RADIOSS User's Code Interface

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User Failure Models

Chapter 6

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6.0 USER FAILURE MODELS

In RADIOSS up to 3 user's failure models (USER1, USER2, and USER3) can be defined for shell and solid element. User's failure model for beam and truss are not yet available.

To define a user's failure model, two or three subroutines for each failure model has to be provided. One subroutine must linked with RADIOSS Starter and two subroutines (one for shell, and one for solid) linked with RADIOSS Engine.

- The Starter subroutine is called lecr04, lecr05, and lecr06 and is used to read the failure data model and to initialize failure material parameters.

- The Engine subroutine for solids is called f04law, f05law, and f06 law and is used to compute failure criteria at an integration point. The corresponding shell subroutine is called f04lawc, f05lawc, and f06lawc.

Note: All communication between RADIOSS and the subroutines takes place within the argument list.

6.1 Starter Subroutine LECRnn

This subroutine reads user failure model input data. The number of specific failure model cards and their formats are free.

The argument list of LECRnn and its individual arguments and descriptions are as follows:

```
C------------------------------------------------------------------------
      SUBROUTINE LECRnn (IIN ,IOUT ,UPARAM ,MAXUPARAM,NUPARAM,  NUVAR,IFUNC,MAXFUNC,NFUNC)
C------------------------------------------------------------------------
```

Argument	Format	Description
IIN	Integer read only scalar	Input file unit (ROOT_nnn0.rad) on which the data are read.
IOUT	Integer read only format	Output file unit (ROOT_nnn0.out).
UPARAM	Float array	Array with a size NUPARAM used to store failure material data.
MAXUPARAM	Integer read only scalar	Maximum possible size of UPARAM.
NUPARAM	Integer scalar	Effective size of UPARAM. (MAXUPARAM, NUPARAM, MAXUPARAM are set to 1000).
NUVAR	Integer scalar	Number of extra variables needed for each integration point of each elements.
IFUNC	Integer array	Array with a size of NFUNC containing the list of RADIOSS functions used in failure model. The function numbers are stored in this array (not in UPARAM) due to a possible renumbering of the function's numbers.
MAXFUNC	Integer read only scalar	Maximum possible size of IFUNC.
NFUNC	Integer scalar	Number of RADIOSS functions.

6.2 Engine Subroutine for Solid Elements (FnnLAW)

This subroutine calculates the criteria of failure model.

Use the float external function `FINTER` (shown below) to get the value Y of the function for the abscissa X.

```
Y=FINTER(IFUNC(I),X,NPF,TF,DYDX)
```

where:	Variable	Description
	Y	Interpolated value
	X	Abscissa value of the function
	I	The ith user's function
	DYDX	Slope
	NPF, TF	Private function parameters

The argument list of FnnLAW is as follows:

```
C-----------------------------------------------------------------------
                SUBROUTINE FnnLAW (
     1     NEL      ,NUPARAM    ,NUVAR          ,NFUNC          ,IFUNC          ,
     2     NPF      ,TF                  ,TIME                ,TIMESTEP    ,UPARAM     ,
     3     NGL      ,NOT_USE_I1 ,NOT_USE_I2 ,NOT_USE_I3 ,NOT_USE_I4,
     4     EPSPXX   ,EPSPYY         ,EPSPZZ          ,EPSPXY          ,EPSPYZ      ,EPSPZX ,
     5     EPSXX    ,EPSYY          ,EPSZZ           ,EPSXY           ,EPSYZ       ,EPSZX   ,
     6     SIGNXX   ,SIGNYY         ,SIGNZZ          ,SIGNXY          ,SIGNYZ      ,SIGNZX ,
     7     PLA      ,DPLA           ,EPSP                ,UVAR                ,OFF      ,
     8     NOT_USED1, NOT_USED2  ,NOT_USED3      ,NOT_USED4 ,NOT_USED5 )
C-----------------------------------------------------------------------
```

Argument	Format	Description
NEL	Integer read only scalar	Number of elements per group. In the Engine subroutine, the element data are treated by groups for vectorization purposes.
NUPARAM	Integer read only scalar	Size of user parameter array.
NUVAR	Integer read only scalar	Number of user integration point element variables.
NFUNC	Integer read only scalar	Number of functions used for failure model materials.
IFUNC	Integer array read only	Array of size NFUNC containing function indexes.
NPF	Integer array private data	Array used by `FINTER` (float external functions).
TF	Float array private data	Array used by `FINTER` (float external functions).

Argument	Format	Description
TIME	Float read only	Current time.
TIMESTEP	Float read only	Current time step.
UPARAM	Float array read only	User failure parameter array of size NUPARAM.
NGL	Integer array read only	Array of size NEL containing the external element number.
EPSPXX, EPSPYY, EPSPZZ, EPSPXY, EPSPYZ, ESPPZX	Float array read only	Array of size NEL containing $\dot{\varepsilon}$ strain rates in directions XX, YY, and ZZ and $\dot{\gamma}$ strain rates in directions XY, YZ, and ZX.
EPSXX, EPSYY, EPSZZ, EPSXY, EPSYZ, EPSZX	Float array read only	Array of size NEL containing ε strain in directions XX, YY, and ZZ and γ strain rates in directions XY, YZ, and ZX.
SIGNXX, SIGNYY, SIGNZZ, SIGNXY, SIGNYZ, SIGNZX	Float array read write	Array of size NEL containing stress in directions XX, YY, ZZ, XY, YZ, and ZX.
PLA	Float array read only	Array of size NEL containing equivalent plastic strain.
DPLA	Float array read only	Array of size NEL containing incremental equivalent plastic strain.
EPSP	Float array read only	Array of size NEL, equivalent of strain rate.
UVAR	Float array read write	Array of size NEL*NUVAR containing integration point element variables.
OFF	Float array read write	Array of size NEL containing deleted element flags. The value is set to 0 if the element if OFF.
NOT_USE_I1, NOT_USE_I2, NOT_USE_I3, NOT_USE_I4	Integer scalar	Not used. Can be used in the future.
NOT_USED1, NOT_USED2, NOT_USED3, NOT_USED4, NOT_USED5	Float scalar	Not used. Can be used in future.

6.3 Engine Subroutine for Shell Elements (FnnLAWC)

This subroutine calculates the criteria of the failure model.

Use the Fortran float external function FINTER (shown below) to get the value Y of the function for the abscissa X.

```
Y=FINTER(IFUNC(I),X,NPF,TF,DYDX)
```

where:	Variable	Description
	Y	Interpolated value
	X	Abscissa value of the function
	I	The ith user's function
	DYDX	Slope
	NPF, TF	Private function parameters

The argument list of FnnLAWC and its individual arguments and descriptions are as follows:

```
C-------------------------------------------------------------------------------
            SUBROUTINE FnnLAWC (
  1      NEL          ,NUPARAM     ,NUVAR          ,NFUNC             ,IFUNC    , NPF ,
  2      TF           ,TIME             ,TIMESTEP     ,UPARAM         , NGL      , IPT
  3      NPT0         ,NOT_USE_I1 ,NOT_USE_I2 ,   NOT_USE_I3 ,
  4      SIGNXX   ,SIGNYY        ,SIGNXY         ,SIGNYZ            ,SIGNZX  ,
  5      EPSPXX   ,EPSPYY        ,EPSPXY         ,EPSPYZ            ,EPSPZX  ,
  5      EPSXX    ,EPSYY           ,EPSXY            ,EPSYZ                ,EPSZX    ,
  7      PLA          ,DPLA             ,EPSP               ,UVAR                ,UEL         ,
  8      OFF  ,LENGTH, AREA,NOT_USED3 ,NOT_USED4 ,NOT_USED5)
C-------------------------------------------------------------------------------
```

Argument	Format	Description
NEL	Integer read only scalar	Number of elements per group. In the Engine subroutine, the element data are treated by groups for vectorization purposes.
NUPARAM	Integer read only scalar	Size of user parameter array.
NUVAR	Integer read only scalar	Number of user integration point element variables.
NFUNC	Integer read only scalar	Number of functions used for failure model materials.
IFUNC	Integer array read only	Array of size NFUNC containing function indexes.
NPF	Integer array private data	Array used by FINTER (float external functions).
TF	Float array private data	Array used by FINTER (float external functions).

Argument	Format	Description
TIME	Float read only	Current time.
TIMESTEP	Float read only	Current time step.
UPARAM	Float array read only	User failure parameter array of size NUPARAM.
IPT	Integer scalar read only	Current layer or integration points.
NPT0	Integer scalar read only	Number of layers or integration points.
NGL	Integer array read only	Array of size NEL containing the external element number.
EPSPXX, EPSPYY, EPSPZZ, EPSPXY, EPSPYZ, ESPPZX	Float array read only	Array of size NEL containing $\dot{\varepsilon}$ strain rates in directions XX, YY, and ZZ and $\dot{\gamma}$ strain rates in directions XY, YZ, and ZX.
EPSXX, EPSYY, EPSZZ, EPSXY, EPSYZ, EPSZX	Float array read only	Array of size NEL containing ε strain in directions XX, YY, and ZZ and γ strain rates in directions XY, YZ, and ZX.
SIGNXX, SIGNYY, SIGNZZ, SIGNXY, SIGNYZ, SIGNZX	Float array read write	Array of size NEL containing stress in directions XX, YY, ZZ, XY, YZ, and ZX.
PLA	Float array read only	Array of size NEL containing equivalent plastic strain.
DPLA	Float array read only	Array of size NEL containing incremental equivalent plastic strain.
EPSP	Float array read only	Array of size NEL, equivalent of strain rate.
UVAR	Float array read write	Array of size NEL*NUVAR containing integration point element variables.
UEL	Float array read write	Array of size NEL, containing the number of layers in which the failure criteria is satisfied for all elements.
OFF	Float array read write	Array of size NEL containing deleted element flags. The value is set to 0 if the element if OFF.
LENGTH	Float array read only	Array of size NEL, characteristic length of the element
AREA	Float array read only	Array of size NEL, surface area of integration point
NOT_USE_I1, NOT_USE_I2, NOT_USE_I3, NOT_USE_I4	Integer scalar	Not used. Can be used in the future.
NOT_USED3, NOT_USED4, NOT_USED5	Float scalar	Not used. Can be used in future.

6.4 Example Subroutine of User Failure Model for Shell and Solid Elements for RADIOSS Starter

```
        SUBROUTINE LECR04(IIN  ,IOUT ,UPARAM ,MAXUPARAM,NUPARAM,
                          NUVAR,IFUNC,MAXFUNC,NFUNC)
C-------------------------------------------------------------------
C   I m p l i c i t   T y p e s
C-------------------------------------------------------------------
        IMPLICIT NONE
C---------+--------+--+--+-----------------------------------------
C VAR     | SIZE   |TYP| RW| DEFINITION
C---------+--------+--+--+-----------------------------------------
C IIN     | 1      | I | R | INPUT FILE UNIT (ROOT_nnn0.rad file)
C IOUT    | 1      | I | R | OUTPUT FILE UNIT (ROOT_nnn0.out file)
C UPARAM  | NUPARAM | F | W | USER FAILURE MODEL PARAMETER ARRAY
C MAXUPARAM| 1     | I | R | MAXIMUM SIZE OF UPARAM
C NUPARAM | 1      | I | W | SIZE OF UPARAM =< MAXUPARAM
C NUVAR   | 1      | I | W | NUMBER OF USER  VARIABLES
C---------+--------+--+--+-----------------------------------------
C IFUNC   | NFUNC  | I | W | FUNCTION NUMBER ARRAY
C MAXFUNC | 1      | I | R | MAXIMUM SIZE OF IFUNC
C NFUNC   | 1      | I | W | SIZE OF IFUNC =< MAXFUNC
C---------+--------+--+--+-----------------------------------------
C---------------------------------------------------
C   D u m m y   A r g u m e n t s
C---------------------------------------------------
      INTEGER IIN,IOUT,MAXUPARAM,NUPARAM,NUVAR,MAXFUNC,NFUNC,
     .        IFUNC(MAXFUNC)
      DOUBLE PRECISION   UPARAM(MAXUPARAM)
C---------------------------------------------------
C   L o c a l   V a r i a b l e s
C---------------------------------------------------
      INTEGER ISHELL, ISOLID
      DOUBLE PRECISION PLAMAX
C=====================================
C
C    EX : element is off if pla > plamax
C
C=====================================
C
      READ(IIN,'(F20.0)')PLAMAX
      IF(PLAMAX.EQ.0)PLAMAX= 1E20
      UPARAM(1) = PLAMAX
      NUPARAM = 1
      NUVAR = 0
C
```

```
         NFUNC = 0
         WRITE(IOUT, 1000)PLAMAX
C for shell
          WRITE(IOUT, 1100)
C for solid
          WRITE(IOUT, 2100)


 1000 FORMAT(
     & 5X,40H  PARAMETER                          ,/,
     & 5X,40H  ---------------------------          ,/,
     & 5X,'MAXIMUM PLASTIC STRAIN   .... .. =',E12.4//)
 1100 FORMAT(
     & 5X,'   SHELL ELEMENT DELETION ')
 2100 FORMAT(
     & 5X,'   SOLID ELEMENT DELETION ')
      RETURN
      END
```

6.4.1 Engine User Subroutine for Solid Elements

```
       SUBROUTINE F04LAW (
     1    NEL    ,NUPARAM    ,NUVAR     ,NFUNC     ,IFUNC      ,
     2    NPF    ,TF         ,TIME      ,TIMESTEP  ,UPARAM     ,
     3    NGL    ,NOT_USE_I1 ,NOT_USE_I2,NOT_USE_I3,NOT_USE_I4,
     4    EPSPXX ,EPSPYY     ,EPSPZZ    ,EPSPXY    ,EPSPYZ     ,EPSPZX ,
     5    EPSXX  ,EPSYY      ,EPSZZ     ,EPSXY     ,EPSYZ      ,EPSZX  ,
     6    SIGNXX ,SIGNYY     ,SIGNZZ    ,SIGNXY    ,SIGNYZ     ,SIGNZX ,
     7    PLA    ,DPLA       ,EPSP      ,UVAR      ,OFF      ,
     8    LENGTH,AREA,NOT_USED3,NOT_USED4,NOT_USED5 )
C----------------------------------------------------------------------
C   I m p l i c i t   T y p e s
C----------------------------------------------------------------------
       IMPLICIT NONE
C---------+--------+--+--+----------------------------------------------
C VAR    | SIZE   |TYP| RW| DEFINITION
C---------+--------+--+--+----------------------------------------------
C NEL    | 1      | I | R | SIZE OF THE ELEMENT GROUP NEL
C NUPARAM | 1      | I | R | SIZE OF THE USER PARAMETER ARRAY
C NUVAR  | 1      | I | R | NUMBER OF FAILURE ELEMENT VARIABLES
C---------+--------+--+--+----------------------------------------------
C NFUNC  | 1      | I | R | NUMBER FUNCTION USED FOR THIS USER LAW
C IFUNC  | NFUNC  | I | R | FUNCTION INDEX
C NPF    | *      | I | R | FUNCTION ARRAY
C TF     | *      | F | R | FUNCTION ARRAY
C---------+--------+--+--+----------------------------------------------
C TIME   | 1      | F | R | CURRENT TIME
```

```
C TIMESTEP|  1      | F | R | CURRENT TIME STEP
C UPARAM  | NUPARAM | F | R | USER FAILURE PARAMETER ARRAY
C---------+--------+--+--+----------------------------------------
C---------+--------+--+--+----------------------------------------
C EPSPXX  | NEL     | F | R | STRAIN RATE XX
C EPSPYY  | NEL     | F | R | STRAIN RATE YY
C ...     |         |   |   |
C EPSXX   | NEL     | F | R | STRAIN XX
C EPSYY   | NEL     | F | R | STRAIN YY
C ...     |         |   |   |
C SIGNXX  | NEL     | F |R/W| NEW ELASTO PLASTIC STRESS XX
C SIGNYY  | NEL     | F |R/W| NEW ELASTO PLASTIC STRESS YY
C ...     |         |   |   |
C ...     |         |   |   |
C PLA     | NEL     | F | R | PLASTIC STRAIN
C DPLA    | NEL     | F | R | INCREMENTAL PLASTIC STRAIN
C EPSP    | NEL     | F | R | EQUIVALENT STRAIN RATE
C---------+--------+--+--+----------------------------------------
C UVAR    |NEL*NUVAR| F |R/W| USER ELEMENT VARIABLE ARRAY
C OFF     | NEL     | F |R/W| DELETED ELEMENT FLAG (=1. ON, =0. OFF)
C---------+--------+--+--+----------------------------------------
C  I N P U T  A r g u m e n t s
C----------------------------------------------
C
       INTEGER NEL, NUPARAM,NPROPMI, NUVAR,NGL(NEL),NOT_USE_I1,
      .       NOT_USE_I2,NOT_USE_I3,NOT_USE_I4
       DOUBLE PRECISION TIME,TIMESTEP,UPARAM(NUPARAM),
      .  DPLA(NEL),EPSP(NEL),PLA(NEL),
      .  EPSPXX(NEL),EPSPYY(NEL),EPSPZZ(NEL),
      .  EPSPXY(NEL),EPSPYZ(NEL),EPSPZX(NEL),
      .  EPSXX(NEL) ,EPSYY(NEL) ,EPSZZ(NEL) ,
      .  EPSXY(NEL) ,EPSYZ(NEL) ,EPSZX(NEL) ,
      .  LENGTH(NEL),AREA(NEL),
      .  NOT_USED3,NOT_USED4,NOT_USED5
C----------------------------------------------
C  I N P U T  O U T P U T  A r g u m e n t s
C----------------------------------------------
       DOUBLE PRECISION UVAR(NEL,NUVAR), OFF(NEL),
      .  SIGNXX(NEL),SIGNYY(NEL),SIGNZZ(NEL),
      .  SIGNXY(NEL),SIGNYZ(NEL),SIGNZX(NEL)
C----------------------------------------------
C  VARIABLES FOR FUNCTION INTERPOLATION
C----------------------------------------------
       INTEGER NPF(*), NFUNC, IFUNC(NFUNC)
       DOUBLE PRECISION FINTER ,TF(*)
       EXTERNAL FINTER
```

```
C       Y = FINTER(IFUNC(J),X,NPF,TF,DYDX)
C       Y     : y = f(x)
C       X     : x
C       DYDX   : f'(x) = dy/dx
C       IFUNC(J): FUNCTION INDEX
C            J : FIRST(J=1), SECOND(J=2) .. FUNCTION USED FOR THIS LAW
C       NPF,TF  : FUNCTION PARAMETER
C-----------------------------------------------
C  L o c a l   V a r i a b l e s
C-----------------------------------------------
      INTEGER I,j
      DOUBLE PRECISION PLAMAX,ZERO
C------------------------------------------------------------
C     ex : element is off if pla > plamax
C
      PLAMAX = UPARAM(1)
C-----------------------------------------------
C    USER VARIABLES INITIALIZATION
C-----------------------------------------------
      IF(TIME.EQ.ZERO)THEN
       DO I=1,NEL
        DO J=1,NUVAR
          UVAR(I,J)= ZERO
        ENDDO
       ENDDO
      ENDIF
C...
      DO I=1,NEL
       IF(OFF(I).LT.0.1) OFF(I)=0.0
       IF(OFF(I).LT.1.0) OFF(I)=OFF(I)*0.8
      END DO
C
      DO I=1,NEL
       IF(OFF(I).EQ.1..AND.PLA(I).GE.PLAMAX)THEN
         OFF(I)=0.8
       ENDIF
ENDDO
C
      RETURN
      END
```

6.4.2 Engine User Subroutine for Shell Elements

```
      SUBROUTINE F04LAWC(
1     NEL ,NUPARAM ,NUVAR ,NFUNC ,IFUNC,NPF,
2     TF ,TIME ,TIMESTEP ,UPARAM ,NGL ,IPT,
3     NPT0 ,NOT_USE_I1,NOT_USE_I2 ,NOT_USE_I3,
4     SIGNXX ,SIGNYY ,SIGNXY ,SIGNYZ ,SIGNZX ,
4     EPSPXX ,EPSPYY ,EPSPXY ,EPSPYZ ,EPSPZX ,
6     EPSXX ,EPSYY ,EPSXY ,EPSYZ ,EPSZX ,
7     PLA ,DPLA ,EPSP ,UVAR ,UEL ,
8     OFF ,NOT_USED1 ,NOT_USED2,NOT_USED3,NOT_USED4,NOT_USED5 )


C------------------------------------------------
C I m p l i c i t T y p e s
C------------------------------------------------
      IMPLICIT NONE
C---------+--------+---+---+-------------------------------------------
C VAR     | SIZE   |TYP| RW| DEFINITION
C---------+--------+---+---+-------------------------------------------
C NEL     | 1      | I | R | SIZE OF THE ELEMENT GROUP NEL
C NUPARAM | 1      | I | R | SIZE OF THE USER PARAMETER ARRAY
C NUVAR   | 1      | I | R | NUMBER OF USER ELEMENT VARIABLES
C---------+--------+---+---+-------------------------------------------
C NFUNC   | 1      | I | R | NUMBER FUNCTION USED FOR THIS USER LAW
C IFUNC   | NFUNC  | I | R | FUNCTION INDEX
C NPF     | *      | I | R | FUNCTION ARRAY
C NPT0    | 1      | I | R | NUMBER OF LAYERS OR INTEGRATION POINTS
C IPT     | 1      | I | R | LAYER OR INTEGRATION POINT NUMBER
C TF      | *      | F | R | FUNCTION ARRAY
C NGL     | NEL    | I | R | ELEMEMT NUMBER
C---------+--------+---+---+-------------------------------------------
C TIME    | 1      | F | R | CURRENT TIME
C TIMESTEP| 1      | F | R | CURRENT TIME STEP
C UPARAM  | NUPARAM| F | R | USER MATERIAL PARAMETER ARRAY
C EPSPXX  | NEL    | F | R | STRAIN RATE XX
C EPSPYY  | NEL    | F | R | STRAIN RATE YY
C ...     |        |   |   |
C EPSXX   | NEL    | F | R | STRAIN XX
C EPSYY   | NEL    | F | R | STRAIN YY
C---------+--------+---+---+-------------------------------------------
C SIGNXX  | NEL    | F |R/W| NEW ELASTO PLASTIC STRESS XX
C SIGNYY  | NEL    | F |R/W| NEW ELASTO PLASTIC STRESS YY
C ...     |        |   |   |
C---------+--------+---+---+-------------------------------------------
C PLA     | NEL    | F | R | PLASTIC STRAIN
C DPLA    | NEL    | F | R | INCREMENTAL PLASTIC STRAIN
```

```
C EPSP    | NEL    | F | R | EQUIVALENT STRAIN RATE
C UVAR    |NEL*NUVAR| F|R/W| USER ELEMENT VARIABLE ARRAY
C OFF     | NEL    | F |R/W| DELETED ELEMENT FLAG (=1. ON, =0. OFF)
C---------+--------+--+--+-----------------------------------------
C I N P U T A r g u m e n t s
C-----------------------------------------------
      INTEGER NEL, NUPARAM, NUVAR, NGL(NEL),MAT(NEL),
     .  IPT,NPT0,NOT_USE_I1,NOT_USE_I2,NOT_USE_I3
      DOUBLE PRECISION TIME,TIMESTEP(NEL),UPARAM(NUPARAM),DPLA(NEL),
     .  EPSP(NEL), PLA(NEL),EPSPXX(NEL),EPSPYY(NEL),EPSPXY(NEL),
     .  EPSPYZ(NEL),EPSPZX(NEL),EPSXX(NEL) ,EPSYY(NEL) ,EPSXY(NEL),
     .  EPSYZ(NEL) ,EPSZX(NEL),
     .  NOT_USED1,NOT_USED2,NOT_USED3,NOT_USED4,NOT_USED5
C
C-----------------------------------------------
C I N P U T O U T P U T A r g u m e n t s
C-----------------------------------------------
      DOUBLE PRECISION UVAR(NEL,NUVAR), OFF(NEL),
     .  SIGNXX(NEL),SIGNYY(NEL),UEL(NEL),
     .  SIGNXY(NEL),SIGNYZ(NEL),SIGNZX(NEL)
C-----------------------------------------------
C VARIABLES FOR FUNCTION INTERPOLATION
C-----------------------------------------------
      INTEGER NPF(*), NFUNC, IFUNC(NFUNC)
      DOUBLE PRECISION FINTER ,TF(*)
      EXTERNAL FINTER
C! Y = FINTER(IFUNC(J),X,NPF,TF,DYDX)
C! Y : y = f(x)
C! X : x
C! DYDX : f'(x) = dy/dx
C! IFUNC(J): FUNCTION INDEX
C! J : FIRST(J=1), SECOND(J=2) .. FUNCTION USED FOR THIS LAW
C! NPF,TF : FUNCTION PARAMETER
C-----------------------------------------------
C L o c a l V a r i a b l e s
C-----------------------------------------------
      INTEGER I,J,NINDX
      DOUBLE PRECISION PLAMAX,ZERO
C-----------------------------------------------
C Ex : ELEMENT IS OFF iF PLA > PLAMAX
C-----------------------------------------------
      PLAMAX = UPARAM(1)
C-----------------------------------------------
C USER VARIABLES INITIALIZATION
C------------------------------------------------
      IF(TIME.EQ.ZERO)THEN
```

```
            DO I=1,NEL
                DO J=1,NUVAR
                UVAR(I,1)=ZERO
                ENDDO
            ENDDO
        ENDIF
C-----------------------------------------------
        DO I =1,NEL
          IF(OFF(I).EQ.1..AND.PLA(I).GE.PLAMAX) THEN
            SIGNXX(I) = 0.
            SIGNYY(I) = 0.
            SIGNXY(I) = 0.
            SIGNYZ(I) = 0.
            SIGNZX(I) = 0.
            OFF(I) = 0.0
          ENDIF
        ENDDO
        RETURN
        END
```

6.4.3 Example input dec

```
#---1----|----2----|----3----|----4----|----5----|----6----|----7----|----8----|----9----|---10----|
/MAT/PLAS_TAB/2
Steel
#       Init. dens.        Ref. dens.
          7.8E-6                  0
#                 E           Nu       Eps_p_max          Eps_t1          Eps_t2
               210           .3              0               0               0
#   Nfunc  Fsmooth          Chard            Fcut           Eps_f
       1        0              0               0               0
#   Ipfun         Fpscale
       0               0
# Funtions
       1
# Scale factors
               1
# Strain rates
               0
#---1----|----2----|----3----|----4----|----5----|----6----|----7----|----8----|----9----|---10----|
/FAIL/USER1/2
#     max. pl_strain
             0.50
#---1----|----2----|----3----|----4----|----5----|----6----|----7----|----8----|----9----|---10----|
```