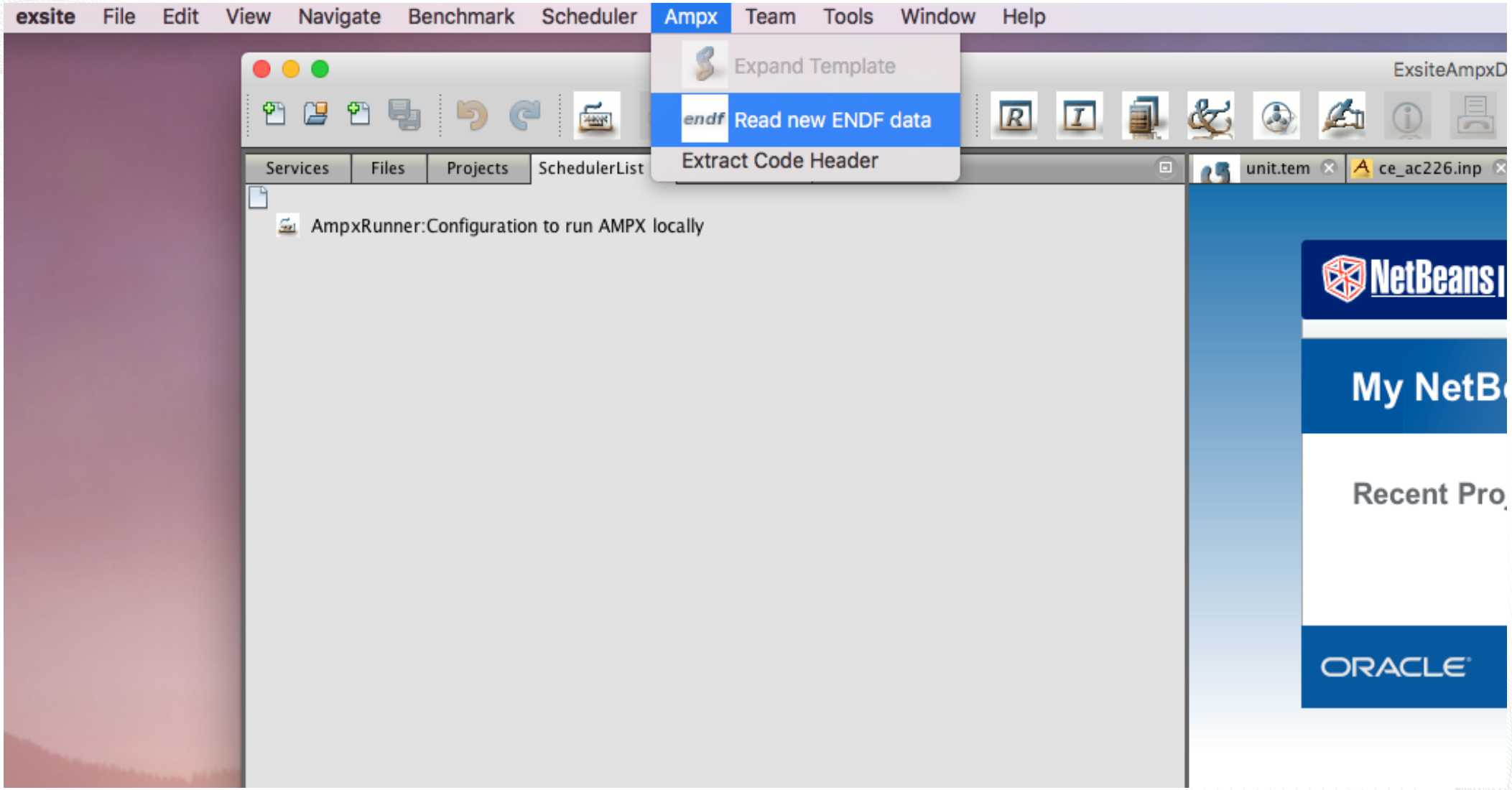
- Edit input files



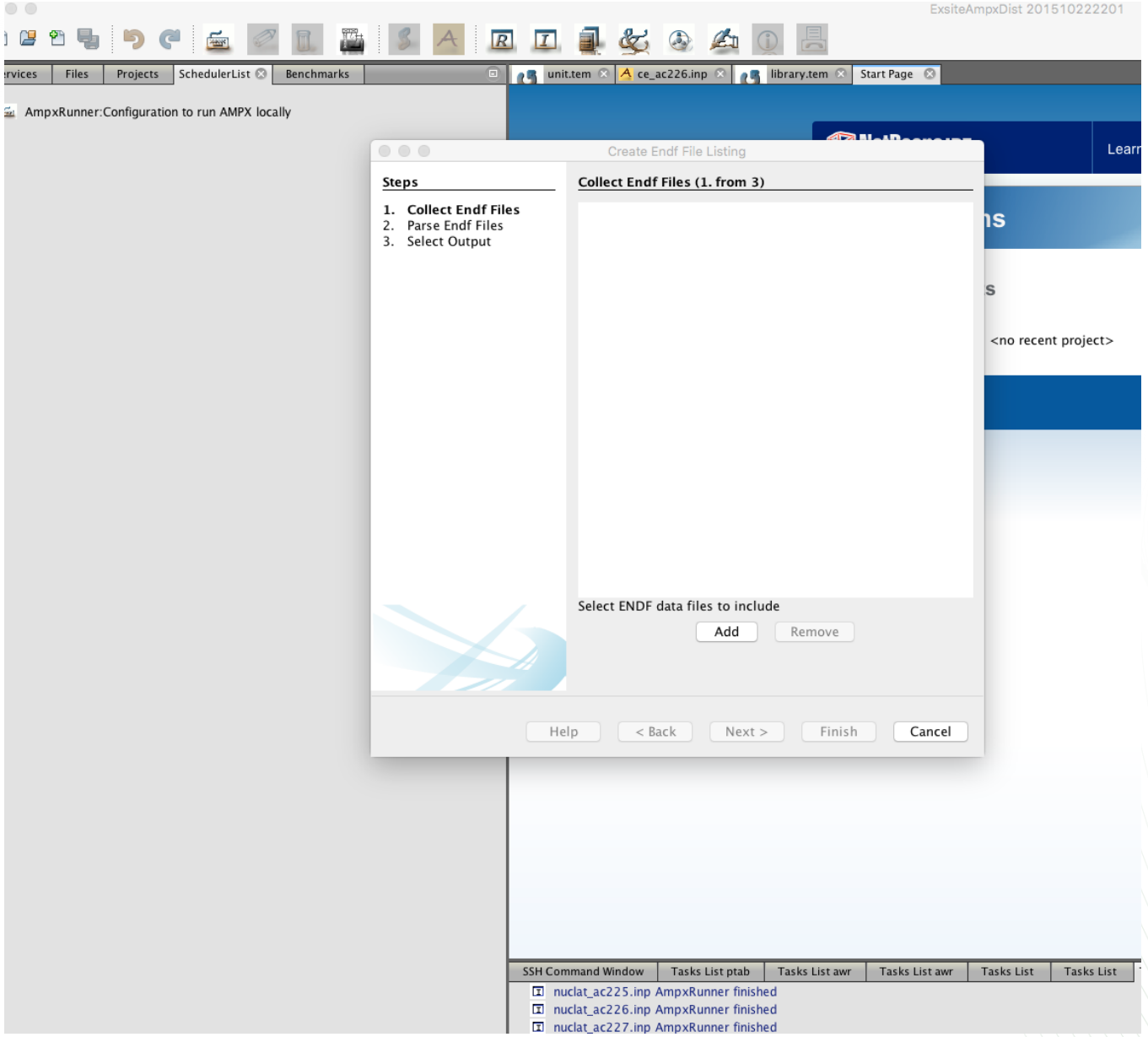
Generating a SCALE cross section library

- Example files template and input files are located in the Ampx/examples directory in SCALE installation
- ExSite is located in Ampx/exsite/bin/exsite in SCALE installation
- AMPX only runs on Linux and Darwin
- If needed ExSite can be used on a Windows platform to prepare the input files provided, then the absolute pathname option is used in the template files

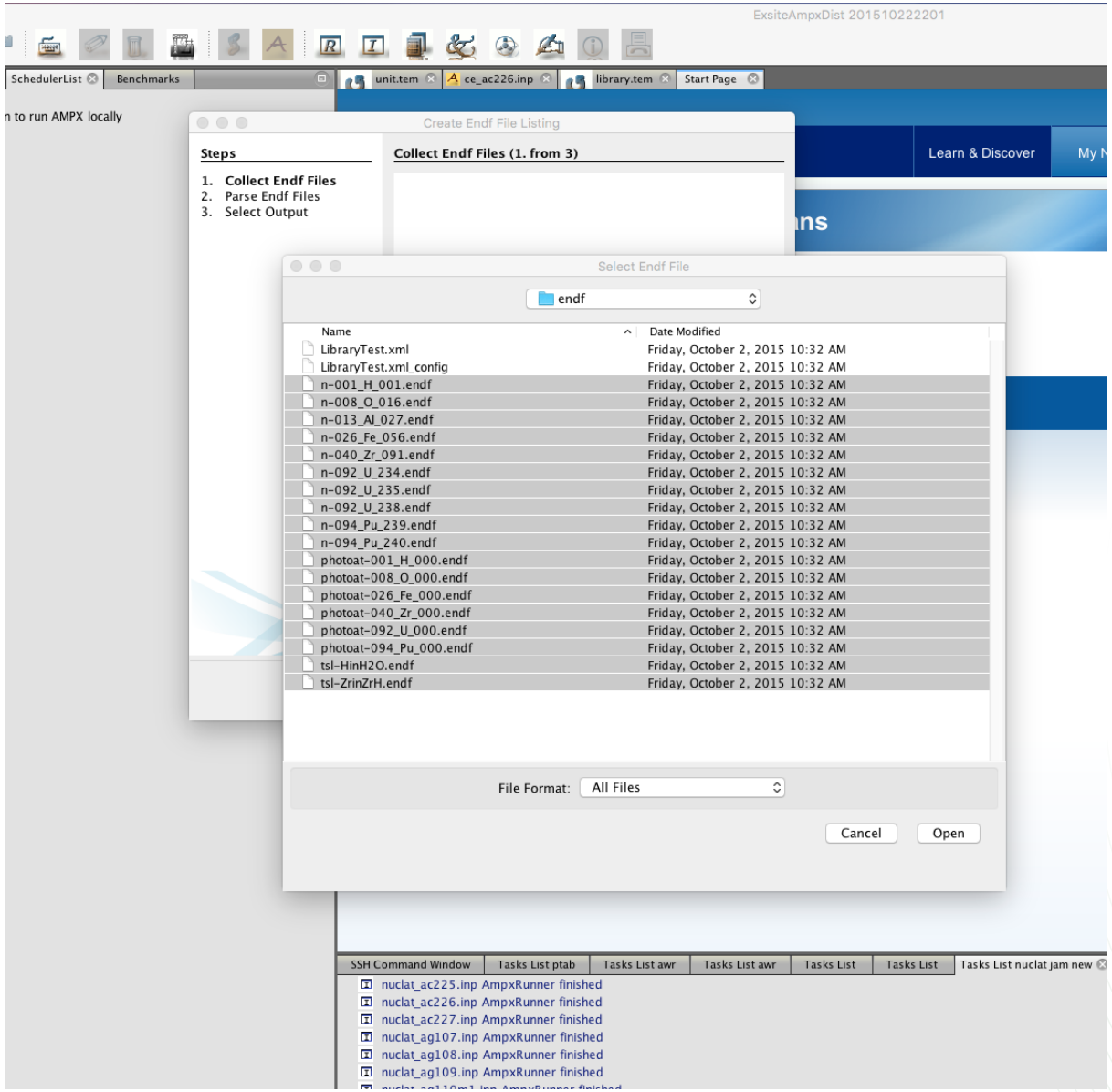
Generating a SCALE cross section library (continued)



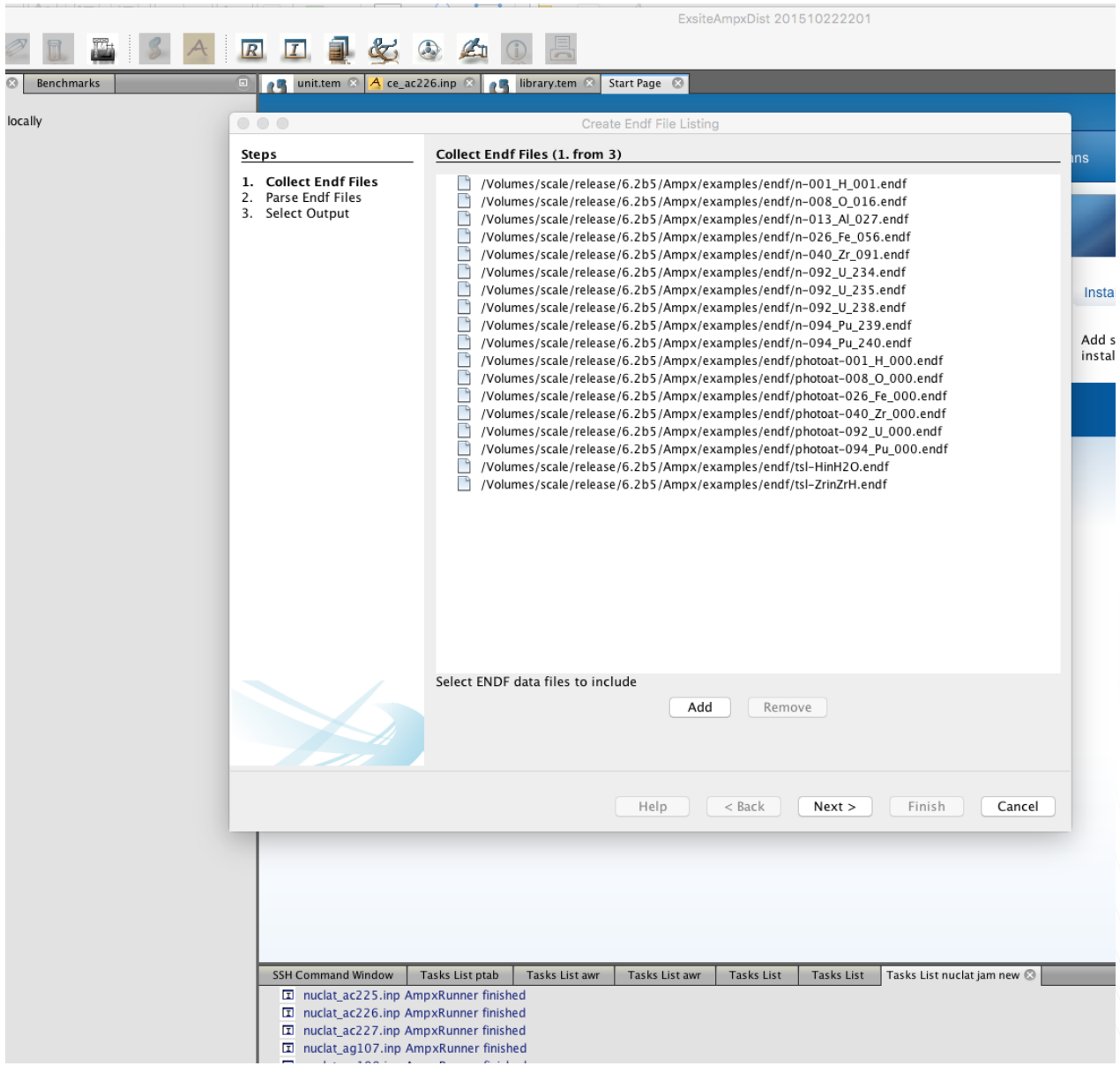
Generating a SCALE cross section library (continued)



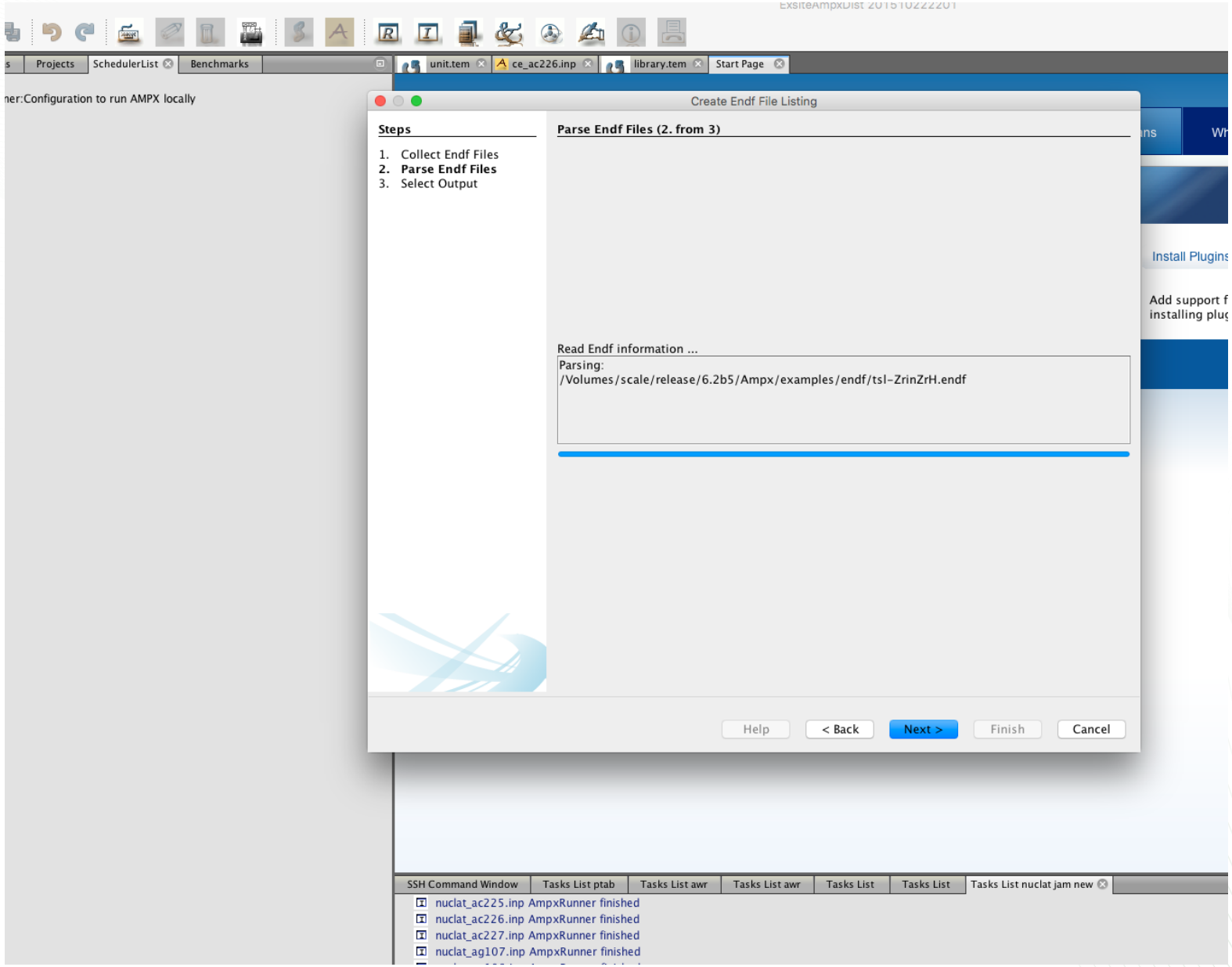
Generating a SCALE cross section library (continued)



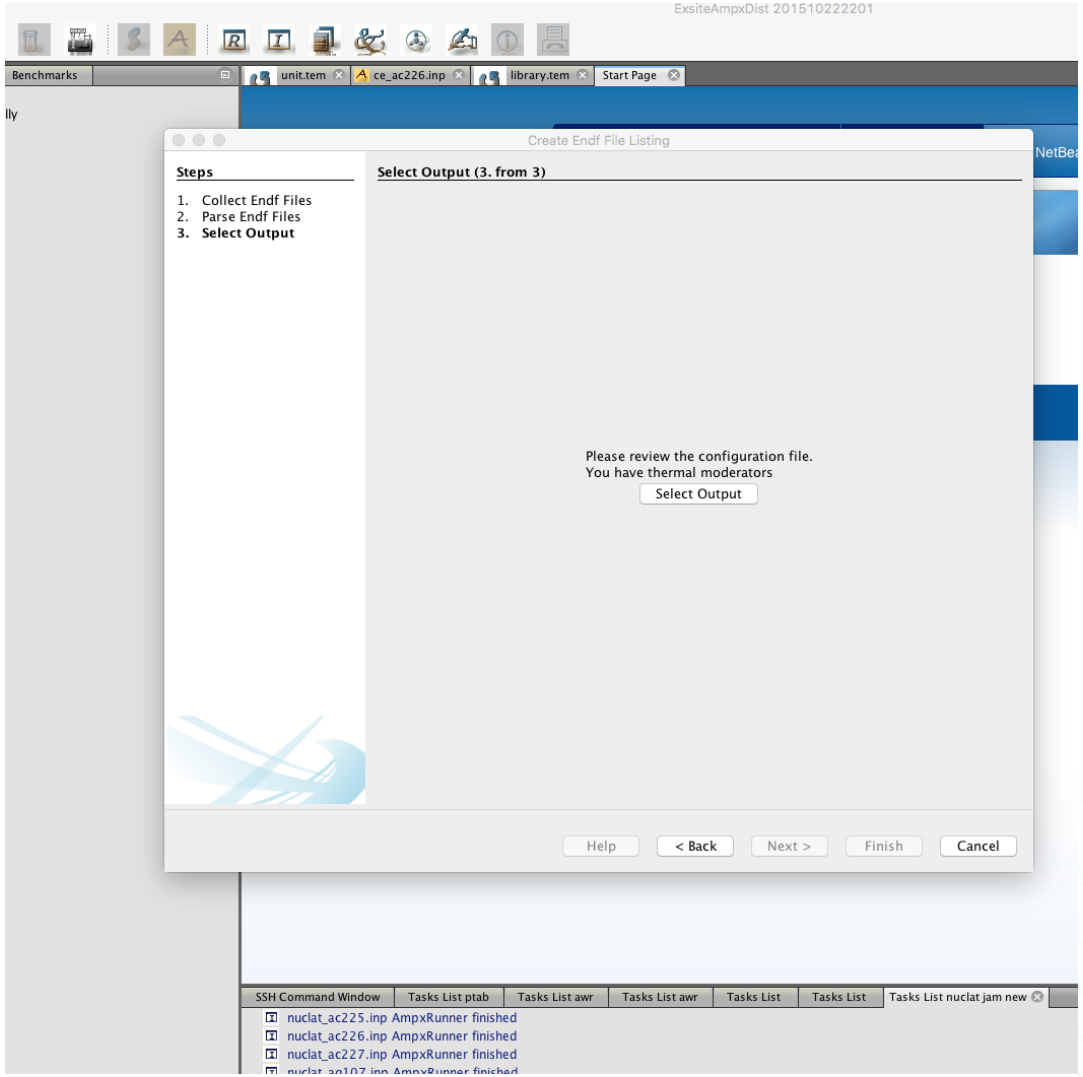
Generating a SCALE cross section library (continued)



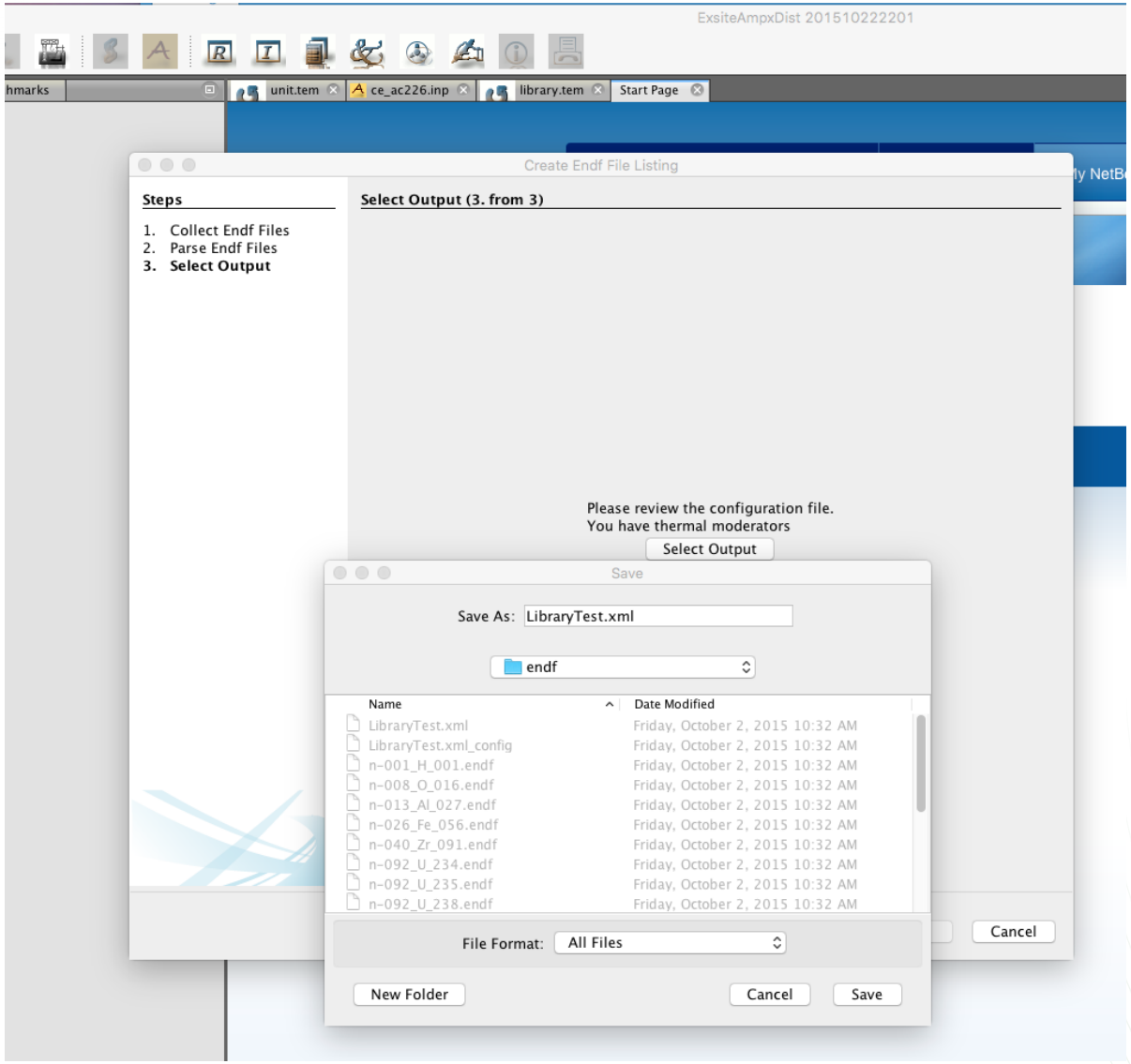
Generating a SCALE cross section library (continued)



Generating a SCALE cross section library (continued)



Generating a SCALE cross section library (continued)

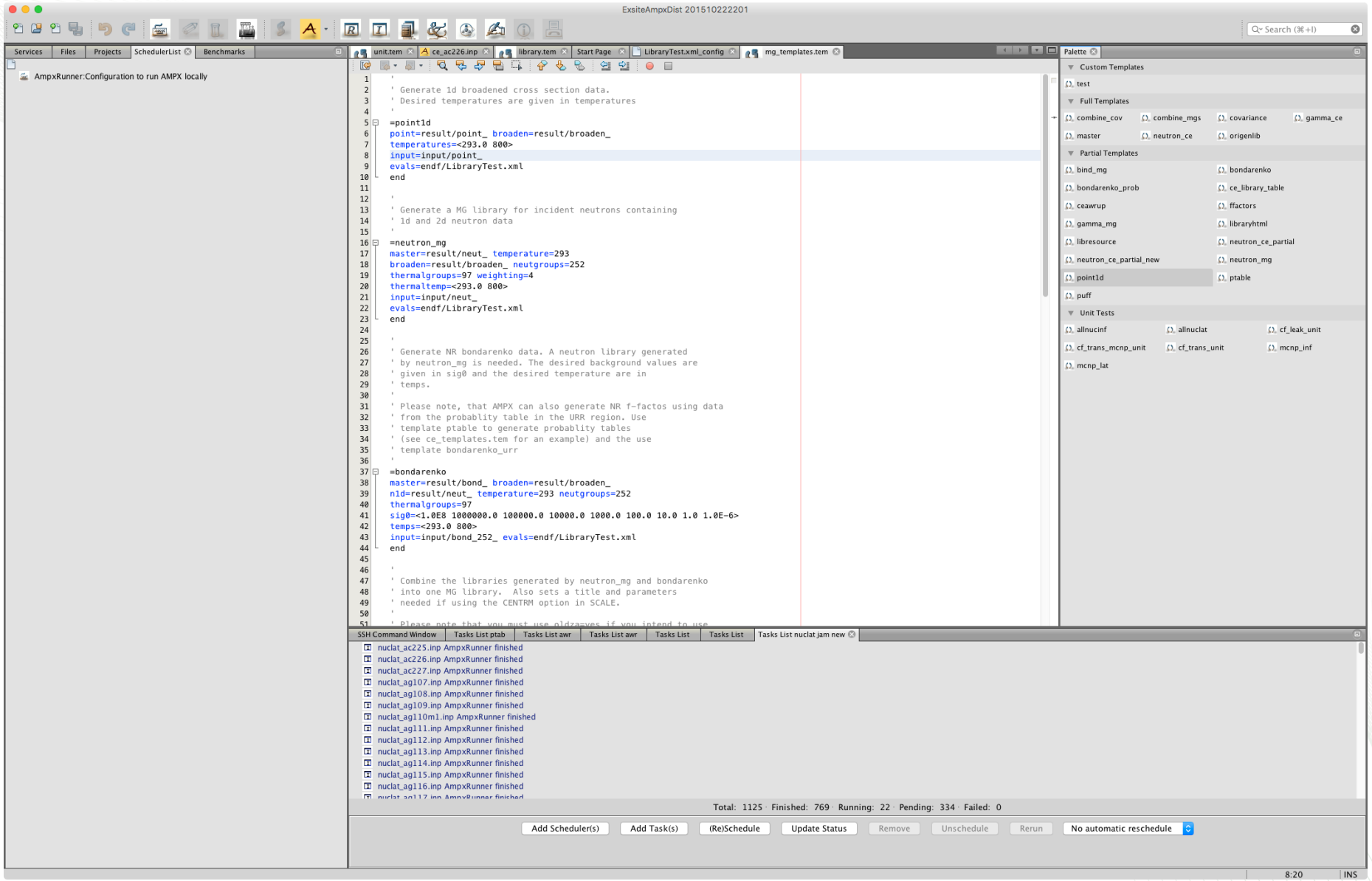


Editing the generated configuration file

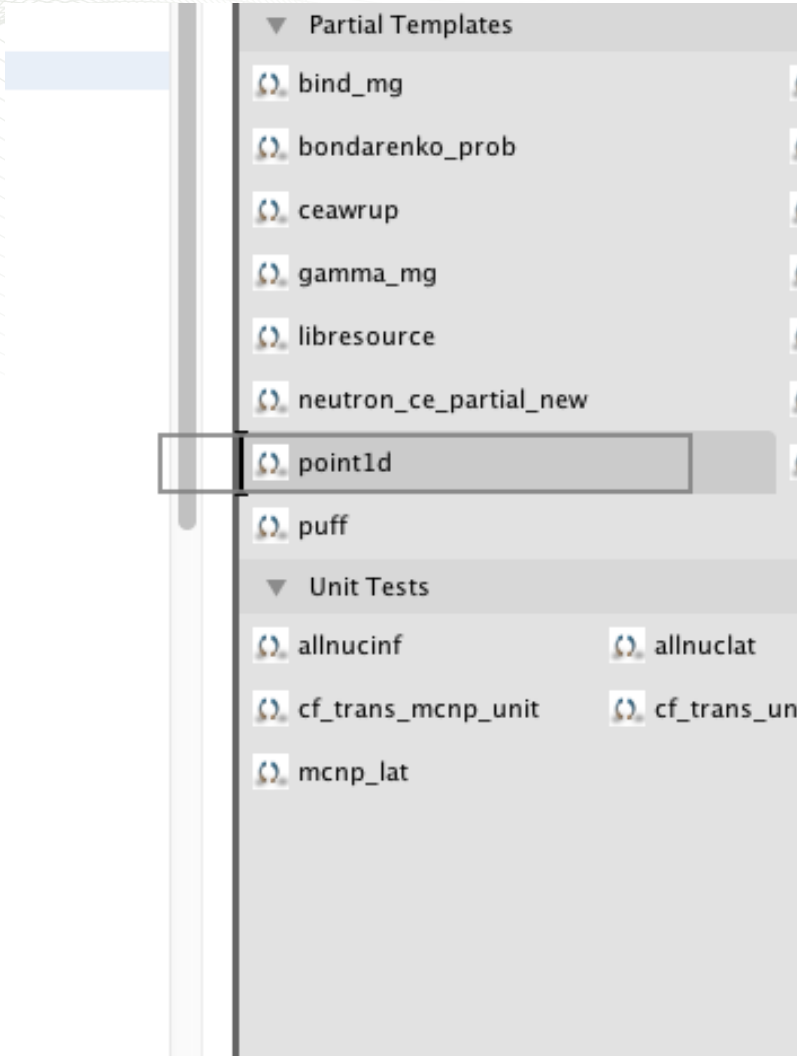
- Unfortunately, the configuration file may need some hand editing for the thermal moderators
- ENDF does not always use the same material number as stated in the file
- The ZA given for the thermal moderator is not always correct

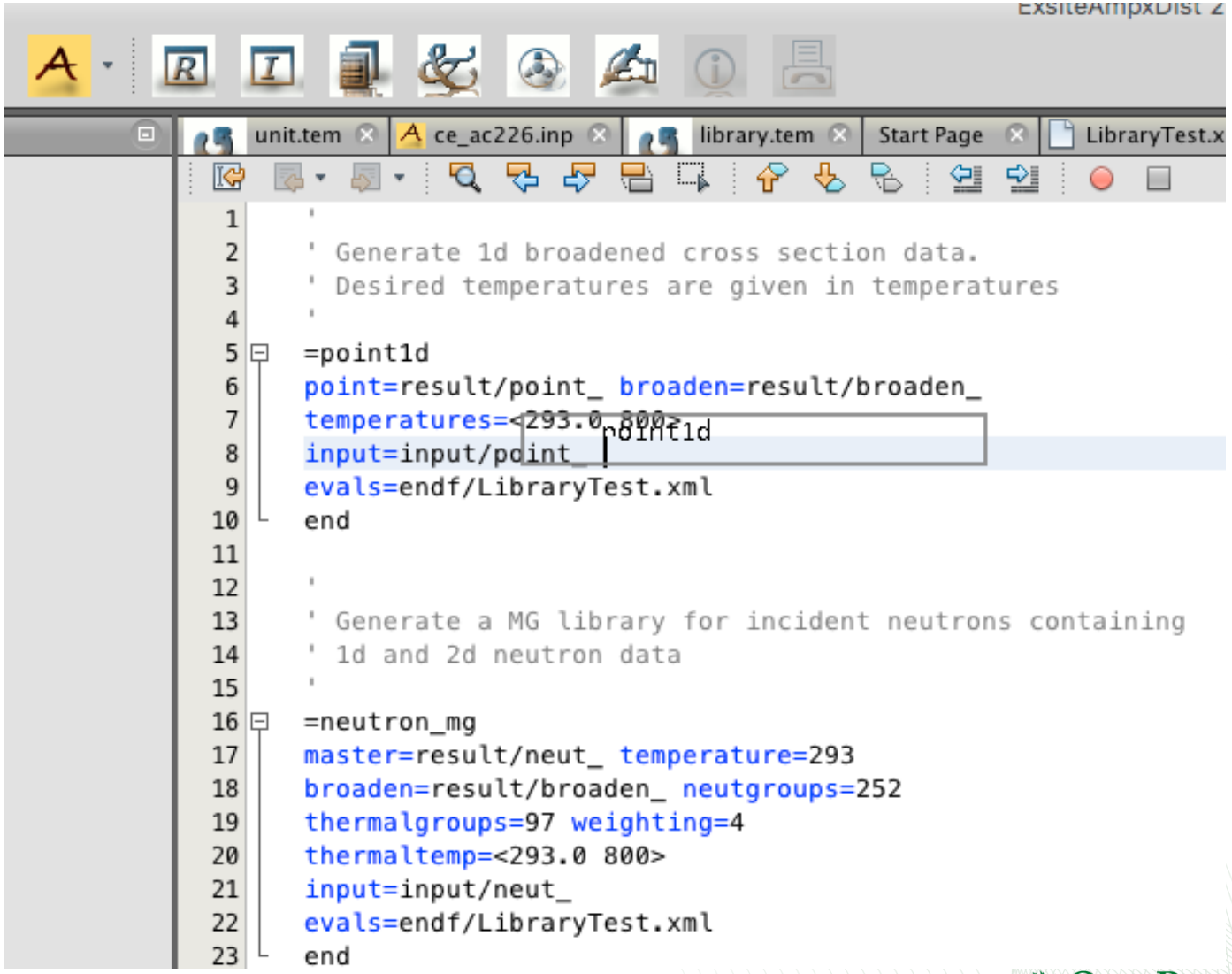
```
<ConfigFile>

<!-- metastable nuclei for which the scale id is different from the  real za value -->
<metastable>
</metastable>


<!-- nuclei for which the scale id is different from the  real za value -->
<specialNuclei>
   <nuclei endf="125" realza="1001" scaleza="8001001" name="hfreegas" /> <!-- for h1 SCALE uses ID=8001001  -->
   <nuclei endf="128" realza="1002" scaleza="8001002" name="dfreegas" />
</specialNuclei>


<!-- thermal nuclei -->
<thermal>
   <nuclei endf="1" realza="101" >   <!-- thermal evaluation h_h2o -->
        <fastMat endf="125" scaleza="1001" name="h-1" />  <!-- bound with fast evaluation h1 uses SCALE ID=1001 -->
   </nuclei>

   <nuclei endf="58" realza="158" >   <!-- thermal evaluation zr_zrh -->
        <fastMat endf="4028" scaleza="1040091" name="zr91-zr5h8" />  <!-- bound with fast evaluation zr91 uses SCALE ID=1040091 -->
   </nuclei>

</thermal>

</ConfigFile>
```

Editing the generated configuration file (continued)

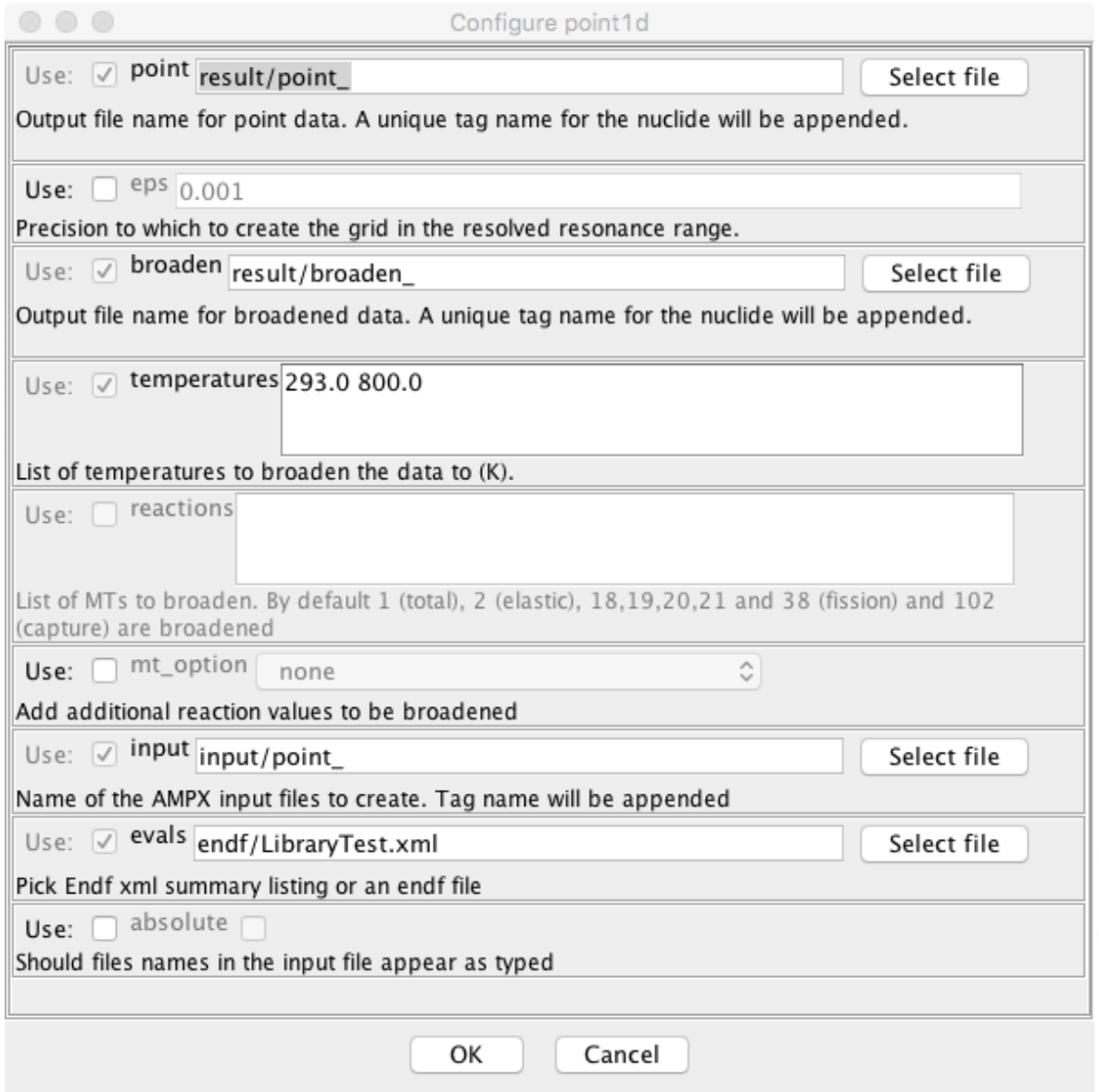


Editing the generated configuration file (continued)





Editing the generated configuration file (continued)



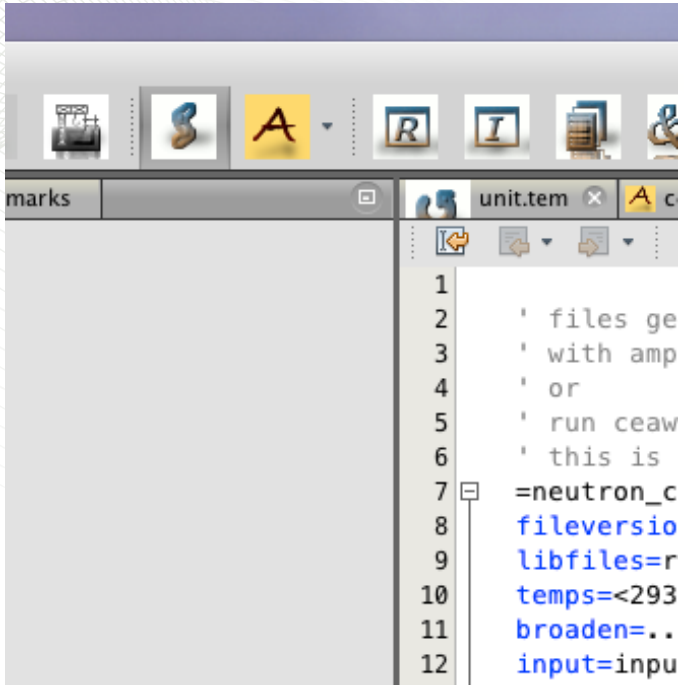
MG library templates

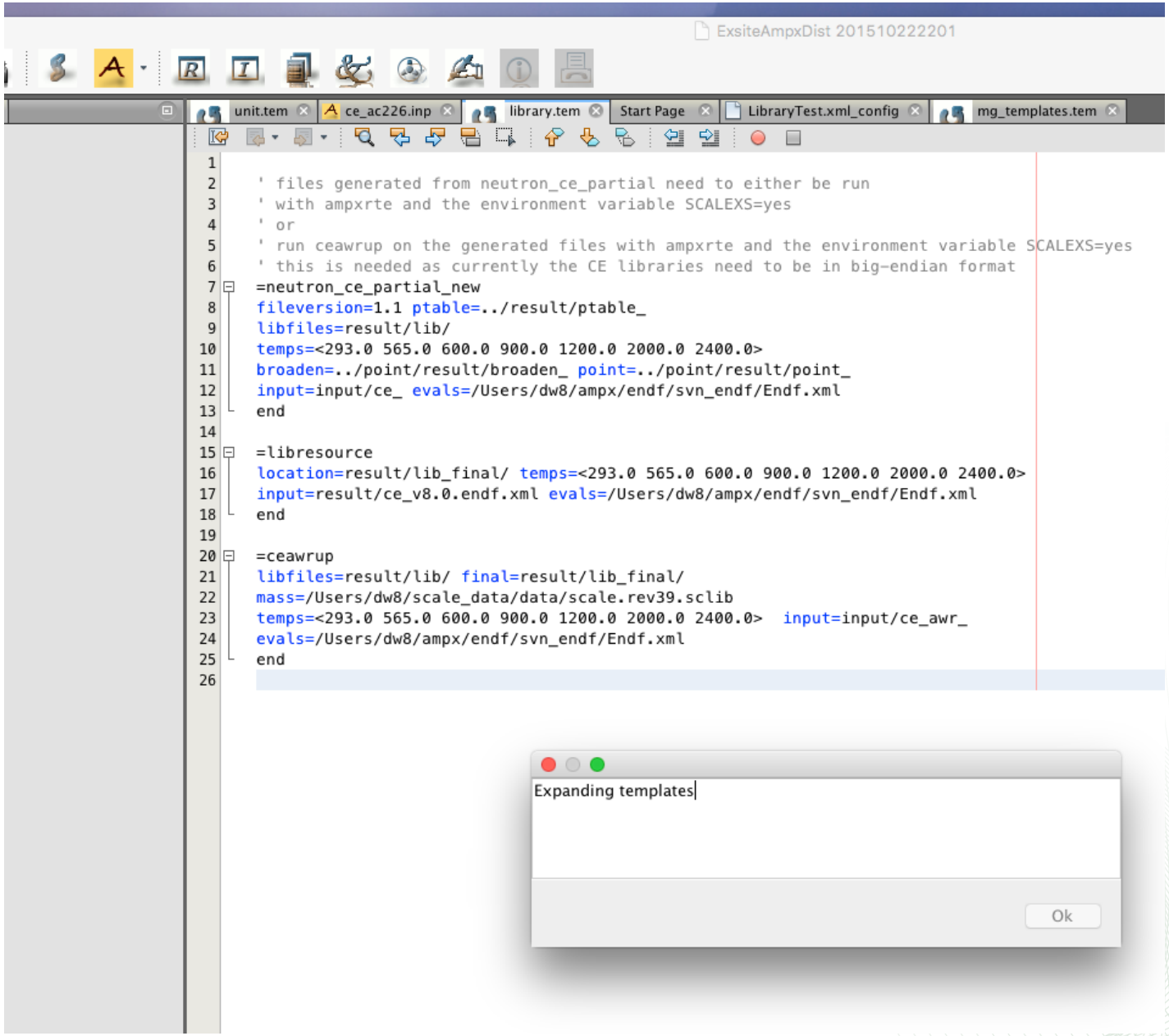
- For multigroup libraries, the following templates are needed
  - point1d
  - neutron_mg
  - bondarenko_prob or bondarenko
  - bind_mg
  - combine_mgs
- If there are no thermal moderators, Template Master combines all the above steps into one template
- Thermal moderators are more complicated, as thermal evaluations from one ENDF file must be combined with one or more fast evaluations from a different ENDF file

MG library templates (continued)

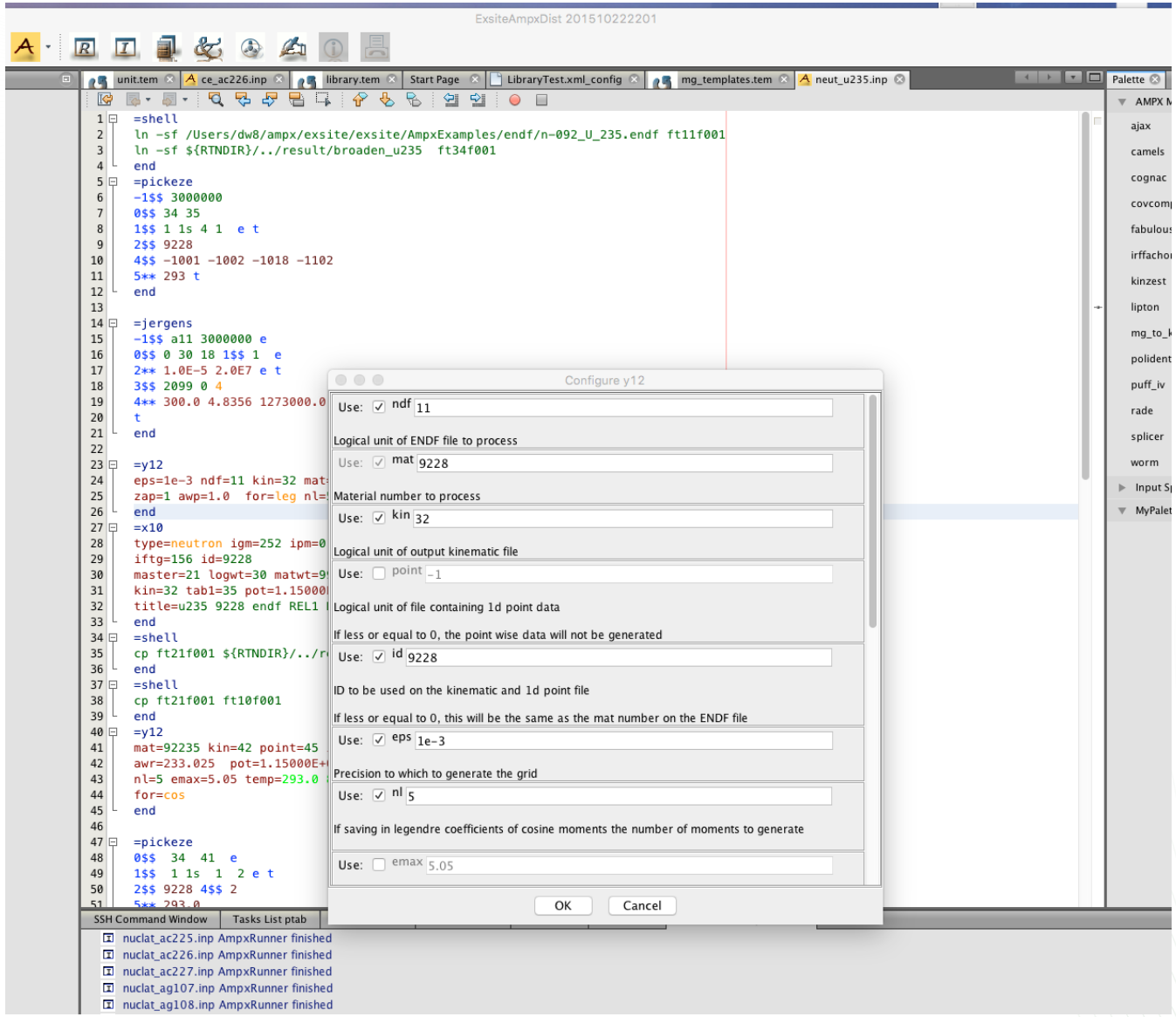
```
'
' Generate a MG library for incident neutrons containing
' 1d and 2d neutron data
'
=neutron_mg
master=result/neut_ temperature=293
broaden=result/broaden_ neutgroups=252
thermalgroups=97 weighting=4
thermaltemp=<293.0 800>
input=input/neut_
evals=endf/LibraryTest.xml
end

'
' Generate NR bondarenko data. A neutron library generated
' by neutron_mg is needed. The desired background values are
' given in sig0 and the desired temperature are in
' temps.
=bondarenko
master=result/bond_ broaden=result/broaden_
n1d=result/neut_ temperature=293 neutgroups=252
thermalgroups=97
sig0=<1.0E8 1000000.0 100000.0 10000.0 1000.0 100.0 10.0 1.0 1.0E-6>
temps=<293.0 800>
input=input/bond_252_ evals=endf/LibraryTest.xml
end
```

MG library templates (continued)



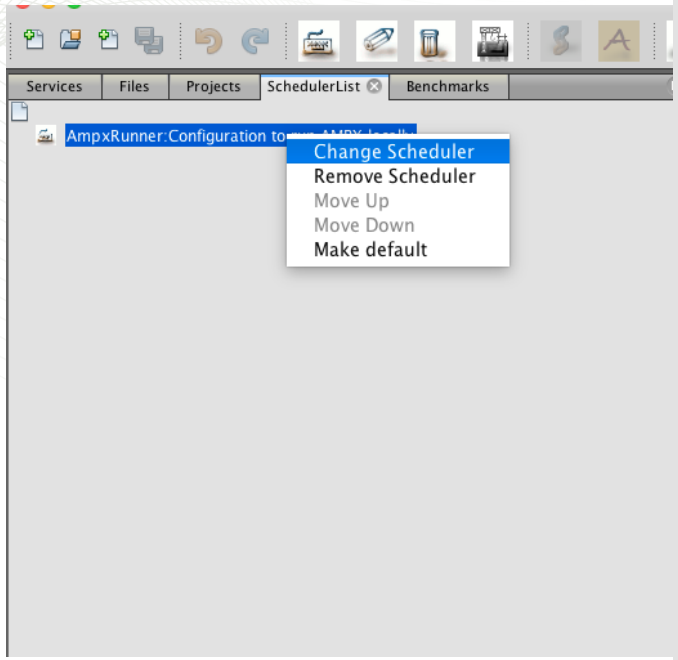


This will generate input files that can be viewed in ExSite



Input files can be run as follows

- From the command line using the usual SCALE commands (ampxrte is the preferred way)
- From the graphical user interface (GUI) if pressing the Ampx button (if set up correctly - see next slide)
- From the GUI in batch mode, if the system does not have a queuing system




```
5   =pickeze
6   -1$$ 3000000
7   0$$ 34 35
8   1$$ 1 1s 4 1  e t
9   2$$ 9228
10  4$$ -1001 -1002 -1018 -1102
```

Change Scheduler

Name:	AmpxRunner
Description:	Configuration to run AMPX locally
Type:	local
Host:	
Directory:	Select
Scheduler:	/Users/dw8/ampx/ampx_scale/build/install/bin/scheduler
RSH command:	

Custom Data

Program:	/Users/dw8/ampx/ampx_scale/build/install/bin/ampxrte	Select
Switches:		
Output Extension:	out	☑ Retrieve ☐ Append
Message Extension:	msg	☑ Retrieve

Cancel OK

```
44  for=cos
45  end
46
47  =pickeze
48  0$$  34  41  e
49  1$$  1 1s  1  2 e t
```

To test the new libraries, there are a few templates that set up SCALE input files

- Allnucinf: infinite medium cases for all nuclides in the library
- Allnuclat: pincell cases for all nuclides in the library
- cf_leak_unit: ^{252}Cf source in a sphere for each nuclide
- cf_trans_unit: transmission through a block of material for each nuclide

Intermediate resonance factors

- The templates outlined above generate narrow resonance factors (Bondarenko-factors)
- In conjunction with some SCALE modules, AMPX can also generate intermediate resonance (IR) factors using homogeneous and heterogeneous lattices
- The current SCALE libraries contain homogenous IR factors for Z >40 and heterogeneous IR-factors for some selected nuclides
- The template ffactor generates input files for homogenous IR factors

Summary

- AMPX is used to generate MG and CE libraries for SCALE
- Covariance libraries and decay libraries can also be generated
- With the help of ExSite, it is easy to generate SCALE libraries from ENDF data
- Templates in ExSite generate SCALE input files to demonstrate how the MG and CE libraries are to be used