Operator POST_RCCM

1 Goal

To check criteria of the RCC-M. It acts in particular:

- of certain criteria of tiredness ZE200 in postprocessing of calculations on pipings (with or without effect of environment),
- criteria of tiredness of B3600 in postprocessing of calculations of pipings,
- criteria of level 0 and of level A of B3200 (with or without effect of environment) EN postprocessing of calculations on structures 2D or 3D;.

The criteria of level 0 aim at securing the material against the damage of excessive deformation, of elastic, elastoplastic instability or plastic. Criteria of level With aim at securing the material against the damage of progressive deformation and tiredness. The damage in fatigue can also be calculated by taking of account the effects of the environment REFERENCE MARK (recent modification of the RCC-M by the AFCEN).

As starter of the order POST_RCCM, it is necessary to specify:

- maybe of the tables of constraints on a segment of analysis exits of calculations finite elements (TYPE_RESU_MECA=' EVOLUTION' and TYPE_RESU_MECA=' B3200');
- that is to say the computation result on a line of piping (TYPE_RESU_MECA=' B3600').
- that is to say the computation result on a line of piping and tables of constraints resulting from calculations finite elements (TYPE_RESU_MECA=' ZE200a' and TYPE_RESU_MECA=' ZE200b');

Product a structure of data of the type table.

Before a first use, it is strongly advised to refer to the reference documents [R7.04.03] and of council [U2.09.03].

Contents

2 Syntax

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TABL_POST_RCCM = POST_RCCM(

     ◊     TYPE_RESU =             /     'VALE_MAX',            [DEFECT]
                                   /     'DETAILS',

     ◊     INFORMATION                   /1    ,
     [DEFECT]
                                   /2    ,

     ◊     TITLE     = title,                                   [KN]

     ♦     TYPE_RESU_MECA =        / 'B3200',
                                   / 'B3600',
                                   / 'ZE200a',
                                   / 'ZE200B',
                                   / 'EVOLUTION',

     # if TYPE_RESU_MECA = ' B3200 '
     ♦     OPTION    = /     'PM_PB',
                       /     'SN',
                       /     'TIREDNESS',
                       /     'EFAT',
     ♦     MATER       =     chechmate   ,                              [to
subdue]
     ◊     SY_MAX      =     symax,                                     [R]
     ◊     METHOD      =     / 'TRESCA',                                [DEFECT]
                             / 'TOUT_INST'
     ◊     TYPE_KE     =     / 'KE_MECA',                               [DEFECT]
                              / 'KE_MIXTE'
     ◊     SOUS_CYCL   =     / 'NOT',                                   [DEFECT]
                              / ' YES ',
     ◊     FACT_SIGM=_F (
           ◊     KT_SN =     ktsn,                                      [R]
           ◊     KT_SP =     ktsp,                                      [R]
                                   ),

     ♦     INDI_SIGM=_F (
           ♦     K1                          =     k1,                  [R]
           ♦     C1                          =     c1,                  [R]
           ♦     K2                          =     K2,                  [R]
           ♦     C2                          =     C2,                  [R]
           ♦     K3                          =     K3,                  [R]
           ♦     C3                          =     C3,                  [R]
                       ),

     ◊     RESU_THER=_F (
           ♦     NUME_RESU_THER    =     numtran,                       [I]
           ♦     TABL_RESU_THER    =     table,                         [table]
                                         ),
     ◊     RESU_NEAR=_F (
           ♦     NUME_RESU_NEAR    =     numtran,                       [I]
           ♦     TABL_RESU_NEAR    =     table,                         [table]
                                       ),

     /     ♦     RESU_MECA=_F (
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                ♦     NUME_RESU_MECA    =     numtran,                [I]
                ♦     TABL_RESU_MECA    =     table,                  [table]
                                  ),

      /     ♦     CHAR_MECA   =_F   (
                ♦     NUME_CHAR   =     numchar,                    [I]
                ◊     NOM_CHAR    =     nomchar,                    [KN]

            /     ♦     MX                =     MX    ,               [R]
                  ♦     MY                =     my    ,               [R]
                  ♦     MZ                =     mz    ,               [R]
                  ◊     FX                =     fx    ,               [R]
                  ◊     FY                =     Fthere      ,                   [R]
                  ◊     FZ                =     FZ    ,               [R]

            /     ♦     MX_CORP           =     MXC   ,               [R]
                  ♦     MY_CORP           =     myC   ,               [R]
                  ♦     MZ_CORP           =     mzC   ,               [R]
                  ◊     FX_CORP           =     fxc   ,               [R]
                  ◊     FY_BODY           =     FthereC     ,                   [R]
                  ◊     FZ_BODY           =     FZC   ,               [R]
                  ♦     MX_TUBU           =     MXT   ,               [R]
                  ♦     MY_TUBU           =     myT   ,               [R]
                  ♦     MZ_TUBU           =     mzT   ,               [R]
                  ◊     FX_TUBU           =     fxT   ,               [R]
                  ◊     FY_TUBU           =     FthereT     ,                   [R]
                  ◊     FZ_TUBU           =     FZT   ,               [R]
                                  ),

◊     RESU_MECA_UNIT=_F (
       /     ♦     TABL_MX     =     tabsigmx    ,                   [table]
             ♦     TABL_MY     =     tabsigmy    ,                   [table]
             ♦     TABL_MZ     =     tabsigmz    ,                   [table]
             ◊     TABL_FX     =     tabsigfx    ,                   [table]
             ◊     TABL_FY     =     tabsigfy    ,                   [table]
             ◊     TABL_FZ     =     tabsigfz    ,                   [table]
             ◊     TABL_PRES   =     tabsigpr    ,                   [table]

       /     ♦     TABL_MX_CORP      =     tabsigmxC   ,             [table]
             ♦     TABL_MY_CORP      =     tabsigmyC   ,             [table]
             ♦     TABL_MZ_CORP      =     tabsigmzC   ,             [table]
             ◊     TABL_FX_CORP      =     tabsigfxC   ,             [table]
             ◊     TABL_FY_CORP      =     tabsigfyC   ,             [table]
             ◊     TABL_FZ_CORP      =     tabsigfzC   ,             [table]
             ♦     TABL_MX_TUBU      =     tabsigmxT   ,             [table]
             ♦     TABL_MY_TUBU      =     tabsigmyT   ,             [table]
             ♦     TABL_MZ_TUBU      =     tabsigmzT   ,             [table]
             ◊     TABL_FX_TUBU      =     tabsigfxT   ,             [table]
             ◊     TABL_FY_TUBU      =     tabsigfyT   ,             [table]
             ◊     TABL_FZ_TUBU      =     tabsigfzT   ,             [table]
             ◊     TABL_PRES         =     tabsigpr    ,             [table]
                           ),

      ◊     SEISME=_F (
             ♦     NUME_SITU   =     numsitu,                        [I]
             ◊     NOM_SITU    =     nomsitu,                        [KN]
             ♦     NB_OCCUR    =     nbocc,                          [I]
             ♦     NB_CYCL_SEISME    =     nbsss,                    [I]
                   /     ♦     CHAR_ETAT   =     num_char_meca,      [I]
                   /     ♦     TABL_MX     =     tabsigmx    ,       [table]
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                    ♦     TABL_MY     =     tabsigmy    ,          [table]
                    ♦     TABL_MZ     =     tabsigmz    ,          [table]
                    ♦     TABL_FX     =     tabsigfx    ,          [table]
                    ♦     TABL_FY     =     tabsigfy    ,          [table]
                    ♦     TABL_FZ     =     tabsigfz    ,          [table]
                          ),

♦     SITUATION=_F (
      ♦     NUME_SITU   =     numsitu,                              [I]
      ◊     NOM_SITU    =     nomsitu,                              [KN]
      ♦     NB_OCCUR    =     nbocc,                                [I]
      ♦     NUME_GROUPE =     (numgroup1, numgroup2,…)              [L_I]
      ◊     NUME_PASSAGE      =     (num1, num2,…)                  [L_I]
      ◊     NUME_PARTOLD      =     num1                            [I]
      ◊     COMBINABLE        =     /'YES',                         [DEFECT]
                                    /'NOT',                         [KN]

            /♦    NEAR_A      =     pressed,                        [I]
             ♦    NEAR_B      =     presb,                          [I]
            /♦    NUME_RESU_ NEAR   =     num_tran          ,       [I]

      ◊     NUME_RESU_THER    =     num_tran          ,             [I]


            /♦    CHAR_ETAT_A =     num_char_meca,                  [I]
             ♦    CHAR_ETAT_B =     num_char_meca,                  [I]
            /♦    CHAR_ETAT_A =     num_char_meca,                  [I]
             ♦    CHAR_ETAT_B =     num_char_meca,                  [I]
             ♦    TEMP_A      =     temphas,                        [R]
             ♦    TEMP_B      =     tempb,                          [R]
            /♦    NUME_RESU_MECA    =     num_tran          ,       [I]

      ◊     O_ETOILE    =     oet   ,                               [R]
      ◊     TABL_TEMP   =     tabtemp,                              [table]
                              ),

◊     ENVIRONNEMENT=_F (
      ♦     FEN_INTEGRE       =     fenint,                         [R]
      ♦     CRIT_EPSI         =     epsilim,                        [R]
      ♦     S_ETOILE          =     set   ,                         [R]
      ♦     TABL_YOUNG        =     tabyoung,                       [table]
      ♦     SEUIL_EPSI_INF    =     epsimin,                        [R]
      ♦     SEUIL_EPSI_SUP    =     epsimax,                        [R]
      ♦     A_ENV             =     aenv,                           [R]
      ♦     B_ENV             =     benv,                           [R]
      ♦     C_ENV             =     cenv,                           [R]
      ♦     SEUIL_T_INF       =     tempmin,                        [R]
      ♦     SEUIL_T_SUP       =     tempmax,                        [R]
      ♦     VALE_T_INF        =     valmin,                         [R]
      ♦     VALE_T_SUP        =     valmax,                         [R]
      ♦     VALE_T_MOY_NUM    =     valmoynum,                      [R]
      ♦     VALE_T_MOY_DEN    =     valmoyden,                      [R]
                                    ),
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```
# if TYPE_RESU_MECA     = 'B3600'

♦     OPTION            = 'TIREDNESS',
♦     MODEL       =     model ,                  [model]

♦     ZONE_ANALYSE=_F (
            ◊     / ALL       =     'YES',            [DEFECT]
                  / GROUP_MA        =     gma1,             [groupma]
♦     CARA_ELEM   =           will cara,
      [cara_elem]

◊     TYPE_KE     =     / 'KE_MECA',                    [DEFECT]
                        / 'KE_MIXTE'
♦     CHAM_MATER=       chmat,                          [cham_mater]
♦     RESU_MECA=_F (
      ♦     NUME_CHAR         =     numchar,            [I]
      ◊     NOM_CHAR          =     nomchar,            [KN]
      ♦     /RESULT     =     resu  ,                   [evol_elas]
                                                  /     [evol_noli]
                  ♦ /   TOUT_ORDRE  =     'YES',
                    /   NUME_ORDRE  =     lordre      ,     [l_I]
                    /   INST        =     linst ,           [l_R]
                    /   NOEUD_CMP   =     lnoecmp,          [l_K16]
                  # If INST:
                    ◊ CRITERION =/'RELATIVE',               [DEFECT]
                                  ◊ PRECISION = / prec,     [R]
                                                / 1.E-6,    [DEFECT]
                                / 'ABSOLUTE',
                                  ♦ PRECISION = prec, [R]

                  ♦ NOM_CHAM  =     /'EFGE_ELNO',
                                    /'SIEF_ELNO',
            /     CHAM_GD           =     cham_effo,        [cham_elem]
                                    )
♦     INDI_SIGM=_F (
                  ◊     C1                =     / 1. ,          [DEFECT]
                                                / c1,       [R]
                  ◊     C2                =     / 1. ,          [DEFECT]
                                                / c2,       [R]
                  ◊     C3                =     / 0.5,      [DEFECT]
                                                / c3,       [R]
                  ◊     K1                =     / 1. ,          [DEFECT]
                                                / k1,       [R]
                  ◊     K2                =     / 1. ,          [DEFECT]
                                                / k2,       [R]
                  ◊     K3                =     / 1. ,          [DEFECT]
                                                / k3,       [R]
                  ♦     / ALL       =     'YES',            [DEFECT]
                        / GROUP_MA  =     gma1,             [groupma]
                  ◊     GROUP_NO    =     gno1,             [groupno]
                  ◊     TYPE_ELEM_STANDARD =    / 'DRO',
                                                / 'NECK',
                                                / 'TRN',
                                                / 'TEE',
            )
```

```
◊     RESU_THER=_F (
      ♦     NUME_RESU_THER    = numtran,        [I]
      ♦     TABL_RESU_THER    = table,          [tabl_post_releve]
      ♦     TABL_MOYE_THER    = table,          [tabl_post_releve]
      ♦     / ALL             =     'YES',      [DEFECT]
            / GROUP_MA        =     gma1,       [groupma]
      ◊     GROUP_NO          =     gno1,       [groupno]
           )

◊     SEISME=_F (
      ♦     NUME_SITU   =     numsitu,                      [I]
      ◊     NOM_SITU    =     nomsitu,                      [KN]
      ♦     NB_OCCUR    =     nbocc,                        [I]
      ♦     NB_CYCL_SEISME    =     nbsss,                  [I]
      ♦     NUME_GROUPE =     numgroup,                     [I]
      ♦     CHAR_ETAT         =     (list_num_char_meca),   [L_I]
      ◊     TEMP_REF          = tref,                       [R]
            )

♦     SITUATION=_F (
      ♦     NUME_SITU   =     numsitu,                      [I]
      ◊     NOM_SITU    =     nomsitu,                      [KN]
      ♦     NB_OCCUR    =     nbocc,                        [I]
      ♦     NUME_GROUPE =     numgroup,                     [I]
      ◊     NUME_PASSAGE      =      (num1, num2) ,         [I]
      ◊     COMBINABLE  =     /'YES',                       [DEFECT]
                              /'NOT',                       [KN]
      ♦     PRES_A      =     pressed     ,                 [R]
      ♦     PRES_B      =     pressb      ,                 [R]
      ◊     TEMP_REF_A  =     tempa ,                       [R]
      ◊     TEMP_REF_B  =     tempb ,                       [R]
      ♦     CHAR_ETAT_A =     (list_num_char_meca),         [L_I]
      ♦     CHAR_ETAT_B =     (list_num_char_meca),         [L_I]
      ◊     NUME_RESU_THER    =     list_num_tran,          [L_I]
            )
```

```
      # if TYPE_RESU_MECA = 'ZE200a'

      ♦     OPTION    = /     'SN',
                        /     'TIREDNESS',
                        /     'EFAT',
      ♦     MATER       =     chechmate   ,                              [to
subdue]
      ◊     SY_MAX      =     symax,                                     [R]
      ◊     METHOD      =     / 'TRESCA',                                [DEFECT]
                              / 'TOUT_INST',
      ◊     TYPE_KE     =     / 'KE_MECA',                               [DEFECT]
                              / 'KE_MIXTE',
      ◊     SOUS_CYCL   =     / 'NOT',                                   [DEFECT]
                              / 'YES'
      ♦     INDI_SIGM=_F (
            ♦     K1                          =     k1,                  [R]
            ♦     C1                          =     c1,                  [R]
            ♦     K3                          =     K3,                  [R]
            ♦     C3                          =     C3,                  [R]

            /     ♦     K2                    =     k2,                  [R]
                  ♦     C2                    =     c2,                  [R]

            /     ♦     K2_TUBU               =     K2T,                 [R]
                  ♦     K2_BODY               =     K2C,                 [R]
                  ♦     C2_TUBU               =     C2T,                 [R]
                  ♦     C2_BODY               =     C2C,                 [R]
                        ),

      ♦     PIPE=_F (
            ♦     R                           =     R,                   [R]
            ♦     EP                          =     ep,                  [R]

            /     ♦     I                     =     I,                   [R]

            /     ♦     R_TUBU                =     rt,                  [R]
                  ♦     R_BODY                =     rc,                  [R]
                  ♦     I_TUBU                =     it,                  [R]
                  ♦     I_BODY                =     ic,                  [R]
                        ),

      ♦     CHAR_MECA   =_F   (
            ♦     NUME_CHAR   =     numchar,                             [I]
            ◊     NOM_CHAR    =     nomchar,                             [KN]

            /     ♦     MX                =     MX    ,                  [R]
                  ♦     MY                =     my    ,                  [R]
                  ♦     MZ                =     mz    ,                  [R]

            /     ♦     MX_CORP           =     MXC   ,                  [R]
                  ♦     MY_CORP           =     myC   ,                  [R]
                  ♦     MZ_CORP           =     mzC   ,                  [R]
                  ♦     MX_TUBU           =     MXT   ,                  [R]
                  ♦     MY_TUBU           =     myT   ,                  [R]
                  ♦     MZ_TUBU           =     mzT   ,                  [R]
                              ),

      ◊     RESU_THER=_F (
                  ♦     NUME_RESU_THER    =     numtran,                 [I]
                  ♦     TABL_RESU_THER    =     table,                   [table]
```

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                                        ),


◊     SEISME=_F (
      ♦     NUME_SITU    =     numsitu,                              [I]
      ◊     NOM_SITU     =     nomsitu,                              [KN]
      ♦     NB_OCCUR     =     nbocc,                                [I]
      ♦     NB_CYCL_SEISME    =     nbsss,                          [I]
      ♦     CHAR_ETAT          =     num_char_meca,                 [I]
                        ),

♦     SITUATION=_F (
      ♦     NUME_SITU    =     numsitu,                              [I]
      ◊     NOM_SITU     =     nomsitu,                              [KN]
      ♦     NB_OCCUR     =     nbocc,                                [I]
      ♦     NUME_GROUPE =     (numgroup1, numgroup2,…)              [L_I]
      ◊     NUME_PASSAGE       =     (num1, num2,…))          [L_I]
      ◊     NUME_PARTOLD       =     num1                           [I]
      ◊     COMBINABLE         =     /'YES',                        [DEFECT]
                                       /'NOT',                      [KN]
      ♦     PRES_A       =     pressed     ,                              [R]
      ♦     PRES_B       =     presb ,                              [R]
      ♦     CHAR_ETAT_A =     num_char_meca,                       [I]
      ♦     CHAR_ETAT_B =     num_char_meca,                       [I]
      ◊     NUME_RESU_THER     =     num_tran          ,           [I]
      ◊     O_ETOILE     =     oet    ,                            [R]
      ◊     TABL_TEMP    =     tabtemp,                            [table]
                                ),

◊     ENVIRONNEMENT=_F (
      ♦     FEN_INTEGRE        =     fenint,                       [R]
      ♦     CRIT_EPSI          =     epsilim,                      [R]
      ♦     S_ETOILE           =     set    ,                      [R]
      ♦     TABL_YOUNG         =     tabyoung,                     [table]
      ♦     SEUIL_EPSI_INF     =     epsimin,                      [R]
      ♦     SEUIL_EPSI_SUP     =     epsimax,                      [R]
      ♦     A_ENV              =     aenv,                         [R]
      ♦     B_ENV              =     benv,                         [R]
      ♦     C_ENV              =     cenv,                         [R]
      ♦     SEUIL_T_INF        =     tempmin,                      [R]
      ♦     SEUIL_T_SUP        =     tempmax,                      [R]
      ♦     VALE_T_INF         =     valmin,                       [R]
      ♦     VALE_T_SUP         =     valmax,                       [R]
      ♦     VALE_T_MOY_NUM     =     valmoynum,                    [R]
      ♦     VALE_T_MOY_DEN     =     valmoyden,                    [R]
                                       ),
```

```
      # if TYPE_RESU_MECA = 'ZE200B'

      ♦     OPTION    = /     'SN',
                        /     'TIREDNESS',
                        /     'EFAT',
      ♦     MATER       =     chechmate,                                  [to
subdue]
      ◊     SY_MAX      =     symax,                                      [R]
      ◊     METHOD      =     / 'TRESCA',                                 [DEFECT]
                               / ' TOUT_INST ',
      ◊     TYPE_KE     =     / 'KE_MECA',                                [DEFECT]
                               / 'KE_MIXTE',
      ◊     SOUS_CYCL   =     / 'NOT',                                    [DEFECT]
                               / ' YES ',
      ♦     INDI_SIGM=_F (
            ♦     K1                          =     k1,                   [R]
            ♦     C1                          =     c1,                   [R]
            ♦     K3                          =     K3,                   [R]
            ♦     C3                          =     C3,                   [R]

            /     ♦     K2                    =     k2,                   [R]
                  ♦     C2                    =     c2,                   [R]

            /     ♦     K2_TUBU               =     K2T,                  [R]
                  ♦     K2_BODY               =     K2C,                  [R]
                  ♦     C2_TUBU               =     C2T,                  [R]
                  ♦     C2_BODY               =     C2C,                  [R]
                        ),

      ♦     PIPE=_F (
            ♦     R                           =     R,                    [R]
            ♦     EP                          =     ep,                   [R]

            /     ♦     I                     =     I,                    [R]

            /     ♦     R_TUBU                =     rt,                   [R]
                  ♦     R_BODY                =     rc,                   [R]
                  ♦     I_TUBU                =     it,                   [R]
                  ♦     I_BODY                =     ic,                   [R]
                        ),

      ♦     CHAR_MECA   =_F   (
            ♦     NUME_CHAR   =     numchar,                              [I]
            ◊     NOM_CHAR    =     nomchar,                              [KN]

            /     ♦     MX                =     MX    ,                   [R]
                  ♦     MY                =     my    ,                   [R]
                  ♦     MZ                =     mz    ,                   [R]

            /     ♦     MX_CORP           =     MXC   ,                   [R]
                  ♦     MY_CORP           =     myC   ,                   [R]
                  ♦     MZ_CORP           =     mzC   ,                   [R]
                  ♦     MX_TUBU           =     MXT   ,                   [R]
                  ♦     MY_TUBU           =     myT   ,                   [R]
                  ♦     MZ_TUBU           =     mzT   ,                   [R]
                              ),

      ◊     RESU_THER=_F (
                  ♦     NUME_RESU_THER    =     numtran,                  [I]
                  ♦     TABL_RESU_THER    =     table,                    [table]
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                                    ),
◊     RESU_NEAR=_F (
            ♦     NUME_RESU_NEAR    =     numtran,                [I]
            ♦     TABL_RESU_NEAR    =     table,                  [table]
                                    ),

◊     SEISME=_F (
      ♦     NUME_SITU   =     numsitu,                            [I]
      ◊     NOM_SITU    =     nomsitu,                            [KN]
      ♦     NB_OCCUR    =     nbocc,                              [I]
      ♦     NB_CYCL_SEISME    =     nbsss,                        [I]
      ♦     CHAR_ETAT         =     num_char_meca,                [I]
                        ),

♦     SITUATION=_F (
      ♦     NUME_SITU   =     numsitu,                            [I]
      ◊     NOM_SITU    =     nomsitu,                            [KN]
      ♦     NB_OCCUR    =     nbocc,                              [I]
      ♦     NUME_GROUPE =     (numgroup1, numgroup2,…)            [L_I]
      ◊     NUME_PASSAGE      =     (num1, num2,…)                [L_I]
      ◊     NUME_PARTOLD      =     num1                          [I]
      ◊     COMBINABLE        =     /'YES',                       [DEFECT]
                                    /'NOT',                       [KN]
      ♦     CHAR_ETAT_A =     num_char_meca,                      [I]
      ♦     CHAR_ETAT_B =     num_char_meca,                      [I]
      ◊     NUME_RESU_THER    =     num_tran          ,           [I]
      ◊     NUME_RESU_ NEAR   =     num_tran          ,           [I]
      ◊     O_ETOILE    =     oet   ,                             [R]
      ◊     TABL_TEMP   =     tabtemp,                            [table]
                               ),

◊     ENVIRONNEMENT=_F (
      ♦     FEN_INTEGRE       =     fenint,                       [R]
      ♦     CRIT_EPSI         =     epsilim,                      [R]
      ♦     S_ETOILE          =     set   ,                       [R]
      ♦     TABL_YOUNG        =     tabyoung,                     [table]
      ♦     SEUIL_EPSI_INF    =     epsimin,                      [R]
      ♦     SEUIL_EPSI_SUP    =     epsimax,                      [R]
      ♦     A_ENV             =     aenv,                         [R]
      ♦     B_ENV             =     benv,                         [R]
      ♦     C_ENV             =     cenv,                         [R]
      ♦     SEUIL_T_INF       =     tempmin,                      [R]
      ♦     SEUIL_T_SUP       =     tempmax,                      [R]
      ♦     VALE_T_INF        =     valmin,                       [R]
      ♦     VALE_T_SUP        =     valmax,                       [R]
      ♦     VALE_T_MOY_NUM    =     valmoynum,                    [R]
      ♦     VALE_T_MOY_DEN    =     valmoyden,                    [R]
                                    ),
```

```
# if TYPE_RESU_MECA = 'EVOLUTION'
      ♦     OPTION    =             /     'PM_PB',
                                    /     'SN',
                                    /     'FATIGUE_ZH210',
                                    /     'STARTING',


      ♦     MATER     = chechmate   ,                                  [to
subdue]

      ◊     SY_MAX    = symax,                                         [R]

      ◊     TYPE_KE     =     / 'KE_MECA',                             [DEFECT]
                              / 'KE_MIXTE'

      ♦     TRANSITOIRE=_F    (
                  ◊     TABL_RESU_MECA    =     tabmeca,             [table]
                  ◊     TABL_SIGM_THER    =     tabth ,              [table]
                  ◊     TABL_RESU_PRES    =     tabpres,             [table]
                  ◊     TABL_SIGM_THETA   =     tabsigt,             [table]

                  ◊     NB_OCCUR          =     /     nocc,          [I]
                                                /     1,             [DEFECT]

                  ◊     /     TOUT_ORDRE        =     'YES',
                        /     INST              =     linst ,        [l_R]
                        /     LIST_INST         =     linst ,        [listr8]
                  ◊     CRITERION = / 'RELATIVE',                    [DEFECT]
                                      ◊    PRECISION =/prec,         [R]
                                                      / 1.E-6,       [DEFECT]
                                    / 'ABSOLUTE',
                                      ♦    PRECISION =  prec,        [R]

                                         )
```

3 Operands commun runs with all the options

3.1 Operand TYPE_RESU

```
TYPE_RESU = /      'VALE_MAX',
            /      'DETAILS',
```

Type of values contained in the table produced as a result:

- VALE_MAX : only the maximum values are given;
- DETAILS : the computed values at every moment are provided.

3.2 Operand TITLE

♦ TITLE = title

Character string describing the title of the table of values created, which appears with the impression of this table by IMPR_TABLE [U4.91.03].

3.3 Operand INFORMATION

♦ INFORMATION = /1
/2

Allows a posting more or less detailed in the file message.

3.4 Types of results: keyword TYPE_RESU_MECA

Five types of postprocessings are available in POST_RCCM :these postprocessings follow the rules of various paragraphs of the RCC-M: B3600, B3200, ZE200.

Results of the type RCC-M B3600 for pipingS : 'B3600'

This kind of result is dedicated to the postprocessing of mechanical calculations (MECA_STATIQUE , STAT_NON_LINE , COMB_SISM_MODAL) on a line of piping. Calculation with tiredness is done according to the rules of the B3600 paragraph.

Several situations can be defined, but in only one group. Situations of earthquake can be taken into account.

Results of the type RCC-M B3200 : 'EVOLUTION' and 'B3200'

'EVOLUTION' is dedicated to the postprocessing of one or more thermomechanical calculations (MECA_STATIQUE, STAT_NON_LINE) on a modeling 2D or 3D. The results are transmitted via tables of constraints, extracted on the segments from analysis. The accessible criteria are:

- for the current zones (except geometrical singularity): criteria of level 0 (option PM_PB), of level A except tiredness (option SN) and of tiredness (option FATIGUE_ZH210) on segments;
- for the geometrical singularities: calculation of the factor of starting (option STARTING) on a circular line of cut around the singularity.

This option is well adapted to the cases where there are few situations to study.

'B3200' is a contrario adapted well to calculations on a component subjected to many situations, possibly distributed in several groups of operation. One earthquake can be taken into account, as well as situations of passage and groups of division. One can also evaluate the environmental resistance to fatigue with this option.

The loadings can be returned in several forms.

This kind of result can thus require R preliminary calculation:

- D be forced related to the thermal transients considered, that it is necessary to extract on the segment from analysis (RESU_THER) ,
- D be forced dependent on the loadings of pressure: in the form of transient (RESU_PRES) or in the form of unit loading with two pressures for the stabilized states (RESU_MECA_UNIT, PRES_A and PRES_B),
- constraints related to the loadings due to the efforts and the times:
  - in the form of transient (RESU_MECA)
  - for unit loadings (efforts and unit total moments applied to the limits of the model) with two torques for the stabilized states (CHAR_ETAT_With and CHAR_ETAT_B). These efforts can be is calculated with C*ode_hasster* , that is to say resulting from database OAR,
  - for unit loadings to which one applies one torque, this torque is calculated by Interpol ation enters two torques (CHAR_ETAT_ With and CHAR_ETAT_ B) who correspond to the temperatures TEMP_A , and TEMP_B and thanks to the temperature during the situation TABL_TEMP.

The accessible criteria are the criteria of level 0 (option PM_PB), of level With except tiredness (option SN), of tiredness (option TIREDNESS) and of environmental tiredness (option EFAT) on segments.

Results of the type RCC-M ZE200 : 'ZE200a' and 'ZE200b'

Method ZE200 of the RCC-M is a mixed method which combines B3200 and B3600. This kind of result is thus dedicated to the postprocessing of mechanical calculations on a line of piping according to B3600 combined with the thermal transients for 'ZE200a' . Method 'ZE200b' draft in more the constraints due to the pressure in the form of transient.

These options are adapted wellS with calculations on a piping subjectedE with many situations, possibly distributed in several groups of operation. One earthquake can be taken into account, as well as situations of passage and groups of division. One can also evaluate the environmental resistance to fatigue with this option.

3.5 Produced table

The order POST_RCCM generate a concept of the type table. The order IMPR_TABLE [U4.91.03] allows to print the contents of the table. For more information, one will be able to refer to the document [U2.09.03].

4 Operands specific to the results of the type B3200

4.1 Preliminaries

From several mechanical computation results on a component, one calculates criteria of level 0 and of level With RCC-M.

The loadings can be returned in several forms.

This kind of result can thus require R preliminary calculation:

- D be forced related to the thermal transients considered, that it is necessary to extract on the segment from analysis (RESU_THER) ,
- D be forced dependent on the loadings of pressure: in the form of transient (RESU_PRES) or in the form of unit loading with two pressures for the stabilized states (RESU_MECA_UNIT, PRES_A and PRES_B),
- constraints related to the loadings due to the efforts and the times:
  - in the form of transient (RESU_MECA)
  - for unit loadings (efforts and unit total moments applied to the limits of the model) with two torques for the stabilized states (CHAR_ETAT_With and CHAR_ETAT_B). These efforts can be is calculated with C*ode_hasster* , that is to say resulting from database OAR. **LE locates used for calculation 2D or 3D must be coherent with that in which the total efforts resulting from calculation beam are expressed.**
  - for unit loadings to which one applies one torque, this torque is calculated by Interpol ation enters two torques (CHAR_ETAT_ With and CHAR_ETAT_ B) who correspond to the temperatures TEMP_A , and TEMP_B and thanks to the temperature during the situation TABL_TEMP.

4.1.1 Option PM_PB

Option allowing to calculate the criteria of level 0 which aim at securing the material against the damage of excessive deformation, plastic instability and elastic and elastoplastic instability. These criteria require the calculation of the equivalent constraints of membrane *Pm*, of membrane local *Pl*, of inflection *Pb* and of membrane plus inflection *Pm+Pb*.

4.1.2 Option SN

Option allowing to calculate the criteria of level With (except tiredness) which aims at securing the material against the damage of progressive deformation. They require the calculation of the amplitude of variation of constraint linearized in a point, noted *Sn*. Under certain conditions, this option also allows the calculation of *Sn** and of the thermal ratchet (if presence of the keyword factor RESU_THER).

Note:

> *With the option ' SN ', calculation is done without combination between the definite situations: each situation will be treated successively. To have the sizes with combination between each situation, it is necessary to use L'option ' TIREDNESS '.*

4.1.3 Option TIREDNESS

The fatigue analyses are carried out within the meaning of the RCCM B3200 on the segment of analysis. Two fictitious transients are thus identified to combine two situations between them [R7.04.03].

4.1.4 Option EFAT

Environmental fatigue analyses (option 'EFAT') are carried out within the meaning of the RCCM B3200 on the segment of analysis. Two fictitious transients are thus identified to combine two situations

between them. Then the effects of the environment REFERENCE MARK on the factor of use are taken into account. It is necessary to add the keyword factor 'ENVIRONMENT' and keywords 'O_ETOILE' and 'TABL_TEMP' under each occurrence of the keyword factor 'SITUATION' [R7.04.03].

4.2 Operand MATER

♦ MATER = chechmate

Name of material containing, for the analyzed segment, the characteristics defined under the keyword ELAS and RCCM of DEFI_MATERIAU [U4.43.01] (E, NAKED, ALPHA, WOHLER, E_REFE, M_KE, N_KE, SM)

Notice on the curves of tiredness:

The question of the prolongation of the curve of tiredness and the concept of limit of endurance are discussed in the § 7.1.1 .

4.3 Operand SY_MAX

◊ SY_MAX = symax,

Conventional limit of elasticity for the maximum temperature reached during the cycle. This operand is used only for the calculation of the thermal ratchet. If elastic limit SY_MAX is not defined, one takes the value defined under the operand SY_02 keyword RCCM in DEFI_MATERIAU [U4.43.01]; if this operand is not either defined, the calculation of the thermal ratchet is impossible.

4.4 Operand METHOD

```
◊ METHOD = / 'TRESCA',          [DEFECT]
           / 'TOUT_INST'
```

There exist two methods of selection of the moments during calculation of Sn or Sp:

- method 'TRESCA' carry out a preselection of the moments based on the signed tresca of each transient, it is more rapid of the two methods and it is thus taken by default if the user does not specify anything. Nevertheless it is less robust that second method [R7.04.03]
- method 'TOUT_INST' combine all the possibilities of moments and can be more expensive in computing times.

4.5 Operand TYPE_KE

```
◊ TYPE_KE = / 'KE_MECA',        [DEFECT]
            / 'KE_MIXTE'
```

The elastoplastic factor of correction That can be calculated in two ways [R7.04.03]:

- KE_MECA : it is the original method, only available in the previous versions to version 7.2;
- KE_MIXTE : this method breaks up the amplitude of variation of the alternating loads into a thermal part and a mechanical part. It is authorized since the modifying 1997 of the RCC-M.
-

4.6 Operand SOUS_CYCL

```
◊ SOUS_CYCL = / 'NOT',          [DEFECT]
              / 'YES'
```

The factor D'use due to the under-cycles of all the situations can be taken into account or not.

4.7 Keyword FACT_SIGM

```
◊      FACT_SIGM=_F (
             ◊      KT_SN                          =      ktsn,
                    [R]
             ◊      KT_SP                          =      ktsp,
                    [R]
         ),
```

Values of stress concentration KT_SN and KT_SP to apply to Sn and/or Sp. Intervenes only in the fatigue analysis.

4.8 Keyword INDI_SIGM

```
◊      INDI_SIGM=_F (… ),
```

Values of the indices of constraints to be used in the analysis of tiredness (values codified in the RCC - Mr. B3683). The user provides for the segment of calculation, the values of C1, C2, C3, K1, K2, K3. This keyword makes it possible to compare results resulting from the method which follows the paragraph ZE200 or the B3600 paragraph.

4.9 Keyword RESU_THER

This keyword factor makes it possible to define the results of thermal calculations. It is répétable as many times as there are different thermal calculations.

4.9.1 Operand NUME_RESU_THER

♦ NUME_RESU_THER = numtran [I]

Number of the thermal transients. This number is used to identify the thermal transient associated with each situation (see keyword SITUATION).

4.9.2 Operand TABL_RESU_THER

♦ TABL_RESU_THER = table [tabl_post_releve]

Table resulting from POST_RELEVE_T, containing for each transitory thermal calculation, the statement of the constraints due to the thermal loading on the section of the grid 2D or 3D chosen by the user at various moments of the transient.

4.10 Keyword RESU_PRES

This keyword factor makes it possible to define the results of calculations of pressure. It is répétable as many times as there are different calculations of pressure. It can be used if RESU_MECA_UNIT and CHAR_MECA are not used.

4.10.1 Operand NUME_RESU_PRES

♦ NUME_RESU_PRES = numtran [I]

Number of the transients of pressure. This number is used to identify the transient of pressure associated with each situation (see keyword SITUATION).

4.10.2 Operand TABL_RESU_PRES

♦ TABL_RESU_PRES = table [tabl_post_releve]

Table resulting from POST_RELEVE_T, containing for each calculation of transitory pressure, the statement of the constraints due to the loading of pressure on the section of the grid 2D or 3D chosen by the user at various moments of the transient.

4.11 Keyword RESU_MECA

This keyword factor makes it possible to define the results of calculations of mechanical origin. It is répétable as many times as there are different calculations of mechanical origin. This keyword is necessary if the keywords CHAR_MECA and RESU_MECA_UNIT were not well informed.

4.11.1 Operand NUME_RESU_MECA

♦ NUME_RESU_MECA = numtran [I]

Number of the transients of mechanical origin. This number is used to identify the mechanical transient associated with each situation (see keyword SITUATION).

4.11.2 Operand TABL_RESU_MECA

♦ TABL_RESU_MECA = table [tabl_post_releve]

Table resulting from POST_RELEVE_T, containing for each transitory mechanical calculation, the statement of the constraints due to the mechanical loading of origin on the section of the grid 2D or 3D chosen by the user at various moments of the transient.

4.12 Keyword CHAR_MECA

This keyword factor makes it possible to define, for each mechanical loading appearing in the situations, the torques applied to the limits of the model, resulting from calculations of type beam. It is répétable as many times as there are mechanical loadings different as a whole from the situations. It can be used if RESU_MECA and RESU_PRES are not used.

4.12.1 Operand NUME_CHAR

Number of the mechanical loading. This number is used to define the loadings associated with each situation (see keyword SITUATION).

4.12.2 Operand NOM_CHAR

Name of the loading mécaniquE (optional).

4.12.3 Operands MX/MY/MZ/FX/FY/FZ

Generalized efforts resulting from calculations of the line of piping, standard beam, for each loading, to apply to the profiles of constraints provided under RESU_MECA_UNIT, by linear combination.

Attention, this supposes that these values are provided in a coherent reference mark with that used for modeling 2D or 3D of the component.

4.12.4 Operands MX_CORP/MX_TUBU, MY_CORP/MY_TUBU,…

♦ MX_CORP = MXC , [R]
♦ MY_CORP = myC , [R]
♦ MZ_CORP = mzC , [R]
◊ FX_CORP = fxC , [R]
◊ FY_CORP = fyC , [R]
◊ FZ_CORP = fzC , [R]
♦ MX_TUBU = MXT , [R]
♦ MY_TUBU = myT , [R]
♦ MZ_TUBU = mzT , [R]
◊ FX_TUBU = fxT , [R]
◊ FY_TUBU = fyT , [R]
◊ FZ_TUBU = fzT , [R]

Generalized efforts applied to the body and the pipe of a pricking. Their significance is identical to that of the operands MX, MY,… used for the lines of piping.

In the case or these operands are used, the tables of corresponding results (TABL_MX_TUBU, TABL_MX_CORP,…) must be specified under the keyword RESU_MECA_UNIT.

4.13 Keyword RESU_MECA_UNIT

◊ RESU_MECA_UNIT=_F (…)

This keyword factor makes it possible to provide the profiles of constraints on the segment chosen, resulting from unit mechanical calculations is on the line of piping (TABL_MX, TABL_MY…), that is to say on pricking (TABL_MX, BODY, TABL_MX_TUBU…).It can be used if RESU_MECA and RESU_PRES are not used.

For the realization of these calculations, it is recommended to apply to the limits of the model 3D of the connections of type 3D-beam with specific discrete elements. One of these elements is embedded, and to the other, one applies unit generalized efforts. In the case of a pricking, one of the ends of the body is blocked, the generalized efforts being applied to the other end of the body and the end of the pipe.

Let us note that it is of use in calculations RCCM of type piping to consider only the moments, this is why the keywords of the type TABL_FX, TABL_FY TABL_FZ are optional. TABL_PRES correspondent with a calculation under pressure interns unit, without forgetting the basic effect.

4.14 Keyword EARTHQUAKE

Only one loading of the type EARTHQUAKE can be defined by group of situations.

4.14.1 Operands NUME_SITU/NOM_SITU/NB_OCCUR/NB_CYCL_SEISME

♦ NUME_SITU = numsitu, [I]
◊ NOM_SITU = nomsitu, [KN]
♦ NB_OCCUR = nbocc , [I]
♦ NB_CYCL_SEISME = nbsss, [I]

Number, name (optional) and many occurrences situation earthquake. NB_CYCL_SEISME is the number of cycles associated with each occurrence with the earthquake, considered as under-cycles in the calculation of the factor of use.

4.14.2 Operands CHAR_ETAT

♦ CHAR_ETAT = num_char_meca, [I]

NRuméro DU mechanical loading (corresponding to the keyword NUME_CHAR keyword factor CHAR_MECA) associated with the situation of earthquake.

4.14.3 Operands TABLE_FX, TABLE_FY,…, TABLE_MZ

Profiles of constraints associatedS with the situation of earthquake, this keyword is necessary if the keyword CHAR_ETAT is not well informed.

4.15 Keyword SITUATION

This keyword factor makes it possible to define the situations. It is répétable as many times as there are situations.

4.15.1 Operands NUME_SITU/NOM_SITU/NB_OCCUR

♦ NUME_SITU = numsitu, [I]
◊ NOM_SITU = nomsitu, [KN]
♦ NB_OCCUR = nbocc, [I]

Number, name (optional) and many occurrences situation.

4.15.2 Operand NUME_GROUPE/NUME_PASSAGE/NUME_PARTWithGE

```
♦   NUME_GROUPE =     (numgroup1, numgroup2,…) ,          [L_I]
◊   NUME_PASSAGE=     (num1, num2,…),               [L_I]
◊   NUME_PARTAGE=     num1                                [I]
```

One indicates under NUME_GROUPE Numéro(S) of group to which situation belongs.

If the situation is one situation of passage, one indicates under NUME_PASSAGE numbers of the various groups which it connects (20 groups with more).
When a situation makes the passage between N groups, it necessarily belongs to these N groups (the numbers under NUME_PASSAGE must appear under NUME_GROUPE).

Note:

Inversement, a situation can belong to various groups without being a situation of passage between these groups (the numbers under NUME_GROUPE are not necessarily under NUME_PASSAGE)

If the situation belongs to a group of Partold, one indicates under NUME_PARTOLD the number of this group of division.

NoticeS :

No relation exists between the number of a group of operation (NUME_GROUPE) and the number of a group of division (NUME_PARTOLD)
A situation can belong to the only one group of division

4.15.3 Operand COMBINABLE

```
♦   COMBINABLE  =     /'YES',                             [DEFECT]
.                     /'NOT',                             [KN]
```

This keyword indicates if a situation is combinable with the others inside its group (case general). If COMBINABLE=' NON', that means that the situation is a under-cycle.

4.15.4 Operands PRES_A/PRES_B

```
◊   PRES_A      =     pressed     ,                              [R]
◊   PRES_B      =     presb ,                              [R]
```

Pressions associated with each of the two stabilized states of the situation.

4.15.5 Operand NUME_RESU_PRES

```
◊   NUME_RESU_PRES    =     num_tran                      [I]
```

Number of transient of pressure associated with the situation. There can be 0 or 1 transient section by section of line (what corresponds to groups of meshs) for each situation. This number corresponds to the keyword NUME_RESU_PRES keyword factor RESU_PRES.

4.15.6 Operand NUME_RESU_THER

```
◊   NUME_RESU_THER    =     num_tran                      [I]
```

Thermal number of transient associated with the situation. There can be 0 or 1 transient section by section of line (what corresponds to groups of meshs) for each situation. This number corresponds to the keyword NUME_RESU_THER keyword factor RESU_THER.
If for a given situation, there are physically two transients for a section, like heating-cooling for example, it is of use to combine these two transients in only one.

4.15.7 Operands CHAR_ETAT_A/CHAR_ETAT_B/ TEMP_A/TEMP_B

♦ CHAR_ETAT_A = num_char_meca, [I]
♦ CHAR_ETAT_B = num_char_meca, [I]
♦ TEMP_A = temphas, [R]
♦ TEMP_B = tempb , [R]

NRuméroS mechanical loadings associated in each stabilized state. These numbers correspond to the keyword NUME_CHAR keyword factor CHAR_MECA.

If keywords TEMP_A and TEMP_B are informed, then the keyword TABL_TEMP must be well informed too. The moments and efforts will be interpolated according to the temperature.

4.15.8 Operand NUME_RESU_MECA

♦ NUME_RESU_MECA = num_tran [I]

Number of mechanical transient of origin associated with the situation. There must be 1 transient section by section of line (what corresponds to groups of meshs) for each situation. This number corresponds to the keyword NUME_RESU_MECA keyword factor RESU_MECA. This keyword is necessary if the keywords CHAR_ETAT_A and CHAR_ETAT_B were not well informed.

4.15.9 Operands O_ETOILE / TABL_TEMP

◊ O_ETOILE = oet, [R]
◊ TABL_TEMP = tabtemp, [table]

These two operands are necessary for and thus of the environmental call fatigue analysis of the option 'EFAT'. For each situation, O_ETOILE represent the degree of oxygen (he is considered here constant) and TABL_TEMP is the table of the temperatures according to time during the transient.

Note:

The table under the keyword TABL_TEMP must be defined at the same moments as the thermal transient of the situation under TABL_RESU_THER.

4.16 Keyword ENVIRONMENT

This keyword factor makes it possible to calculate the environmental resistance to fatigue. It is not répétable because indexes the data necessary to calculation but common to all the situations.

4.16.1 Operand FEN_INTEGRE

♦ FEN_INTEGRE = fenint, [R]

Integrated Fen which intervenes in the calculation of the factor of environment.

4.16.2 Operand CRIT_EPSI

♦ CRIT_EPSI = epsilim, [R]

Threshold in deformation from which the factor of environment does not intervene.

4.16.3 Operands TABL_YOUNG

♦ TABL_YOUNG = tabyoung, [table]

Table providing the module of Young (column YOUNG) according to the temperature (column TEMP). A linear interpolation is made starting from this table to evaluate the Young modulus who intervenes of the calculation of the factor of environment.

4.16.4 Operands S_ETOILE

♦ S_ETOILE = set , [R]

Content of suffer analyzed metal (thus commun run with all the situations) equal to a constant.

4.16.5 Operands SEUIL_EPSI_INF/SEUIL_EPSI_SUP

♦ SEUIL_EPSI_INF = epsimin, [R]
♦ SEUIL_EPSI_SUP = epsimax, [R]

Thresholds which intervene in the calculation the speed of deformation.

4.16.6 Operands A_ENV/B_ENV/C_ENV

♦ A_ENV = aenv, [R]
♦ B_ENV = benv, [R]
♦ C_ENV = cenv, [R]

Constants which intervene in the general expression of the factor of environment.

4.16.7 Operands SEUIL_T_INF/SEUIL_T_SUP/VALE_T_INF/VALE_T_SUP/VALE_T_MOY_NUM/VALE_T_MOY_DEN

♦ SEUIL_T_INF = tempmin, [R]
♦ SEUIL_T_SUP = tempmax, [R]
♦ VALE_T_INF = valmin, [R]
♦ VALE_T_SUP = valmax, [R]
♦ VALE_T_MOY_NUM = valmoynum, [R]
♦ VALE_T_MOY_DEN = valmoyden, [R]

Thresholds which intervene in the calculation of the T* temperature.

4.17 Produced table and example

The table produced by POST_RCCM depends onOPTION of calculation and type of result requested under the operand TYPE_RESU:

- if TYPE_RESU=' VALE_MAX' (option by default): the table is simple and comprises only the maximum parameters various sizes (Pm, Pb, Pmpb, Sn, Sn*, Sp, Salt, Fu, Fu_environnement and sizes related to the ratchet) at the two ends
- if TYPE_RESU=' DETAILS' : the table is much richer. It comprises maximum parameters quoted previously (line 'MAXIMUM') more all calculated parameters, for each situation (lines of the type 'SITU') and each combination of situation (lines of the type 'COMB'), with or without earthquake, and the combinations which really intervened in the calculation of the factor of use (line 'FACT'). IL is then strongly recommended to print the table with successive filters so that it is easily exploitable.

  - ***Impression of the maximum one:*** if TYPE_RESU='VALE_MAX' or with a filter in IMPR_TABLE : FILTRE=_F (NOM_PARA=' TYPE', VALE_K=' MAXI'), the produced table can contain according to the option requested following parameters: PM_MAX, PB_MAX, PMPB_MAX, SN_MAX, SN*_MAX, SIGM_M_PRES, SN_THER_MAX, CRIT_LINE_MAX, SP_THER_MAX, CRIT_PARA_MAX, SP_MAX, SALT_MAX, FU_TOTAL and FOne_TOTAL.

  - ***Impression of the sizes of each situation:*** with a filter in IMPR_TABLE : FILTRE= (_F (NOM_PARA=' TYPE', VALE_K=' SITU'),

_F (NOM_PARA=' SEISME', VALE_K=' AVEC' *or* ' SANS')),
the produced table contains according to the option requested following parameters for each situation (with or without earthquake): PM, PB, PMPB, SNR, INST_SN_1, INST_SN_2, SN*, INST_SN*_1, INST_SN*_2, SIG_PRES_MOY, SN_THER, CRIT_LINE, SP_THER, CRIT_PARAB, SP1 (MECA), INST_SALT_1, INST_SALT_2, SALT and FU_UNIT.

- ***Impression of the sizes of each combination of situations:*** with a filter in IMPR_TABLE :
FILTRE= (_F (NOM_PARA=' TYPE', VALE_K=' COMB'),
_F (NOM_PARA=' SEISME', VALE_K=' AVEC' *or* ' SANS')),
the produced table contains according to the option requested following parameters for each one of combinations of situations (with or without earthquake): SNR, INST_SN_1, INST_SN_2, SN*, INST_SN*_1, INST_SN*_2, SIG_PRES_MOY, SN_THER, CRIT_LINE, SP_THER, CRIT_PARAB, SP1 (MECA), INST_SALT_1, INST_SALT_2, SALT and FU_UNIT.

- ***Impression of the combinationS situations who intervened in the calculation of factor of use :*** with a filter in IMPR_TABLE :
FILTRE= (_F (NOM_PARA=' TYPE', VALE_K='FACT'),),
the produced table contains according to the option requested following parameters for each one of combinations of situations who intervened in the calculation of the factor of use FU_TOTAL : SNR, INST_SN_1, INST_SN_2, SN*, INST_SN*_1, INST_SN*_2, INST_SALT_1, INST_SALT_2, SALT, FU_UNIT, NOCC_PRIS, FU_PARTIEL.

If Option ' EFAT ' is called, a size is added daNS the maximum ones by report with the option 'TIREDNESS' : FUEN_TOTAL. Moreover, if TYPE_RESU=' DETAILS' , three sizes are added in the lines of the type 'FACT': FEN, FEN_INTEGRE, and FOne_PARTIAL.

For the follow-up of calculations, DES additional information can be in particular found in the file message for the option TIREDNESS. ON can thus follow at the origin then at the end of the segment : treatment of each situation then combinations of situations and the posting of FU_TOTAL (of which the part related to the sous_cycles and the part related to the seismic sous_cycles)

S tests **rccm01has, rccm01B, rccm01c, rccm01d, rccm01e and rccm07** providedSENT in particular complete examples of use. For more information, one will be able to also refer to the document [U2.09.03].

5 Operands specific to the results of the type B3600

5.1 Opening remarks concerning the stages preliminary to this postprocessing

From several mechanical computation results (MECA_STATIQUE, STAT_NON_LINE, COMB_SISM_MODAL) on a line of piping, one calculates criteria of tiredness by the option TIREDNESS. The data necessary to postprocessing are summarized here (and detailed in the following paragraph):

- Geometry of the line of piping.
- The material field: it is the map of materials assigned to the groups of meshs of the grid by AFFE_MATERIAU which it is necessary to add the curve of tiredness, E_REFE, M_KE and N_KE (keywords RCCM).
- AFFE_CARA_ELEM allows to affect the elementary characteristics.
- Indices of constraints (in each node of the grid).
- The scenario of operation containing the list of the situations:
  - For each situation:
    1) Many occurrences of each situation (thus of each stabilized state).
    2) Pressure and average temperature of each stabilized state.
    3) List of the mechanical loadings of each stabilized state.
    4) The group of membership of the situation.
    5) The associated thermal transient.
- Results of calculations for each mechanical loading (including the earthquake), located by its number, with for information the name of the loading case: field by elements with the nodes of generalized efforts, for each loading (EFGE_ELNO, or SIEF_ELNO).
- For each node, a reference to a definite thermal result below.
- Results of thermal calculations: calculations finite elements 2D or 3D which gives information depend at the same time on the geometry and the transient. There is thus a thermal calculation by type of junction, and type of transient. In practice two are carried out POST_RELEVE_T by transient and different type of thickness or geometry: one POST_RELEVE_T with the option EXTRACTION, and a second with the option AVERAGE

Preliminary calculations to carry out are thus:

- Calculations of type beam (elastic design) for each loading (one makes use only of the moments, expressed in a local reference mark with each element, locates presumedly identical for all the results) composing each of the two stabilized states of each situation.
- A seismic calculation (inertial answer and displacements of anchoring) (only one type of earthquake taken into account).
- The calculation of each thermal transient, in as many grids 2D or 3D that there are different thicknesses or components.

Operands and keywords of the option TIREDNESS were selected in order to allow a later use in link with tool OAR. They are thus inspired by the specifications of database OAR [3].

5.2 Operand CHAM_MATER

♦ CHAM_MATER = chmat

It is the material field containing, for all the meshs of the model, the characteristics material useful to TIREDNESS and definite under the keyword ELAS_FO, TIREDNESS and RCCM of DEFI_MATERIAU [U4.43.01] (E, NAKED, ALPHA, WOHLER, E_REFE, M_KE, N_KE, SM).

Notice on the curves of tiredness:

For the small amplitudes of constraints, the difficulty of the prolongation of the curve of tiredness can arise: for example, for the curves of tiredness of the RCCM beyond 10^6 cycles, the corresponding constraint, 180 MPa is regarded as limit of endurance, i.e. that very forced lower than 180 MPa must produce a factor of null use, or an infinite number of cycles acceptable.
The method adopted here corresponds to this concept of limit of endurance: if the amplitude of constraint is lower than the first X-coordinate of the curve of tiredness, then one takes a factor of null use.

5.3 Operand CARA_ELEM

♦ CARA_ELEM = will cara

It is the field of characteristics of the elements of beams (external ray and thickness, angle and radius of curvature of the elbows) defined by AFFE_CARA_ELEM.

5.4 Operand MODEL

♦ MODEL = model

It is the model (finite element of beam) on which were carried out calculations of the mechanical loadings.

5.5 Operand TYPE_KE

```
◊ TYPE_KE = / 'KE_MECA',
        [DEFECT]
                          / 'KE_MIXTE'
```

The elastoplastic factor of correction That can be calculated in two ways [R7.04.03]:

- KE_MECA : it is the original method, only available in the previous versions to version 7.2;
- KE_MIXTE : this method breaks up the amplitude of variation of the alternating loads into a thermal part and a mechanical part. It is authorized since the modifying 1997 of the RCC-M.

5.6 Keyword ZONE_ANALYSE

This keyword makes it possible to limit the fatigue analysis to meshs or groups of mesh of the line of piping.

5.6.1 Operands ALL/GROUP_MA

```
◊ / ALL = 'YES' ,
  / GROUP_MA = gma1 , [groupma]
```

By default the calculation of the factor of use is made for all the nodes of the model.

These keyword make it possible to restrict the analysis with groups of meshs, which makes it possible to save time of calcu L.

5.7 Keyword RESU_MECA

This keyword factor makes it possible to define the results of mechanical calculations. It is répétable as many times as there are mechanical loadings different as a whole from the situations.

5.7.1 Operand NUME_CHAR

Number of the mechanical loading. This number is used to define the loadings associated with each situation (see keyword SITUATION).

5.7.2 Operand NOM_CHAR

Name (optional) of the mechanical loading.

5.7.3 Operand RESULT/CHAM_GD

```
/     ♦     CHAM_GD      =     cham_effo   ,                  [cham_elem]
/     ♦     RESULT       =     resu,                  /       [evol_elas]
                                                      /       [evol_noli]
                 /     TOUT_ORDRE   =     'YES' ,
                /      NUME_ORDRE         =     lordre      ,      [l_I]
                /      LIST_ORDRE         =     lordre      ,      [listIs]
                /      INST               =     linst ,            [l_R]
                /      NOEUD_CMP          =     lnoecmp,           [l_K16]
                /      LIST_INST          =     linst ,            [listr8]
                ♦      NOM_CHAM           =     /     'EFGE_ELNO',
                                                /     'SIEF_ELNO',
```

The results of calculations for each loading (fields by elements with the nodes of generalized efforts) can be defined:

- that is to say a field by element: cham_effo who is of type EFGE_ELNO, or SIEF_ELNO,
- that is to say a structure of data result (exit of MECA_STATIQUE or STAT_NON_LINE) with parameters of extraction: moment, NOM_CHAM=' EFGE_ELNO', or 'SIEF_ELNO'...) or resulting from COMB_SISM_MODAL or MODE_STATIQUE with the additional parameter of extraction NOEUD_CMP.

For the latter, the fields of efforts relating to the earthquake are the moments for each component of each earthquake, resulting from a quadratic combination NOEUD_CMP= ('COMBI', 'QUAD') for the inertial answer; and of the nodes and the directions (for example NOEUD_CMP= ('N1', 'DX')) for displacements of anchorings.

5.8 Operand INDI_SIGM

♦ INDI_SIGM =_F (…)

Values of the indices of constraints to be used in the analysis of tiredness (values codified in the RCC - Mr. B3683, variable according to the type of junction). The user provides for each group of meshs, or each node of each mesh, the values of C1, C2, C3, K1, K2, K3, knowing that the values by default are those which correspond to the right parts of pipings, which facilitates the introduction of the data. One will be able to have for example:

```
INDI_SIGM=  _F (  GROUP_MA=' GMA1'),
```

(assignment of the values by default for all the nodes of all the meshs of GMA1)

TYPE_ELEM_STANDARD is a keyword optional, purely informative, allowing to clearly show more in the table the results according to the type of elements and junctions. One will be able to give, as in OAR, [3] a description of the type:

- DRO : to some extent right,
- NECK : for an elbow,
- TRN : for a transition from thickness,

- TEE : for a t-piece.

5.9 Keyword RESU_THER

This keyword factor makes it possible to define the results of thermal calculations. It is répétable as many times as there are different thermal calculations and geometrical discontinuities or materials.
As an indication, there can be: (many discontinuities) * (many thermal transients).

5.9.1 Operand NUME_RESU_THER

♦ NUME_RESU_THER = numtran [I]

Number of the thermal transients. This number is used to identify the thermal transient associated with each situation (see keyword SITUATION).

5.9.2 Operand TABL_RESU_THER

♦ TABL_RESU_THER = table [table]

Table resulting for example from POST_RELEVE_T, containing for each transitory thermal calculation, the statement of the temperatures on a section (chosen by the user) of the grid 2D or 3D of a junction or a right part at various moments of the transient. The origin of the section must be the internal skin.

♦ TABL_MOYE_THER = table [table]

Table resulting for example from POST_RELEVE_T (OPERATION=' MOYENNE'), container for each transitory thermal calculation, averages of order 0 and 1 of the temperatures on the selected section (in coherence with TABL_RESU_THER) at various moments of the transient.
These quantities are used to calculate the values of ΔT_1, ΔT_2, T_a and T_b [R7.04.03].

5.9.3 Operands ALL / GROUP_MA/MESH/GROUP_NO/NODE

```
◊  /  ALL       =  'YES' ,
   /  GROUP_MA  =  gma1  ,                [groupma]

◊  GROUP_NO     =  gno1  ,                [groupno]
```

The table and the transient are associated is with a group of meshs (in general this group contains all the right parts which see the same thermal transient), that is to say with a mesh, and a node of this mesh (what corresponds in general to a junction). One will be able to have for example:

```
RESU_THER     =_F (NUME_RESU_THER     =     1,
                   TABL_RESU_THER=     tabl1,
                   TABL_MOYE_THER=     tabl11,
                   GROUP_MA=' gma1'),
                 _F (NUME_RESU_THER     =     1,
                   TABL_RESU_THER=     tabl2,
                   TABL_MOYE_THER=     tabl22,
                   GROUP_MA =     'Gmy2'      ,
                   GROUP_NO =     'GNo1'      )
```

5.10 Keyword EARTHQUAKE

This keyword factor makes it possible to define the situations of earthquake. There can be one earthquake by group of situations.

5.10.1 Operands NUME_SITU/NOM_SITU/NB_OCCUR/NB_CYCL_SEISME/NUME_GROUPE/TEMP_REF

```
♦  NUME_SITU   =  numsitu     ,            [I]
◊  NOM_SITU    =  nomsitu     ,            [KN]
```

```
♦    NB_OCCUR     =     nbocc                                    [I]
♦    NB_CYCL_SEISME    =     nbsss ,                             [I]
◊    NUME_GROUPE =     numgroup,                                 [I]
◊    TEMP_REF          =     temp,                               [R]
```

Number of the situation, and name (indicative). NB_OCCUR corresponds to the keyword OCCURRENCE file OAR and indicates the number of occurrences of the situation. NB_CYCL_SEISME provides the number of under-cycles for each occurrence of the earthquake, regarded as under-cycles in the calculation of the factor of use.

NUME_GROUPE allows to define the number of group to which the situation belongs. There can be one earthquake by group of situations.

The temperature of reference TEMP_REF situation of earthquake is useful only if the properties materials depend on the temperature (apertureRand RCCM_FO of DEFI_MATERIAU).

5.10.2 Operand CHAR_ETAT

```
♦    CHAR_ETAT    =     (list_num_char_meca),                [L_I]
```

CHAR_ETAT allows to define the list of the mechanical numbers of loadings associated with the situation of earthquake. These numbers correspond to the keyword NUME_CHAR keyword factor CHAR_MECA. They must correspond to the results of inertial calculation using COMB_SISM_MODAL, and of each displacement of anchoring under earthquake, obtained either using MODE_STATIQUE, that is to say on a case-by-case basis.

5.11 Keyword SITUATION

This keyword factor makes it possible to define the definitions of the situations. It is répétable as many times as there are situations.

5.11.1 Operands NUME_SITU/NOM_SITU/NB_OCCUR

```
♦    NUME_SITU    =     numsitu     ,                           [I]
◊    NOM_SITU     =     nomsitu     ,                           [KN]
♦    NB_OCCUR     =     nbocc       ,                           [I]
```

Number of the situation, and name (indicative). NB_OCCUR corresponds to the keyword OCCURRENCE file OAR and indicates the number of occurrences of the situation.

NUME_GROUPE allows to define the number of group to which the situation belongs. For the results of the type B3600 , it is not for the moment not possible to combine situations of groups different connected by a situation from passage.

5.11.2 Operand NUME_GROUPE/NUME_PASSAGE

```
♦    NUME_GROUPE =     numgroup,                                [I]
◊    NUME_PASSAGE      =     (num1, num2),                      [L_I]
```

Number of group of situation for each situation. The situations of two different groups cannot be combined between them, except if there exists a situation of passage.

For the situations of passage, num1 and num2 indicate the two numbers of groups connected by this situation.

5.11.3 Operands PRES_A/PRES_B/TEMP_REF_A/TEMP_REF_B

```
♦    PRES_A       =     pressed     ,                           [R]
♦    PRES_B       =     pressb      ,                           [R]
◊    TEMP_REF_A   =     tempa,                                  [R]
◊    TEMP_REF_B   =     tempb,                                  [R]
```

Temperatures (stabilized) and pressures associated with each of the two stabilized states of the situation. The temperatures are used for the calculation of the properties materials to the two

stabilized states; operands TEMP_REF_A and TEMP_REF_B are thus useful only if the properties materials depend on the temperature (operand RCCM_FO of DEFI_MATERIAU).

5.11.4 Operands CHAR_ETAT_A/CHAR_ETAT_B

♦ CHAR_ETAT_A = (list_num_char_meca), [L_I]
♦ CHAR_ETAT_B = (list_num_char_meca), [L_I]

List of the mechanical numbers of loadings associated in each stabilized state. These numbers correspond to the keyword NUME_CHAR keyword factor CHAR_MECA.

In the case general, only one mechanical loading is associated in each stabilized state.

5.11.5 Operand NUME_RESU_THER

◊ NUME_RESU_THER = list_num_tran [L_I]

List of numbers of tables resulting from thermal calculations associated with the situation. With each situation a thermal transient (or several in the case of various sections is associated with lines). If for a given situation, there are physically two transients, like the heating - cooling for example, it is of use in B3600 to combine these two transients in only one.

For each situation, one provides N tables which represent the calculation of the same thermal transient in various places of the line (for each thickness or each discontinuity). These numbers must belong to the list of the numbers provided under the keyword NUME_RESU_THER keyword factor RESU_THER.

5.11.6 Operand COMBINABLE

♦ COMBINABLE = /'YES', [DEFECT]
/'NOT', [KN]

This keyword indicates if a situation is combinable with the others inside its group (case general).

If COMBINABLE=' NON', that means that the situation is a under-cycle.

5.12 Example of use

The test rccm02 provides a complete example of use. For more information, one will be able to refer to the document [U2.09.03].

6 Operands specific to the results of the type ZE200a and ZE200b

6.1 Preliminaries

From several mechanical computation results on a line of piping, one thus calculates only criteria of level A of the RCC-M (not of option 'PM_PB'). Methods 'ZE200has'and'ZE200b' are very similar. Moreover only name ZE200 exists in the RCC-M (and not ZE200a and ZE200b). The difference between the two methods lies in the definition of the loading of pressure. In 'ZE200b', the loading of pressure is in the form of transient and thus requires a calculation on the grid 2D or 3D in order to extract on the segment the constraints due to the pressure whereas in 'ZE200a' the pressure intervenes in the equations of the B3600 type.

Preliminary calculations to carry out in C*ode_hasster* or to extract from database OAR (so available):

- Calculation of each thermal transient, on the grid 2D or 3D.
- Calculations of type beam (elastic design) for each loading (one makes use only of the moments, expressed in a local reference mark with each element, locates presumedly identical for all the results) composing each of the two stabilized states of each situation.

The data necessary to postprocessing are summarized here:

- The material (presumedly single initially) that the segment of study crosses: isotropic elastic material for which it is necessary to add the curve of tiredness, E_REFE, M_KE and N_KE.
- Geometry of the line of piping.
- Indices of constraints
- The scenario of operation (available in OAR) containing the list of the situations:
  - For each situation:
    - Many occurrences of each situation.
    - Pressure and average temperature of each stabilized state if 'ZE200a'.
    - Associated transient of pressure if 'ZE200b'.
    - List of the mechanical loadings of each stabilized state.
    - The group of membership of the situation.
    - The associated thermal transient. The temperature during the situation if one wishes to evaluate the environmental resistance to fatigue.
- The definition of each mechanical loading (including the earthquake), located by its number, with for information the name of, and the torque loading case of generalized moments correspondent to this loading, to apply to the limits of the model.
- Results of thermal calculations: extraction of the constraints on a segment of the model finite elements 2D or 3D. There is thus a thermal calculation by transient.

6.1.1 Option SN

Option allowing to calculate the criteria of level With (except tiredness) which aims at securing the material against the damage of progressive deformation. They require the calculation of the amplitude of variation of constraint linearized in a point, noted Sn and of the Sn* amplitude.

Note:

With the option ' SN ', calculation is done without combination between the definite situations: each situation will be treated successively. To have the sizes with combination between each situation, it is necessary to use L'option ' TIREDNESS ' or 'EFAT'.

6.1.2 Option TIREDNESS

Fatigue analyses (option 'TIREDNESS') are carried out within the meaning of RCCM ZE200 on the segment of analysis. Two fictitious transients are thus identified to combine two situations between them [R7.04.03].

6.1.3 Option EFAT

Environmental fatigue analyses (option 'EFAT') are carried out on the segment of analysis. Two fictitious transients are thus identified to combine two situations between them. Then the effects of the environment REFERENCE MARK on the factor of use are taken into account. The keyword factor should be added 'ENVIRONMENT' and keywords 'O_ETOILE' and 'TABL_TEMP' under each occurrence of the keyword factor 'SITUATION' [R7.04.03].

6.2 Operand MATER

♦ MATER = chechmate

Name of material containing, for the analyzed segment, the characteristics defined under the keyword ELAS and RCCM of DEFI_MATERIAU [U4.43.01] (E, NAKED, ALPHA, WOHLER, E_REFE, M_KE, N_KE, SM)

Notice on the curves of tiredness:

> *The question of the prolongation of the curve of tiredness and the concept of limit of endurance are discussed in the § 7.1.1 .*

6.3 Operand SY_MAX

◊ SY_MAX = symax,

Conventional limit of elasticity for the maximum temperature reached during the cycle. This operand is used only for the calculation of the thermal ratchet. If elastic limit SY_MAX is not defined, one takes the value defined under the operand SY_02 keyword RCCM in DEFI_MATERIAU [U4.43.01].

6.4 Operand METHOD

◊ METHOD = / 'TRESCA', [DEFECT]
/ 'TOUT_INST'

There exist two methods of selection of the moments during calculation of Sn or Sp:

- method 'TRESCA' carry out a preselection of the moments based on the signed tresca of each transient, it is more rapid of the two methods and it is thus taken by default if the user does not specify anything. Nevertheless it is less robust that second method [R7.04.03]
- method 'TOUT_INST' combine all the possibilities of moments and can be more expensive in computing times, especially at the time of the taking into account of an earthquake.

6.5 Operand TYPE_KE

◊ TYPE_KE = / 'KE_MECA', [DEFECT]
/ 'KE_MIXTE'

The elastoplastic factor of correction That can be calculated in two ways [R7.04.03]:

- KE_MECA : it is the original method, only available in the previous versions to version 7.2;

- KE_MIXTE : this method breaks up the amplitude of variation of the alternating loads into a thermal part and a mechanical part. It is authorized since the modifying 1997 of the RCC-M.
-

6.6 Operand SOUS_CYCL

```
◊   SOUS_CYCL   =   / 'NOT',          [DEFECT]
                    / 'YES'
```

The factor D'use due to the under-cycles of all the situations can be taken into account or not.

6.7 Keyword INDI_SIGM

```
♦   INDI_SIGM=_F (… ),
```

Values of the indices of constraints to be used in the analysis of tiredness (values codified in the RCC - Mr. B3683). The user provides for the segment of calculation, the values of C1, C2, C3, K1, K2, K3. For a junction of piping, the user then returns only the values of K2 and C2 which correspond to the body and the pipe.

6.8 Keyword PIPE

```
♦   PIPE =_F (
    ♦   R      =   R,                    [R]
    ♦   EP     =   ep,                   [R]

    /   ♦   I          =   I,            [R]

    /   ♦   R_TUBU     =   rt,           [R]
        ♦   R_BODY     =   rc,           [R]
        ♦   I_TUBU     =   it,           [R]
        ♦   I_BODY     =   ic,           [R]
        ),
```

Geometrical characteristics of piping: thickness EP, ray R and moment of inertia I. In the case of a junction of pipings, one returns also the ray of the body and of the pipe and one substitutes for inertia I inertias of the body and the pipe (I_TUBU and I_CORP).

6.9 Keyword CHAR_MECA

This keyword factor makes it possible to define, for each mechanical loading appearing in the situations, the torques applied to the limits of the model, resulting from calculations of type beam. It is répétable as many times as there are mechanical loadings different as a whole from the situations.

6.9.1 Operand NUME_CHAR

Number of the mechanical loading. This number is used to define the loadings associated with each situation (see keyword SITUATION).

6.9.2 Operand NOM_CHAR

Name of the mechanical loading (optional).

6.9.3 Operands MX/MY/MZ

```
♦   MX   =   MX,                          [R]
♦   MY   =   my,                          [R]
♦   MZ   =   mz,                          [R]
```

Generalized moments resulting from calculations of the line of piping, standard beam, for each loading.

Attention, this supposes that these values are provided in a coherent reference mark with that used for modeling 2D or 3D of the component.

6.9.4 Operands MX_CORP/MX_TUBU, MY_CORP/MY_TUBU,…

♦ MX_CORP = MXC, [R]
♦ MY_CORP = myC, [R]
♦ MZ_CORP = mzC, [R]
♦ MX_TUBU = MXT, [R]
♦ MY_TUBU = myT, [R]
♦ MZ_TUBU = mzT, [R]

Generalized moments applied to the body and the pipe of a pricking. Their significance is identical to that of the operands MX, MY,… used for the lines of piping.

6.10 Keyword RESU_THER

This keyword factor makes it possible to define the results of thermal calculations. It is répétable as many times as there are different thermal calculations.

6.10.1 Operand NUME_RESU_THER

♦ NUME_RESU_THER = numtran [I]

Number of the thermal transients. This number is used to identify the thermal transient associated with each situation (see keyword SITUATION).

6.10.2 Operand TABL_RESU_THER

♦ TABL_RESU_THER = table [tabl_post_releve]

Table resulting from POST_RELEVE_T, containing for each transitory thermal calculation, the statement of the constraints due to the thermal loading on the section of the grid 2D or 3D chosen by the user at various moments of the transient. The origin of the section must be the internal skin.

6.11 Keyword RESU_PRES (if 'ZE200b')

This keyword factor makes it possible to define the results of calculations of pressure in the form of transient. It is répétable as many times as there are different calculations of pressure when the method is used 'ZE200b'.

6.11.1 Operand NUME_RESU_PRES

♦ NUME_RESU_PRES = numtran [I]

Number of the transients of pressure. This number is used to identify the transient of pressure associated with each situation (see keyword SITUATION).

6.11.2 Operand TABL_RESU_PRES

♦ TABL_RESU_PRES = table [tabl_post_releve]

Table resulting from POST_RELEVE_T, containing for each calculation of transitory pressure, the statement of the constraints due to the loading of pressure on the section of the grid 2D or 3D chosen by the user at various moments of the transient.

6.12 Keyword EARTHQUAKE

Only one loading of the type EARTHQUAKE can be definite porR all them groupS situations.

6.12.1 Operands NUME_SITU/NOM_SITU/NB_OCCUR/NB_CYCL_SEISME

```
♦   NUME_SITU    =     numsitu,                          [I]
◊   NOM_SITU     =     nomsitu,                          [KN]
♦   NB_OCCUR     =     nbocc,                            [I]
♦   NB_CYCL_SEISME = nbsss,                             [I]
```

Number, name and many occurrences situatioN earthquake. NB_CYCL_SEISME is the number of cycles associated with each occurrence with the earthquake, considered as under-cycles in the calculation of the factor of use.

6.12.2 Operands CHAR_ETAT

```
♦   CHAR_ETAT          =     num_char_mechas ,           [L_I]
```

NRuméro DU mechanical loading (corresponding to the keyword NUME_CHAR keyword factor CHAR_MECA) associated with the situation of earthquake.

6.13 Keyword SITUATION

This keyword factor makes it possible to define the situations. It is répétable as many times as there are situations.

6.13.1 Operands NUME_SITU/NOM_SITU/NB_OCCUR

```
♦   NUME_SITU    =     numsitu,                          [I]
◊   NOM_SITU     =     nomsitu,                          [KN]
♦   NB_OCCUR     =     nbocc,                            [I]
```

Number, name and many occurrences situatioN.

6.13.2 Operand NUME_GROUPE/NUME_PASSAGE/NUME_PARTWithGE

```
♦   NUME_GROUPE =     (numgroup1, numgroup2,…) ,        [L_I]
◊   NUME_PASSAGE=     (num1, num2,…),             [L_I]
◊   NUME_PARTAGE=     num1                              [I]
```

One indicates under NUME_GROUPE Numéro(S) of group to which situation belongs.

If the situation is one situation of passage, one indicates under NUME_PASSAGE numbers of the various groups which it connects (20 groups with more).
When a situation makes the passage between N groups, it necessarily belongs to these N groups (the numbers under NUME_PASSAGE must appear under NUME_GROUPE).

Note:

> *Inversement, a situation can belong to various groups without being a situation of passage between these groups (the numbers under NUME_GROUPE are not necessarily under NUME_PASSAGE)*

If the situation belongs to a group of Partold, one indicates under NUME_PARTOLD the number of this group of division.

NoticeS :

> *No relation exists between the number of a group of operation (NUME_GROUPE) and the number of a group of division (NUME_PARTOLD)*
> *A situation can belong to the only one group of division*

6.13.3 Operand COMBINABLE

```
◊   COMBINABLE  =     /'YES ,                           [DEFECT]
```

/'NOT', [KN]

This keyword indicates if a situation is combinable with the others inside its group (case general). If COMBINABLE=' NON', that means that the situation is a under-cycle.

6.13.4 Operands PRES_A/PRES_B (if 'ZE200a')

♦ PRES_A = pressed , [R]
♦ PRES_B = presb , [R]

Pressions associated with each of the two stabilized states of the situation in method 'ZE200a'.

6.13.5 Operands CHAR_ETAT_A/CHAR_ETAT_B

♦ CHAR_ETAT_A = num_char_meca, [I]
♦ CHAR_ETAT_B = num_char_meca, [I]

NRuméro of mechanical loading associated in each stabilized state. This number corresponds to the keyword NUME_CHAR keyword factor CHAR_MECA. UN only loading mechanical is associated in each stabilized state.

6.13.6 Operand NUME_RESU_THER

◊ NUME_RESU_THER = num_tran [I]

Thermal number of transient associated with the situation. There can be 0 or 1 transient section by section of line (what corresponds to groups of meshs) for each situation. This number corresponds to the keyword NUME_RESU_THER keyword factor RESU_THER.

If for a given situation, there are physically two transients for a section, like heating-cooling for example, it is of use to combine these two transients in only one.

6.13.7 Operand NUME_RESU_PRES (if 'ZE200B')

◊ NUME_RESU_PRES = num_tran [I]

Number of transient of pressure associated with the situation if the method is 'ZE200b'. There can be 0 or 1 transient section by section of line (what corresponds to groups of meshs) for each situation. These numbers correspond to the keyword NUME_RESU_PRES keyword factor RESU_PRES.

6.13.8 Operands O_ETOILE / TABL_TEMP

◊ O_ETOILE = oet, [R]
◊ TABL_TEMP = tabtemp, [table]

These two operands are necessary for and thus of the environmental call fatigue analysis of the option 'EFAT'. For each situation, O_ETOILE represent the degree of oxygen (he is considered here constant) and TABL_TEMP is the table of the temperatures according to time during the transient.

Note:

The table under the keyword TABL_TEMP must be defined at the same moments as the thermal transient of the situation under TABL_RESU_THER.
The temperature must be imperatively defined on the nodes of the segment of analysis considered (one thus needs a column ABSC_CURV).

6.14 Keyword ENVIRONMENT

This keyword factor makes it possible to calculate the environmental resistance to fatigue. It is not répétable because indexes the data necessary to calculation but common to all the situations.

6.14.1 Operand FEN_INTEGRE

♦ FEN_INTEGRE = fenint, [R]

Integrated Fen which intervenes in the calculation of the factor of environment.

6.14.2 Operand CRIT_EPSI

♦ CRIT_EPSI = epsilim, [R]

Threshold in deformation from which the factor of environment does not intervene.

6.14.3 Operands TABL_YOUNG

♦ TABL_YOUNG = tabyoung, [table]

Young modulus according to the temperature. A linear interpolation is made starting from this table to evaluate the Young modulus who intervenes of the calculation of the factor of environment.
This table must obligatorily contain Lbe parameters of name 'TEMP' and 'YOUNG'.

6.14.4 Operands S_ETOILE

♦ S_ETOILE = set, [R]

Content of suffer analyzed metal (thus commun run with all the situations) equal to a constant.

6.14.5 Operands SEUIL_EPSI_INF/SEUIL_EPSI_SUP

♦ SEUIL_EPSI_INF = epsimin, [R]
♦ SEUIL_EPSI_SUP = epsimax, [R]

Thresholds which intervene in the calculation the speed of deformation.

6.14.6 Operands A_ENV/B_ENV/C_ENV

♦ A_ENV = aenv, [R]
♦ B_ENV = benv, [R]
♦ C_ENV = cenv, [R]

Constants which intervene in the general expression of the factor of environment.

6.14.7 Operands SEUIL_T_INF/SEUIL_T_SUP/VALE_T_INF/VALE_T_SUP/VALE_T_MOY_NUM/VALE_T_MOY_DEN

♦ SEUIL_T_INF = tempmin, [R]
♦ SEUIL_T_SUP = tempmax, [R]
♦ VALE_T_INF = valmin, [R]
♦ VALE_T_SUP = valmax, [R]
♦ VALE_T_MOY_NUM = valmoynum, [R]
♦ VALE_T_MOY_DEN = valmoyden, [R]

Thresholds which intervene in the calculation of the T* temperature.

6.15 Produced table and example

The table produced by POST_RCCM depends onOPTION of calculation and type of result requested under the operand TYPE_RESU:

- if TYPE_RESU=' VALE_MAX' (option by default): the table is simple and comprises only the maximum parameters various sizes (Sn, Sn*, Sp, Salt, Fu, Fu_environnement and sizes related to the ratchet) at the two ends
- if TYPE_RESU=' DETAILS' : the table is much richer. It comprises maximum parameters quoted previously (line 'MAXIMUM') more all calculated parameters, for each situation (lines of the type 'SITU') and each combination of situation (lines of the type 'COMB'), with or without earthquake, and the combinations which really intervened in the calculation of the factor of use (line 'FACT'). IL is then strongly recommended to print the table with successive filters so that it is easily exploitable.

  - ***Impression of the maximum one:*** if TYPE_RESU='VALE_MAX' or with a filter in IMPR_TABLE : FILTRE=_F (NOM_PARA=' TYPE', VALE_K=' MAXI'), the produced table can contain according to the option requested following parameters: SN_MAX, SN*_MAX, SIGM_M_PRES, SN_THER_MAX, CRIT_LINE_MAX, SP_THER_MAX, CRIT_PARA_MAX, SP_MAX, SALT_MAX, FU_TOTAL and FOne_TOTAL.

  - ***Impression of the sizes of each situation:*** with a filter in IMPR_TABLE :
    FILTRE= (_F (NOM_PARA=' TYPE', VALE_K=' SITU'),
    _F (NOM_PARA=' SEISME', VALE_K=' AVEC' *or* ' SANS')),
    the produced table contains according to the option requested following parameters for each situation (with or without earthquake): SNR, INST_SN_1, INST_SN_2, SN*, INST_SN*_1, INST_SN*_2, SIG_PRES_MOY, SN_THER, CRIT_LINE, SP_THER, CRIT_PARAB, SP1 (MECA), INST_SALT_1, INST_SALT_2, SALT and FU_UNIT.

  - ***Impression of the sizes of each combination of situations:*** with a filter in IMPR_TABLE :
    FILTRE= (_F (NOM_PARA=' TYPE', VALE_K=' COMB'),
    _F (NOM_PARA=' SEISME', VALE_K=' AVEC' *or* ' SANS')),
    the produced table contains according to the option requested following parameters for each one of combinations of situations (with or without earthquake): SNR, INST_SN_1, INST_SN_2, SN*, INST_SN*_1, INST_SN*_2, SIG_PRES_MOY, SN_THER, CRIT_LINE, SP_THER, CRIT_PARAB, SP1 (MECA), INST_SALT_1, INST_SALT_2, SALT and FU_UNIT.

  - ***Impression of the combinationS situations who intervened in the calculation of factor of use :*** with a filter in IMPR_TABLE :
    FILTRE= (_F (NOM_PARA=' TYPE', VALE_K='FACT'),),
    the produced table contains according to the option requested following parameters for each one of combinations of situations who intervened in the calculation of the factor of use FU_TOTAL : SNR, INST_SN_1, INST_SN_2, SN*, INST_SN*_1, INST_SN*_2, INST_SALT_1, INST_SALT_2, SALT, FU_UNIT, NOCC_PRIS, FU_PARTIEL.

If Option ' EFAT ' is called, a size is added daNS the maximum ones by report with the option 'TIREDNESS' : FUEN_TOTAL. Moreover, if TYPE_RESU=' DETAILS' , three sizes are added in the lines of the type 'FACT': FEN, FEN_INTEGRE, and FOne_PARTIAL.

For the follow-up of calculations, DES additional information can be in particular found in the file message for the option TIREDNESS. ON can thus follow at the origin then at the end of the segment : treatment of each situation then combinations of situations and the posting of the FU_TOTAL (of which the part related to the sous_cycles and the part related to the seismic sous_cycles)

S testS **rccm13a** ('ZE200a') and **rccm13b** ('ZE200b') providedSENT of the complete examples of use. For more information, one will be able to also refer to the document [U2.09.03].

7 Operands specific to the results of the type EVOLUTION

For a precise description of the calculations carried out by these options, one can consult the document [R7.04.03] and the note of use [U2.09.03].

The characteristics of materials necessary to the calculation of the criteria are to be defined by the order DEFI_MATERIAU [U4.43.01]. The computed values and the limiting values are stored in the table tabl_post_rccm, that one prints using the order IMPR_TABLE [U4.91.03].

Notice on the use DE characteristic of material according to the temperature :

> *For postprocessing, rules RCC-M B require the use of the material characteristics, like Sm, at the maximum temperature of the transients.*
>
> *The operator DEFI_MATERIAU [U4.43.01] however the definition of the material characteristics authorizes according to the temperature (keyword factor RCCM_FO).*
> *With the option ' EVOLUTION ', the user must define the material characteristics, for postprocessing, only by the keyword factor RCCM order DEFI_MATERIAU . Indeed, to use this option ' EVOLUTION ' , the user has to provide in data input only constraints, the thermal evolution being ignored even if it exists in the preceding stages of calculation.*
> *With the option ' EVOLUTION ', the use of the characteristics according to the temperature thus involves an error of execution.*

The analysis is made in postprocessing one or more thermomechanical calculations (MECA_STATIQUE, STAT_NON_LINE) on a modeling 2D or 3D. The results are transmitted via tables of constraints, extracted on the segments from analysis. These tables of constraints can be created by the orders POST_RELEVE_T or MACR_LIGN_COUPE. The possible options of calculation are:

1) criteria of level 0 by the option PM_PB ;
2) criteria of level With (except tiredness) by the option SN ;
3) criteria of tiredness (also of level With) by the option FATIGUE_ZH210 ;
4) criteria of starting in singular zones by the option STARTING.

The first three options can be called only or simultaneously. The last option can be called only: it indeed requires a statement of the constraints on a circular line of cut around the geometrical singularity, whereas the other options are dedicated to segments crossing the structure.

This option is well adapted to the cases where there are few situations to study. It is not possible to take into account situations of earthquake.

7.1.1 Operand MATER

♦ MATER = chechmate

It is the material containing the characteristics useful to POST_RCCM and definite under the keyword RCCM of DEFI_MATERIAU [U4.43.01].

Notice on the curves of tiredness:

> *For the small amplitudes of constraints, the difficulty of the prolongation of the curve of tiredness can arise: for example, for the curves of tiredness of the RCCM beyond 10^6 cycles, the corresponding constraint, 180 MPa is regarded as limit of endurance, i.e. that very forced lower than 180 MPa must produce a factor of null use, or an infinite number of cycles acceptable.*
>
> *It is pointed out that the curve of tiredness is defined in the properties material (keyword TIREDNESS/WOHLER) as being the number of cycle to the rupture according to the half-amplitude of the constraint Salt. The small amplitudes of constraints thus correspond to the*

prolongation on the left of the curve. Several situations can arise, according to the type of prolongation retained in DEFI_FONCTION :

- if PROL_GAUCHE = 'EXCLUDED' or 'CONSTANT', is calculated by supposing that the first value of the curve of Wohler provided is the limit of endurance of material. In other words, very forced alternate smaller than the first value indicated in DEFI_FONCTION will correspond to a factor of null use. The method adopted here thus corresponds well to the concept of limit of endurance;
- if PROL_GAUCHE = 'LINEAR', the curve is prolonged in a linear way. Attention, the prolongation is not done in coordinates logarithmic curve, therefore one can have considerable factors of use even for the low values of Salt. To return to the concept of limit of endurance, it is then recommended to add in the definition of the curve the number of acceptable cycles for a very low value of Salt (calculated with the hand for example by interpolation with a law power).

7.1.2 Operand SY_MAX

◊ SY_MAX = symax,

Conventional limit of elasticity for the maximum temperature reached during the cycle. This operand is used only for the calculation of the thermal ratchet (cf § 7.1.4.2). If elastic limit SY_MAX is not defined, one takes the value defined under the operand SY_02 keyword RCCM in DEFI_MATERIAU [U4.43.01]; if this operand is not either defined, the calculation of the thermal ratchet is impossible.

7.1.3 Option PM_PB

Option allowing to calculate the criteria of level 0 who aim at securing the material against the damage of excessive deformation, plastic instability and elastic and elastoplastic instability. These criteria require the calculation of the equivalent constraints of membrane *Pm*, of membrane local *Pl*, of inflection *Pb* and of membrane plus inflection *Pm+Pb*.

The operands necessary are MATER, the table of the constraints TABL_RESU_MECA (built by POST_RELEVE_T or MACR_LIGN_COUPE after mechanical calculation on the place of post - treatment) and possibly the table of the constraints TABL_SIGM_THER built starting from a calculation with the thermal loading only.

The points of calculation are the two ends of the segment of analysis. If several segments of extraction were used to define the same table of constraints, calculation is done successively for each one of them.

The limiting values are Sm and 1,5*Sm, Sm being the working stress function of material and temperature, given by the keyword SM keyword RCCM in DEFI_MATERIAU [U4.43.01].

Note:

The calculation of PM and PMPB is only done starting from the primary constraints, therefore except constraints of thermal origin. If TABL_SIGM_THER is informed, one supposes that the result indicated in TABL_RESU_MECA corresponds to a thermomechanical calculation and one thus withdraws the thermal stresses to him. If only TABL_RESU_MECA is informed, calculation is done directly starting from the constraints indicated in the table.

7.1.4 Option SN

Option allowing to calculate the criteria of level With (except tiredness) which aims at securing the material against the damage of progressive deformation. They require the calculation of the amplitude of variation of constraint linearized in a point, noted *Sn*.

If the user asks it (presence of the operand TABL_SIGM_THER) one carries out also the calculation of Sn*.

If the user asks it (presence of the operands TABL_SIGM_THER and TABL_RESU_PRES) one carries out also the calculation of the thermal ratchet.

The operands necessary are MATER and the table of the constraints TABL_RESU_MECA (built by POST_RELEVE_T or MACR_LIGN_COUPE after mechanical calculation on the place of post - treatment) to inform in the keyword TRANSIENT.

The points of calculation are the two ends of the segment of analysis. If several segments of extraction were used to define the same table of constraints, calculation is done successively for each one of them.

The value limits *Sn* is 3*Sm, Sm being the working stress function of material and temperature, given by the keyword SM keyword factor RCCM in DEFI_MATERIAU [U4.43.01].

Note:

The keyword TABL_RESU_MECA can be repeated several times under only one keyword TRANSIENT. For the calculation of Sn and Sn, there will be however no combination between the situations thus defined: each table of constraints will be treated successively.*

7.1.4.1 Calculation of Sn*

If the operand TABL_SIGM_THER keyword factor TRANSIENT is present, one carries out also the calculation of *Sn**.

It is necessary, so that calculation is coherent and in conformity with the RCC-M, that constraints provided in TABL_SIGM_THER were obtained with a thermal loading only, knowing that the result given by TABL_RESU_MECA can be due to a combination of this thermal loading with other loadings. It is necessary thus that the moments of the table TABL_SIGM_THER correspond to those of the table TABL_RESU_MECA.

7.1.4.2 Calculation of the thermal ratchet

If operands TABL_SIGM_THER and TABL_RESU_PRES keyword factor TRANSIENT are present, one carries out also the calculation of the thermal ratchet. For that, it is also necessary beforehand to have defined the conventional limit of elasticity for the maximum temperature reached during the cycle is by the operand SY_MAX of POST_RCCM; maybe by the operand SY_02 keyword RCCM in DEFI_MATERIAU [U4.43.01]. If no elastic limit is defined, the calculation of the thermal ratchet is impossible.

It is necessary, so that calculation is coherent and in conformity with the RCC-M, that constraints provided in TABL_RESU_PRES were obtained with a direct loading of compression.

In table result appear, for each end of each segment of analysis, the limit elastic SY, the amplitude of variation of the thermal constraint of origin SP_THER, the maximum of general membrane stress due to the pressure SIGM_M_PRES and two acceptable values maximum of the amplitude of variation of the thermal stress calculated either by supposing a linear temperature variation in the wall (VALE_MAXI_LINE), that is to say by supposing a parabolic temperature variation in the wall (VALE_MAXI_PARAB).

7.1.5 Option FATIGUE_ZH210

Option allowing to calculate the factor of use resulting from the combination of one or more transients, according to the method of the additional RCC-M ZH210.

The amplitude of variation of constraint in each end of the segment of analysis is calculated starting from the tables of constraints TABL_RESU_MECA, for each combination of moments belonging to (X) transitory (S) definite (S) by the user. Then one applies a method of combination and office plurality to obtain the factor of total use, cf [R7.04.03].

The moments corresponding to the extreme states must be specified by the user by the operands NUME_ORDRE, INST or LIST_INST.

Note:

The keyword TABL_RESU_MECA can be repeated several times under only one keyword TRANSIENT . For the fatigue analysis, the results contained in each table of constraints will be combined between them.

*For the operands NUME_ORDRE, INST or LIST_INS, a possible confusion is the use of the list of the moments of thermomechanical calculations (MECA_STATIQUE, STAT_NON_LINE)) instead of the list of the moments corresponding **with the extreme states** waited by operator POST_RCCM. In the first case, every moment of calculations is then regarded as extrema of constraints and leads to computing times which can be important.*

7.1.6 Option STARTING

Option allowing to calculate the factor of starting on the level of a singular zone. For this option, the constraints are to be provided as starter in the table TABL_SIGM_THETA and must correspond to the extraction of the constraints, in local reference mark, on a circular line of cut of diameter D_AMORC (parameter material defined in the RCC-M) around the geometrical singularity. The tables of constraints can be created by using the operator MACR_LIGN_COUPE (TYPE=' ARC').

For this option, it is also obligatory to define in the properties materials (keyword RCCM) coefficients of the law of starting (A_AMORC and B_AMORC), the diameter of the circle on which the constraints are extracted (D_AMORC) and the coefficient between constraint and effective constraint (R_AMORC).

7.2 Operand TYPE_KE

```
◊  TYPE_KE  =  / 'KE_MECA',          [DEFECT]
               / 'KE_MIXTE'
```

The elastoplastic factor of correction That can be calculated in two ways [R7.04.03]:

- KE_MECA : it is the original method, only available in the previous versions to version 7.2;
- KE_MIXTE : this method breaks up the amplitude of variation of the alternating loads into a thermal part and a mechanical part. It is authorized since the modifying 1997 of the RCC-M.

7.3 Keyword TRANSIENT

This keyword factor makes it possible to define it (or them) transitory (S) to study.

7.3.1 Operand ENTITLE

Allows to give a name to the transient. This name will be displayed in the produced table.

7.3.2 Operand TABL_RESU_MECA

```
◊  TABL_RESU_MECA  =  tabmeca
```

Table of the constraints on the segment of analysis, built for example by POST_RELEVE_T or MACR_LIGN_COUPE starting from mechanical results of type evol_elas and evol_noli.

7.3.3 Operand TABL_SIGM_THER

```
◊  TABL_SIGM_THER = tabth
```

Table of the constraints on the segment of analysis, built for example by POST_RELEVE_T or MACR_LIGN_COUPE on a result got with a thermal loading only. This keyword allows in particular the calculation of Sn* [§7.1.4.1].

7.3.4 Operand TABL_SIGM_THETA

◊ TABL_SIGM_THETA = sigt

This operand is to be used only in the case of the option STARTING [§7.1.6]. It corresponds to the table of the constraints, in local reference mark, on a circular line of cut around the geometrical singularity. The table must obligatorily comprise the columns ANGLE, ABSC_CURV, INST and SIZZ, where SIZZ corresponds to the constraint sigma_thêta_thêta in the local reference mark of the line of cut. The diameter of the circle on which the constraints are extracted is a parameter material (operand D_AMORC of DEFI_MATERIAU/RCCM)

Such a table can be built using the operator MACR_LIGN_COUPE (TYPE=' ARC', REPERE=' CYLINDRIQUE').

7.3.5 Operand TABL_RESU_PRES

◊ TABL_RESU_PRES = tabpres

Table of the constraints on the segment of analysis, built for example by POST_RELEVE_T or MACR_LIGN_COUPE on a result got with the direct loading of compression. This keyword allows the calculation of the thermal ratchet [§7.1.4.2].

7.3.6 Operand NB_OCCUR

◊ NB_OCCUR = / nocc,
/ 1, [DEFECT]

Many occurrences for the calculation of the factor of use.

7.3.7 Operands TOUT_ORDRE / INST / LIST_INST / PRECISION / CRITERION

◊ TOUT_ORDRE, INST, LIST_INST

These keywords allow the selection of the moments corresponding to the fields gathered in the tables of constraints tabmeca, HT and /ou sigp under the reference symbols previously specified.

◊ PRECISION, CRITERION

Keywords (optional) defining the precision (10^{-6} by default into relative) and the search criterion (RELATIVE by default) of a sequence number starting from a value of moment.

7.4 Production run

It is checked that the moments of calculation of the table tabth are identical to those of the table tabmeca. On the other hand, one cannot check only the thermal transients which contributed to the mechanical results tabth and tabmeca are identical. It is to the user to ensure coherence (including on the data materials).

Note:

SI the various provided tables as starter comprise the coordinates of the points, of the checks of coherences are carried out: alignment of the points (for the options PM_PB, SN and FATIGUE_ZH210) or diameter of the circular line of cut (option STARTING); checking of coherence enters the various situations.
It is thus strongly recommended not to remove the coordinates of the points in the tables of statements of constraints.

7.5 Example of use

An example of use of the operator POST_RCCM with results of the type EVOLUTION can be found in the case test **rccm01**.

A calculation of the criteria of the RCCM proceeds in the following way:

1) definition of the parameters of material and the curve of tiredness,
2) definitions of the mechanical and thermal loadings,
3) linear thermomechanical calculation or not linear,
4) (if calculation of Sn*) mechanical calculation with thermal loading only,
5) (if calculation of the thermal ratchet) mechanical calculation with direct compression,
6) definition of the segment of analysis and extraction of the results with POST_RELEVE_T or MACR_LIGN_COUPE,

then (possibly in continuation):

```
SN1=POST_RCCM (MATER=MAT,
               TYPE_RESU=' VALE_MAX',
               TYPE_RESU_MECA=' EVOLUTION',
               OPTION=' SN',
               TITRE=' SN, RESULT: RESU2b WITH RESUTH',
               TRANSITOIRE=_F (TABL_RESU_MECA = T_RESU2b,
                               TABL_SIGM_THER = T_RESUTHb,)
               )

IMPR_TABLE (TABLE = sn1)
```

An example of use of the operator POST_RCCM with results of the type EVOLUTION for the option STARTING can be found in the case test **rccm09**.

For more information, one will be able to refer to the documents [U2.09.03] and [R7.04.03].

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