

PARCS input

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Outline

- A few important items about PARCS input
- PARCS input structure
- Skeleton of an example PARCS input file
- Description of 8 blocks used in the example input
- How to run standalone PARCS
- Example 1: deplete a uniform core
- Example 2: shuffle the core after depletion
- Example 3: deplete the core after shuffle
- Example 4: load the core using history file for sensitivity study

A few important items about PARCS input*

- **Input was designed to use as many default values as possible**
 - Very short inputs are possible for 2G nodal PWR problems
- **Input restrictions**
 - Block names start in 1st column (CASEID, PARAM, CNTL, GEOM, TH, TRAN, PFF, ONEDK, PLOT)
 - Card names start in 2nd or later column
 - Card input can be in external files through “file” card
 - In general, block order is arbitrary (exception is FMFD; the FMFD block must be before GEOM)
 - In general, card order within a block can be arbitrary
 - BANG (!) is a comment
 - SLASH (/) is end of case
 - DOT (.) is end of input
 - Input is case insensitive
 - Multiple data on a single card can be separated by space
 - Fortran-style free format STAR (*) can be used for repeating data: e.g., 8*1.2 means repeat 1.2 eight times
 - Any empty lines are ignored
 - Tabs are not allowed

*source: V. Seker, PARCS: NRC's Advanced Reactor Core Simulator, PARCS training at INL, August 2008

PARCS input structure**

```
! Comment
BLOCKNAME_I
  CARD_1  field_1  field_2  field_3  .... ! Comment
  CARD_2  field_1  field_2  field_3  ....
  CARD_3  field_1  field_2  field_3  ....
  CARD_4  field_1  field_2  field_3  ....
  ....

BLOCKNAME_II
  CARD_1  field_1  field_2  field_3  ....
  CARD_2  field_1  field_2  field_3  ....
  CARD_3  field_1  field_2  field_3  ....
  CARD_4  field_1  field_2  field_3  ....
  ....

BLOCKNAME_III
  CARD_1  field_1  field_2  field_3  ....
  CARD_2  field_1  field_2  field_3  ....
  CARD_3  field_1  field_2  field_3  ....
  CARD_4  field_1  field_2  field_3  ....
  ....
```

**source: T. Downar, et al., PARCS (NRC – v3.3.2 release), Vol. I: Input Manual, Feb. 18, 2020

14 Blocks currently available in PARCS:

CASEID	CNTL	PARAM
DEPL	GEOM	FDBK
TH	MCYCLE	
XSEC*	GEOMHEX*	TRAN*
FMFD*	PFF*	ONEDK*

*not covered in the current session.

Only two of the PARCS blocks are strictly required:

- (1) one of either the GEOM or GEOMHEX blocks, and
- (2) one of either the XSEC or DEPL blocks.

The CNTL and PARAM blocks are only needed if default specifications are not being used.

All other blocks, i.e., FDBK through ONEDK, represent optional functionality and are only input if activated via CNTL cards.

What does a PARCS input look like?

```
!*****
```

CASEID example1 ! the output files will all have "example1" in their names, i.e. example1.parc_out

```
!*****
```

CNTL ! Global calculational control of the various PARCS simulation features.

core_type PWR ! Mainly sets top inserted CR banks

... ! Skipped several lines of input here.

```
!*****
```

PARAM ! Parameters that are used to specify the solution and iteration control.

nlupd_ss 3 5 1 ! 3 CMFD solves per nodal, 5 CMFDs for first sweep, 1 TH per set of CMFD

...

```
!*****
```

GEOM ! Geometric modeling information.

geo_dim 9 9 32 1 1 ! X assem cols, y assem rows ,n z planes, n lower ax refl, n upper ax refl

...

```
!*****
```

FDBK ! Initial input data associated with T/H feedback effects.

fa_powpit 20.4597 21.50 ! avg. assembly power(MW) and assembly pitch(cm)

...

```
!*****
```

TH ! Parameters associated with the PARCS internal T/H solver.

unif_th 0.74300 600.0 291.85 ! cool den, ftemp(C), ctemp(C); used when no TH feedback (intthflg = F)

...

What does a PARCS input look like? (cont.)

```
!*****
```

DEPL ! Macroscopic core depletion specification.

INP_HST 'shuf_cycle2.parcs_cyc-02' 1 2 ! history file; 1 means the file is ASCII; 2 is 2nd data block

...

```
!*****
```

MCYCLE ! Multi-cycle modeling specification.

bank_def 1 400.0 400.0 400.0 230.0 400.0 400.0 400.0 400.0 0.0 ! Last bank is Pyrex/Waba

! Definition of a cycle

cycle_def 1 ! One depletion step, but two NK states, before and after

depl_step 0.0001 ! Length of step in days, effectively no change in burnup

power_lev 2*0.001 ! Both before and after power level in %

bank_seq 2*1 ! Use bank_def 1 for before and after CR state

...

CYCLE_IND 1 0 2 ! cycle numbering, shuf ID, cycle ID; execute a cycle depletion

CONV_EC 0.1 1 ! convergence criterion (GWD/T), max number of iteration; will terminate whichever criteria is first met.

```
!*****
```

The CNTL block

!*****

CNTL ! Global calculational control of the various PARCS simulation features.

core_type PWR ! This card affects the default values used for reflector conditions;
! BWR, CANDU, PBR and how control rod insertion is handled.

int_th T -1 ! "True" to use internal T/H solver (TH block is required). "False" to use external T/H solution (see EXT_TH card).
! "-1" for simple mass/energy solution; "1" for PATHS solver.

xe_sm 1 1 ! "0", "1", and "2" for no, equilibrium, and transient Xenon, respectively; "3" for read in Xe from history file.

!

core_power 100.0 ! Initial core power in %; must > 0; use a small value (e.g., 1e-4) for zero power conditions.

! A(1) B(2) C(3) D(4) SA(5) SB(6) SC(7) SD(8) BP(9)

bank_pos 400.0 400.0 400.0 230.0 400.0 400.0 400.0 400.0 0.0 ! Initial control rod bank position in steps withdrawn.

!

ppm 1285.0 ! Initial boron concentration.

search ppm 1.0 1800.0 ! Search for CBC, in the range of 1 to 1800ppm.
! "CRP" to search CRP; or use "keff" to perform eigenvalue calculation, search is disabled in that case.

mult_cyc T ! If "true", fuel shuffling specification is required in MCYCLE.

detector T 250.0 2 ! Detector response calculation is invoked; normalization factor; "2" for corner point balance.

!-----

depletion T 1.0e-4 T ! Flag to invoke depletion option; eigenvalue convergence criteria; stores interp. Para. In memory.

! TREE,nset,adf,xes,ene,jlf,chi,chd,vel,det,yld,cdf,gff,bet,lam,dht

TREE_XS T 61 T T F F F F T T F T F F F ! Tree structure XS invoked; Number of XS sets (#fuelZones+refl. Regions)

!

pow flux th prec xesm pin

PLOT_OPTS 0 0 0 0 0 2 ! "0" for no data beyond normal is printed; "1" for 1D axial and 2D radial; "2" for 3D data.

PIN_POWER T ! Flag to invoke pin power calculation.

The PARAM block

```
!*****
```

PARAM ! Parameters that are used to specify the solution and iteration control.

nlupd_ss 3 5 1 ! nonlinear update frequency (3-d); initial outer iter.; #TH updates/nodal_update

n_iters_ss 15 200 ! max inner iter.; max outer iter.

conv_ss 1.0e-6 1.0e-5 5.0e-5 ! keff, global fission source, local fiss source convergence.

cnv_th_ss 0.001 ! relative fuel temp convergence.

wielandt 0.3 10.0 1.0 ! eigenvalue shift method.

decusp 2 ! CR de-cusping (flux shape correction + axial discontinuity factor)

cmfd 2 ! CMFD with correction factors for discontinuity factors and diffusion coefficients

! → Overall decusp and wielandt are the most useful

The GEOM block (1/2)

```
!*****
```

```
*****
```

```
GEOM ! Geometric modeling information.
```

```
geo_dim 9 9 32 1 1
```

```
!nasyx,nasyy,nz,nzbr,nztr
```

```
rad_conf ! radial core config (SE  
quadrant)
```

```
!      1  2  3  4  5  6  7  8  9
      37 37 37 37 37 37 37 37 6
      37 39 37 39 37 37 39 37 6
      37 37 37 37 39 37 26 37 6
      37 39 37 37 37 37 39 37 6
      37 37 39 37 37 37 37 5 7
      37 37 37 37 37 26 37 6 0
      37 39 21 39 37 37 5 8 0
      37 37 37 37 5 4 8 0 0
      4 4 4 4 7 0 0 0 0
```

```
file './depl_asm_training.geom'
```

```
!***** The "depl_asm_training.geom" (shorten version) ****
```

```
grid_x      1*10.75 8*21.50
```

```
neutmesh_x  1*1 8*1
```

```
grid_y      1*10.75 8*21.50
```

```
neutmesh_y  1*1 8*1
```

```
!           refl fuel      refl ! grid spacer ignored
```

```
grid_z      16.951 30*12.192 36.226 ! length here
```

```
!           W E N S B T
```

```
boun_cond   0 2 0 2 2 2 ! 0, 1, 2, 3, and 4 for reflective, zero  
flux,
```

```
! Zero incoming flux, Albedo, extrapolation distance,  
respectively.
```

```
assy_type 4 1 30*3 2 REFL ! S - 1-sided refl
```

```
assy_type 31 1 30*31 2 FUEL ! 3.1%
```

```
assy_type 37 1 30*37 2 FUEL ! 3.7%
```

```
...
```

```
PINCAL_LOC
```

```
 1  2  3  4  5  6  7  8  0
 9 10 11 12 13 14 15 16 0
17 18 19 20 21 22 23 24 0
25 26 27 28 29 30 31 32 0
33 34 35 36 37 38 39 0 0
40 41 42 43 44 45 46 0
47 48 49 50 51 52 0 0
53 54 55 56 0 0 0
 0  0  0  0  0
```

The GEOM block (2/2)

crb_def 4 ! Four Types;

! # none AIC B4C length of each segment in cm
1 0 2 1 0 5.08 101.6 259.08

2 0 1 0 3.81 360.68 500 ! None Pyrx None
3 0 1 0 15.24 335.28 500 ! None WABA None !
4 1 500.0 ! TP bars

! A(1) B(2) C(3) D(4) SA(5) SB(6) SC(7) SD(8) BP(9)
crb_type 1 1 1 1 1 1 1 1 3

cr_axinfo 16.591 1.5875 ! Control rod position when
! Fully inserted (cm); Control rod step size (cm);

bank_conf !
4 0 1 0 0 0 3 0 0
0 9 0 9 0 6 9 0 0
1 0 3 0 9 0 2 0 0
0 9 0 0 0 7 9 0 0
0 0 9 0 4 0 5 0 0
0 6 0 8 0 0 0 0
3 9 2 9 5 0 0 0
0 0 0 0 0 0 0
0 0 0 0 0

file './depl_detect.geom'

!***** In one of the “*.P_{MAX}” file (shorten version) ****

STA_VAR 4 CR DC PC TF
BRANCHES 1 2 6 18 18

...
DC 2 0.0 0.76971 600 800
DC 3 1.0 0.60811 600 800
DC 4 1.0 0.76971 600 800
DC 5 2.0 0.60811 600 800
DC 6 2.0 0.76971 600 800
...

!***** the “**depl_detect.geom**” file (shorten version) ****

DET_XY_LOC 56
1 2 3 4 5 6 7 8 0
...
53 54 55 56 0 0 0
0 0 0 0 0
DET_Z_LOC 30 1
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
24 25 26 27 28 29 30 31
DET_Z_WEI 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1
DET_NAME
1 D01

PARCS input: last update March 2024

The FDBK and TH blocks

!*****

FDBK ! Initial input data associated with T/H feedback effects.

fa_powpit 20.4597 21.50 ! avg. assembly power(MW) and pitch(cm);

!*****

TH ! Parameters associated with the PARCS internal T/H solver.

unif_th 0.74300 600.0 291.85 ! cool den, ftemp(C), ctemp(C); used when no TH feedback (intthflg = F)

!

flow_cond 291.67 85.963 ! tin(C),mass flow/assembly(Kg/sec)

n_pingt 264 25 ! npin,ngt

pin_dim 4.096 4.750 0.57 6.02 ! pelletrad, cladrad, cladthick, rgt(mm)

hgap 8000.0 ! hgap(w/M^2-C)

n_ring 8 ! number of meshes in pellet

The DEPL block

```
!*****
DEPL
  INP_HST  'shuf_cycle2.parcs_cyc-02' 1 2  ! history file; "1" means the file is ASCII; "2" means restart position
  INP_OPT  F F F F  ! flag to read boron, CR position, TH para., Xe/Sm densities from hist file.
!
  HST_OPT   T T T T F !types of histories used for XS evel: LHCR,LHDC,LHPC(coolant poison),LHTF,LHTC
  OUT_OPT   T T T T F !PPOW,PHST(history distribution),PTHS(instantaneous TH variables),PXESM,PXSS(no longer
supported)

file './pmax_training.dir'
```

```
!***** the pmax_training.dir file *****
!
  Index          PMAXS File Name          Br_struct
PMAXS_F  1  './PMAXS_training/refl_B.PMAX'    1  ! bottom reflector
PMAXS_F  2  './PMAXS_training/refl_T.PMAX'    2  ! top reflector
PMAXS_F  3  './PMAXS_training/refl_S.PMAX'    3  ! side reflector (S)
...
PMAXS_F 31  './PMAXS_training/3.1.PMAX'      11 ! 3.1wt%
PMAXS_F 37  './PMAXS_training/3.7.PMAX'      13 ! 3.7wt%  ...
```

The MCYCLE block

MCYCLE ! Multi-cycle modeling specification.

! A(1) B(2) C(3) D(4) SA(5) SB(6) SC(7) SD(8) BP(9)
 bank_def 1 400 400 400 230 400 400 400 400 0

! a short cycle
 cycle_def 1
 depl_step 0.0001
 power_lev 2*0.001
 bank_seq 2*1

! a long cycle
 CYCLE_DEF 1 5 ! 5 changes in burnup, six states
 EXPO POWR BANK FLOW ENTH PRES
 0.0 15.8 1 3800.0 1233.7 6812020
 0.0216 24.7 2 7976.7 1238.9 6812020
 0.1285 20.4 2 5177.9 1232.1 6812020
 0.1704 42.4 3 10062.9 1232.2 6812020
 0.2535 55.7 4 11160.4 1236.4 6812020
 0.3455 67.4 5 9048.0 1213.2 6936126

LOCATION	0								
H-8	G-8	F-8	E-8	D-8	C-8	B-8	A-8		0
H-9	G-9	F-9	E-9	D-9	C-9	B-9	A-9		0
H-10	G-10	F-10	E-10	D-10	C-10	B-10	A-10		0
H-11	G-11	F-11	E-11	D-11	C-11	B-11	A-11		0
H-12	G-12	F-12	E-12	D-12	C-12	B-12		0	0
H-13	G-13	F-13	E-13	D-13	C-13	B-13		0	
H-14	G-14	F-14	E-14	D-14	C-14		0	0	
H-15	G-15	F-15	E-15		0	0			
	0	0	0	0	0				

SHUF_MAP 1 1 ! shuf index, shuf mode: 1-indiv; 2-batch

-37	D-13	-37	D-13	D-13	D-13	-37	D-13	0
D-13	-39	B-13	-39	D-13	-37	-39	D-13	0
-37	B-13	-37	B-13	-39	D-13	-26	C-11	0
D-13	-39	B-13	D-13	B-13	-37	-39	F-8	0
B-13	D-13	-39	B-13	B-13	-37	B-13		0
D-13	-37	B-13	-37	-37	-26	B-8		0
-37	-39	-21	-39	D-13	B-8		0	0
D-13	D-13	C-11	F-8		0		0	
0	0	0	0	0				

!

CYCLE_IND 1 0 1 ! cycle numbering, shuf ID, cycle ID
 CYCLE_IND 2 1 1

CONV_EC 0.1 2
 ! Conv. Cri. (GWD/T)
 ! max number of iteration
 ! will terminates whichever criteria is first met.

Running standalone PARCS*

- PARCS execution
 - From Windows prompt
 - > parcs.exe input_name.inp
 - File name does not have to have any specific extension
 - From Linux prompt
 - \$ [path-to-PARCS-binary/binary_name]/ input_name.inp
 - e.g., /projects/PARCS/v336/parcs-v336-linux2-gfortran-x64-release.x ee_cycle1.inp
 - >screen.txt

Example 1: deplete a uniform core

CASEID example1

CNTL

```
core_type    PWR
int_th       T -1
xe_sm        1  1
core_power    100
bank_pos      400 400 400 230 400 400 400 400 0
ppm           1285.0
search        ppm  1.0 1800.0
mult_cyc      T
depletion     T 1.0e-4 T
```

...

GEOM

```
geo_dim      9 9 32 1 1 !nasyx,nasyy,nz,nzbr,nztr
rad_conf
37 37 37 37 37 37 37 37 6
37 37 37 37 37 37 37 37 6
37 37 37 37 37 37 37 37 6
37 37 37 37 37 37 37 37 6
37 37 37 37 37 37 37 5 7
37 37 37 37 37 37 37 6 0
37 37 37 37 37 37 5 8 0
37 37 37 37 5 4 8 0 0
4 4 4 4 7 0 0 0 0
```

...

MCYCLE

```
bank_def 1 400 400 400 230 400 400 400 400 400 ! BP rods out.
```

...

! a long cycle

```
cycle_def 2 ! 21 steps
depl_step 20*-2.0 ! 40 GWd/MTU
bank_seq 21*1
power_lev 21*100
inlet_ent 21*-564.81 ! temperature (K)
flow_rate 21*85.963 ! kg/sec/assembly
```

...

```
CYCLE_IND 1 0 2 ! Execute shuffle and a depletion cycle.
```

```
CONV_EC 0.1 1 ! convergence criterion (GWD/T), max number of
iteration
```

Other blocks included in this input but not shown here: PARAM, FDBK, TH, and DEPL (they are the same as those shown in previous slides).

negative value in inlet_ent means the input is for temperature.

Example 1: the output files

```
[h56@node1 example1]$ ls
depl_assm_training.geom  example1.parcs_pin003  example1.parcs_pin016  example1.parcs_pin029  example1.parcs_pin042  example1.parcs_pin055
depl_detect.geom         example1.parcs_pin004  example1.parcs_pin017  example1.parcs_pin030  example1.parcs_pin043  example1.parcs_pin056
error_msg.txt            example1.parcs_pin005  example1.parcs_pin018  example1.parcs_pin031  example1.parcs_pin044  example1.parcs_rst-01
example1.inp             example1.parcs_pin006  example1.parcs_pin019  example1.parcs_pin032  example1.parcs_pin045  example1.parcs_sum
example1.inp_parcs_err   example1.parcs_pin007  example1.parcs_pin020  example1.parcs_pin033  example1.parcs_pin046  example1.parcs_xml
example1.inp_paths_err   example1.parcs_pin008  example1.parcs_pin021  example1.parcs_pin034  example1.parcs_pin047  old
example1.parcs_cyc-01    example1.parcs_pin009  example1.parcs_pin022  example1.parcs_pin035  example1.parcs_pin048  pmax_training.dir
example1.parcs_det       example1.parcs_pin010  example1.parcs_pin023  example1.parcs_pin036  example1.parcs_pin049  run_example1.inp
example1.parcs_dpl       example1.parcs_pin011  example1.parcs_pin024  example1.parcs_pin037  example1.parcs_pin050  screen1.txt
example1.parcs_msg       example1.parcs_pin012  example1.parcs_pin025  example1.parcs_pin038  example1.parcs_pin051
example1.parcs_out       example1.parcs_pin013  example1.parcs_pin026  example1.parcs_pin039  example1.parcs_pin052
example1.parcs_pin001    example1.parcs_pin014  example1.parcs_pin027  example1.parcs_pin040  example1.parcs_pin053
example1.parcs_pin002    example1.parcs_pin015  example1.parcs_pin028  example1.parcs_pin041  example1.parcs_pin054
```

Example 1: the *.parcs_dpl file

```
[h56@node1 example1]$ cat example1.parcs_dpl
```

CYCLE 1

PT	RE	Keff	Power	AxOff	Pz	Pxy	Pxyz	PPin	Days	B(GW/T)	Bmax	Beta	notch	ppm	Tf(K)	Tm(K)	d(g/cc)	void(%)	Xe(1/cc)	Sm(1/cc)
1	0	1.044591	100.0	-10.2	1.354	1.640	2.257	2.289	0.0	0.000	0.000	0.0	2456	1800.0	883.7	586.1	0.69354	0.00	2.913E+15	1.891E+16
2	0	1.024916	100.0	-3.3	1.211	1.577	1.922	2.210	46.0	2.000	4.514	0.0	2456	1800.0	880.1	585.5	0.69547	0.00	3.059E+15	2.172E+16
3	0	1.005186	100.0	0.2	1.149	1.512	1.724	2.143	92.0	4.000	8.357	0.0	2456	1800.0	877.5	585.2	0.69662	0.00	3.154E+15	2.377E+16
4	0	0.999999	100.0	-2.7	1.134	1.464	1.688	2.104	138.0	6.000	11.718	0.0	2456	1587.8	876.5	585.6	0.69595	0.00	3.199E+15	2.525E+16
5	0	0.999999	100.0	-4.4	1.151	1.426	1.668	2.066	184.1	8.000	14.932	0.0	2456	1313.0	875.8	585.9	0.69556	0.00	3.212E+15	2.631E+16
6	0	0.999999	100.0	-4.7	1.146	1.396	1.625	2.033	230.1	10.000	18.080	0.0	2456	1054.5	875.2	586.0	0.69553	0.00	3.207E+15	2.708E+16
7	0	0.999999	100.0	-4.8	1.142	1.370	1.584	2.005	276.1	12.000	21.165	0.0	2456	810.6	874.7	586.0	0.69554	0.00	3.190E+15	2.763E+16
8	0	0.999999	100.0	-5.0	1.139	1.349	1.550	1.982	322.1	14.000	24.192	0.0	2456	579.9	874.4	586.0	0.69553	0.00	3.164E+15	2.799E+16
9	0	0.999999	100.0	-5.1	1.135	1.330	1.517	1.964	368.1	16.000	27.163	0.0	2456	361.7	874.1	586.1	0.69552	0.00	3.131E+15	2.820E+16
10	0	1.000000	100.0	-5.1	1.130	1.313	1.493	1.950	414.1	18.000	30.067	0.0	2456	154.0	873.8	586.1	0.69554	0.00	3.092E+15	2.828E+16
11	0	0.996693	100.0	-4.4	1.115	1.297	1.450	1.936	460.1	20.000	32.948	0.0	2456	0.1	873.4	586.0	0.69578	0.00	3.052E+15	2.830E+16
12	0	0.982211	100.0	-0.7	1.049	1.282	1.363	1.922	506.2	22.000	35.752	0.0	2456	0.1	872.7	585.6	0.69690	0.00	3.022E+15	2.835E+16
13	0	0.967983	100.0	0.6	1.065	1.267	1.373	1.908	552.2	24.000	38.380	0.0	2456	0.1	872.4	585.4	0.69733	0.00	2.988E+15	2.836E+16
14	0	0.954163	100.0	1.4	1.074	1.253	1.373	1.894	598.2	26.000	40.924	0.0	2456	0.1	872.2	585.3	0.69760	0.00	2.953E+15	2.833E+16
15	0	0.940696	100.0	1.7	1.078	1.241	1.369	1.882	644.2	28.000	43.406	0.0	2456	0.1	872.0	585.3	0.69772	0.00	2.918E+15	2.827E+16
16	0	0.927694	100.0	1.9	1.080	1.230	1.362	1.870	690.2	30.000	45.848	0.0	2456	0.1	871.9	585.2	0.69782	0.00	2.881E+15	2.816E+16
17	0	0.915050	100.0	2.2	1.084	1.221	1.357	1.860	736.2	32.000	48.256	0.0	2456	0.1	871.7	585.2	0.69793	0.00	2.844E+15	2.804E+16
18	0	0.902822	100.0	2.3	1.083	1.212	1.348	1.850	782.2	34.000	50.634	0.0	2456	0.1	871.6	585.2	0.69797	0.00	2.807E+15	2.789E+16
19	0	0.890994	100.0	2.5	1.085	1.206	1.342	1.841	828.3	36.000	52.990	0.0	2456	0.1	871.5	585.2	0.69806	0.00	2.771E+15	2.773E+16
20	0	0.879568	100.0	2.6	1.084	1.199	1.335	1.833	874.3	38.000	55.328	0.0	2456	0.1	871.5	585.2	0.69809	0.00	2.734E+15	2.755E+16
21	0	0.868532	100.0	2.7	1.084	1.196	1.329	1.826	920.3	40.000	57.651	0.0	2456	0.1	871.4	585.1	0.69815	0.00	2.699E+15	2.737E+16

Equilibrium Core Convergence Criterion: 1.00000E-01
 Max Burnup Change From Previous Cycle (GWD/T): 5.76506E+01

Example 1: the *.parcs_cyc-01 file

EXP 2D MAP									
	1	2	3	4	5	6	7	8	9
1	47.922	45.959	47.802	46.280	50.535	49.964	41.792	30.516	0.000
2	45.959	33.676	46.192	33.190	46.696	47.670	29.877	29.267	0.000
3	47.802	46.192	49.096	47.011	33.588	46.226	40.439	28.840	0.000
4	46.280	33.190	47.011	51.455	50.748	47.419	26.775	22.027	0.000
5	50.535	46.696	33.588	50.748	53.570	49.107	34.063	0.000	0.000
6	49.964	47.670	46.226	47.419	49.107	44.145	27.477	0.000	
7	41.792	29.877	40.439	26.775	34.063	27.477	0.000	0.000	
8	30.516	29.267	28.840	22.027	0.000	0.000	0.000		
9	0.000	0.000	0.000	0.000	0.000				

H	G	F	E	D	C	B	A
0.00	27.81	0.00	26.79	0.00	27.72	0.00	39.68
26.77	0.00	26.46	0.00	27.88	0.00	0.00	26.72
0.00	26.48	0.00	26.78	0.00	26.20	0.00	28.40
26.67	0.00	23.80	27.76	23.80	0.00	0.00	39.53
0.00	28.05	0.00	23.84	22.72	0.00	25.97	
27.76	0.00	26.09	0.00	0.00	0.00	27.26	
0.00	0.00	0.00	0.00	25.97	27.26		
39.72	27.76	28.40	38.85				

The *.parcs_cyc-* file can be used as a history file to restart another run.

It contains assembly type layout, ppm conc, CR bank positions at each PT step; 2D, 1D, and 3D maps at each PT step for RPF (rel. power), EXP, HCR (CR hist.), HDC (co. density), HPC (co. poison), HTF (fuel temp), I_D (Iodine?), XEN (Xe, 1E15), PMN (Promethium, 1E16), SMN (Sm), TFU (fuel temp), DCO (co. den.), TCO (co. temp.), PCO (coolant poison).

Example 2: shuffle the core after depletion

CASEID example2_shuf

|*****|

CNTL

core_type PWR
int_th T -1
xe_sm 1 1
core_power 100
bank_pos 400 400 400 230 400 400 400 400 0
ppm 1285.0
search ppm 1.0 1800.0
mult_cyc T
depletion T 1.0e-4 T

DEPL

INP_HST 'example1.parcs_cyc-01' 1 21

...

MCYCLE

...

LOCATION 0
H-8 G-8 F-8 E-8 D-8 C-8 B-8 A-8 0
H-9 G-9 F-9 E-9 D-9 C-9 B-9 A-9 0
H-10 G-10 F-10 E-10 D-10 C-10 B-10 A-10 0
H-11 G-11 F-11 E-11 D-11 C-11 B-11 A-11 0
H-12 G-12 F-12 E-12 D-12 C-12 B-12 0 0
H-13 G-13 F-13 E-13 D-13 C-13 B-13 0
H-14 G-14 F-14 E-14 D-14 C-14 0 0
H-15 G-15 F-15 E-15 0 0 0
0 0 0 0 0

SHUF_MAP 1 1 ! shuf index, shuf mode: 1-indiv; 2-batch

-37	D-13	-37	D-13	D-13	D-13	-37	D-13	0
D-13	-39	B-13	-39	D-13	-37	-39	D-13	0
-37	B-13	-37	B-13	-39	D-13	-26	C-11	0
D-13	-39	B-13	D-13	B-13	-37	-39	F-8	0
B-13	D-13	-39	B-13	B-13	-37	B-13	0	0
D-13	-37	B-13	-37	-37	-26	B-8	0	0
-37	-39	-21	-39	D-13	B-8	0	0	0
D-13	D-13	C-11	F-8	0	0	0	0	0
0	0	0	0	0	0	0	0	0

CYCLE_IND 1 0 1 ! cycle numbering, shuf ID, cycle ID

CYCLE_IND 2 1 1

CONV_EC 0.1 2 ! convergence criterion (GWD/T), max number of iteration; will terminate whichever criteria is met.

Other blocks included in this input but not shown here: GEOM, PARAM, FDBK, and TH (they are the same as those shown in previous slides).

Example 3: deplete the core after shuffle

```
CASEID  example3
!*****
*****
CNTL
    core_type      PWR
    int_th         T  -1
    xe_sm          1   1
    core_power     100
    bank_pos       400 400 400 230 400 400
400 400 0
    ppm           1285.0
    search         ppm      1.0      1800.0
    mult_cyc       T
    depletion      T  1.0e-4  T
    ...
GEOM
    geo_dim        9  9 32  1  1
!nasyx,nasyy,nz,nzbr,nztr
    rad_conf
        37  37  37  37  37  37  37  37  6
        37  39  37  39  37  37  39  37  6
        37  37  37  37  39  37  26  37  6
        37  39  37  37  37  37  39  37  6
        37  37  39  37  37  37  37  5  7
        37  37  37  37  37  26  37  6  0
        37  39  21  39  37  37  5  8  0
        37  37  37  37  5  4  8  0  0
        4  4  4  4  7  0  0  0  0
```

```
DEPL
    INP_HST      'example2_shuf.parcs_cyc-02' 1 2
    INP_OPT      F F F F ! flag to read boron, CR position,TH para,Xe from
the history file.
    ...
MCYCLE
    bank_def    1  400 400 400 230 400 400 400 400 400 ! BP rods out.
    ...
    cycle_def   2  ! 21 steps
    depl_step   20*-1.0 ! 20 GWD/MTU
    bank_seq    21*1
    power_lev   21*100
    inlet_ent   21*-564.81
    flow_rate   21*85.963
    ...
    CYCLE_IND   1  0  2  ! Execute a depletion cycle.
    CONV_EC     0.1  1  ! convergence criterion (GWD/T), max number of
iteration
```

Other blocks included in this input but not shown here: PARAM, FDBK, and TH (they are the same as those shown in previous slides).

Example 4: load the core using history file for sensitivity study

CASEID example4_580_zppt ! K, fuel temp sensitivity study at ZPPT

!*****

CNTL

```
core_type    PWR
int_th       F -1
xe_sm        0 0
core_power    0.0001
bank_pos     230.0 230.0 230.0 230.0 230.0 230.0
230.0 230.0 0.0
ppm          1350
search keff   1.0 1800
mult_cyc     F
...
```

!-----

PARAM

...
GEOM

...

TH

```
unif_th      0.74300 306.85 291.85 ! cool den,
ftemp(C), ctemp(C); used when no TH feedback
(intthflg = F)
```

...

FDBK

```
fa_powpit    18.7876 21.50 ! avg. assembly power(3626/193, MW)
and pitch(cm);
```

DEPL

```
INP_HST      'example3.parcs_cyc-01' 1 21
INP_OPT       F F F F ! flag to read boron, CR position, TH para, Xe from
the history file.
HST_OPT       T T T T F !types of histories used for XS evel:
LHCR,LHDC,LHPC(coolant poison),LHTF,LHTC
OUT_OPT       T T T T F !PPOW,PHST(history
distribution),PTHS(instantaneous TH variables),PXESM,PXSS(no longer
supported)
```

```
file './pmax_training.dir'
```

!*****

.

All blocks for this input are shown here, although some are shortened for illustration.

Example 4: load the core using history file for sensitivity study (cont.)

CASEID example4_580_eoc ! K, fuel temp sensitivity study
at EOC

!*****

CNTL

```
core_type    PWR
int_th       F -1 !
xe_sm        3 3
core_power    0.0001
bank_pos     230.0 230.0 230.0 230.0 230.0 230.0
230.0 230.0 0.0
ppm          30.2
search keff  1.0 2500
mult_cyc     F
...
```

!-----

PARAM

...
GEOM

...

TH

```
unif_th      0.74300 306.85 291.85 ! cool den,
ftemp(C), ctemp(C); used when no TH feedback
(intthflg = F)
```

...

FDBK

```
fa_powpit    18.7876 21.50 ! avg. assembly power(3626/193, MW)
and pitch(cm);
```

DEPL

```
INP_HST      'example3.parcs_cyc-01' 1 21
INP_OPT       F F F T ! flag to read boron, CR position,TH para,Xe from
the history file.
HST_OPT       T T T T F !types of histories used for XS evel:
LHCR,LHDC,LHPC(coolant poison),LHTF,LHTC
OUT_OPT       T T T T F !PPOW,PHST(history
distribution),PTHS(instantaneous TH variables),PXESM,PXSS(no longer
supported)
```

file './pmax_training.dir'

!*****

.

All blocks for this input are shown here, although some are shortened for illustration.

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