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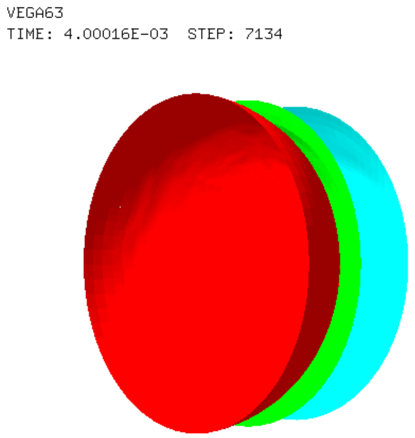
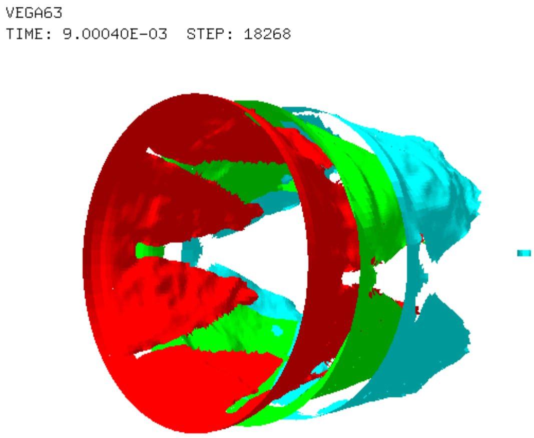
2018





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JRC112052

EUR 29259 EN

PDF ISBN 978-92-79-86762-0 ISSN 1831-9424 doi:10.2760/5627

Luxembourg: Publications Office of the European Union, 2018

How to cite this report: Casadei F., Larcher M., Valsamos G., Aune V., *A solution mapping algorithm in EUROPLEXUS*, EUR 29259 EN, ISBN 978-92-79-86762-0, doi:10.2760/5627, PUBSY No. 112052

A solution mapping algorithm in EUROPLEXUS

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May 20, 2018

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1 Introduction

This report presents the implementation in the EUROPLEXUS code of the possibility of storing a solution for later re-mapping it as initial conditions for a subsequent simulation.

EUROPLEXUS [1] (also abbreviated as EPX) is a computer code jointly developed by the French Commissariat à l'Energie Atomique (CEA DMT Saclay) and by EC-JRC. The code application domain is the numerical simulation of fast transient phenomena such as explosions, crashes and impacts in complex three-dimensional fluid-structure systems. The Cast3m [2] software from CEA is used as a pre-processor to EPX when it is necessary to generate complex meshes.

The interest for a general solution re-mapping algorithm in a code such as EPX is evident, since such an algorithm would allow to perform complex simulations that would be impossible or impractical (e.g. due to high CPU cost) to carry out as a monolithic calculation.

A fully general remapping algorithm may be extremely complex to set up, especially in a code such as EPX which contains a lot of complicated models and modelling possibilities. However, even a more modest algorithm with some limitations could be very useful in practice.

The present work was stimulated by the collaboration between JRC and NTNU about the simulation of complex shock tube experiments performed in a dedicated facility in Trondheim. A shock tube is a very long facility consisting of three main parts: *i*) a driver section, which is initially pressurized and contains also some firing chambers separated by membranes; *ii*) the shock tube proper, consisting of a rather long (~16 m) constant-section rigid-wall tube where the shock wave is formed and propagated; and *iii*) the test section, where the specimen to be studied under shock loading is placed.

A typical experiment may take about 30 ms to release and propagate the shock wave until it reaches the specimen, which thereafter fails in just one or two ms. Thus, in a monolithic simulation the majority of the CPU time would be spent in the first (and less interesting, albeit fundamental) phase of the calculation. Hence the idea of splitting the simulation into two parts.

During systematic test campaigns, often the first phase (wave generation and transmission) is kept constant, and only the specimen is changed. It is therefore a waste of CPU time to repeat the full simulation for each experiment. The transmission phase is independent of the particular specimen chosen and may (should in fact) be simulated only once. The mapping algorithm should then be able to store the solution at the end of the transmission phase. Then, the solution would be mapped on the same *or on a different* mesh as initial condition for a subsequent simulation where a specific test specimen is inserted. The mapping strategy then consists of two parts:

- A command to generate and store the map file during the first simulation.
- A command to read back the previously stored map file and to use as initial conditions for a subsequent simulation.

The two commands are described in the next Section.

It should be noted that prior to this work EPX already offered a mapping technique called "blast mapping" and represented by the `MAPB` command described in [3]. The two mapping strategies are similar (they both involve two phases) but the MAPB command is dedicated to the particular case of 1D to 2D or 1D to 3D mapping under *perfectly spherical* blast conditions (in the first phase.) Therefore, only a 1D solution may be used in the current implementation of the MAPB command.

The present MAPP command is potentially more general since it allows mapping from a full 3D model, although with some limitations in this first implementation (see Section 2.3). Hopefully the present mapping model will become more (if not fully) general in forthcoming developments.

2 Mapping commands

We now describe the newly developed commands for the mapping.

2.1 The ECRI FICH MAPP directive

The new command to generate the map file is part of the ECRI directive:

```
ECRI ... FICH <FORM> <SPLI> MAPP <nmapp> OBJE /LECT/ /CTIM/
```

- The optional FORM keyword creates a formatted (ASCII) map file, instead of the default unformatted (binary) map file.
- The optional SPLI keyword splits the map file into several files in case the map has to be written at more than one time station. Such files are automatically named <basename>_0001.map, <basename>_0002.map etc., where <basename> is the base name of the EPX input file.
- The optional nmapp is the number of the logical unit of the map file or the file name in quotes. If omitted, the program chooses a file name by default. The default extension is .MAP.
- The OBJE keyword introduces the list of elements (specified by the following /LECT/) whose solution must be stored on the map file for subsequent mapping on an equivalent (or a different) mesh.
- Finally, the /CTIM/ directive allows to choose the time station(s) at which the mapping file should be produced.

2.2 The INIT MAPP directive

The new command to read back a map file and to use it for initialization of the second calculation is part of the INIT directive:

```
INIT ... MAPP <FORM> <nmapp> <MATC> OBJE /LECT/
```

- The optional FORM keyword specifies that the map file is formatted (ASCII.) By default, an unformatted (binary) map file is assumed.
- The optional nmapp is the number of the logical unit of the map file or the file name in quotes.
- The optional MATC keyword declares (under the user's responsibility) that the target object perfectly matches the source object, i.e. that the two objects are composed by the same elements and by the same nodes (albeit perhaps with different element and node indexes.) This option greatly facilitates and speeds up the solution mapping (since it requires no interpolation, but only a relatively simple search) and should be used whenever appropriate.
- The OBJE keyword introduces the list of elements (specified by the following /LECT/) of the current model onto which the solution from the map file should be mapped.

2.3 Limitations

Although it has been designed for full generality, the mapping algorithm is subjected to some limitations in its current implementation:

- The mapping can only affect the *fluid* sub-domain. In other words, both the *source* object and the *target* object must be composed exclusively of fluid Finite Elements and of fluid Finite Volumes of the CCFV family, i.e. cell-centred finite volumes. No node-centred Finite volumes (of the NCVF family) and no structural elements are treated at the moment. Both 2d-3D and 1D VFCCs are allowed in the same calculation.

- The nodes of the two objects must be Eulerian (i.e., fixed in space).

- The spatial dimension of the two objects must be the same.

At least some of these limitations will be progressively removed as part of forthcoming developments.

3 Implementation notes

The new generic mapping algorithm is mainly implemented in a new module M_MAPPING. Besides the usual "service" routines typical of any module (initialization and destruction of the data structure, reading of the input commands, etc.) the module features three main routines:

- WRITE_MAPPING generates and writes the mapping file during the first run. This routine is called from IMPSOR (or from IMPSOR_MPI in parallel calculations.)

- READ_MAPPING reads back the mapping file and stores it in a dedicated data structure which will then be used in the initialization phase of the calculation, after the entire input data set has been read. This routine is called from INIT, the routine which reads the `INIT` (initial conditions) directive.

- APPLY_MAPPING uses the previously read back mapping data to (re-)initialize the starting conditions for the second run. This routine is called by INITIA.

One of the major tasks of the mapping strategy is to search for a correspondence between the mesh used in the first run (more precisely, the part of that mesh stored in the map file), called the *source mesh*, and the mesh used in the second run (again, the part of that mesh that the user declares as affected by the mapping), or *target mesh*.

3.1 Data structure

The data structure, besides some scalars, consists mainly of a series of arrays. We will refer to these as either *non-flattened* or *flattened* arrays. A non-flattened array refers to the original numbering of elements and nodes in the corresponding mesh (of either the first or a subsequent run.) Since the data concern only a subset of the meshes, non-flattened arrays typically contain *holes* in their numbering. A flattened array, instead, refers only to the subset of elements and nodes used for the mapping and therefore contains no holes.

The most important non-flattened arrays are:

- MAP_FROM(1:N_MAP_FROM) contains the list of the N_MAP_FROM elements forming the source mesh (original numbering in the first simulation.)

- MAP_TO(1:N_MAP_TO) contains the list of the N_MAP_TO elements forming the target mesh (original numbering in the second simulation.)

- VFCC_MAP_FROM(1:N_VFCC_MAP_FROM) contains the list of the N_VFCC_MAP_FROM VFCCs in the source mesh (original numbering in the first simulation.)

- VFCC_1D_MAP_FROM(1:N_VFCC_1D_MAP_FROM) contains the list of the N_VFCC_1D_-MAP_FROM one-dimensional VFCCs (1D-VFCCs) in the source mesh (original numbering in the first simulation.)
- VFCC_MAP_TO(1:N_VFCC_MAP_TO) contains the list of the N_VFCC_MAP_TO VFCCs in the target mesh (original numbering in the second simulation.)
- VFCC_1D_MAP_TO(1:N_VFCC_1D_MAP_TO) contains the list of the N_VFCC_1D_MAP_TO one-dimensional VFCCs (1D-VFCCs) forming the source mesh (original numbering in the second simulation.)

The most important flattened arrays are:

- MAP_NUMN(:) contains the connectivity (list of the nodes) of the N_MAP_FROM elements forming the source mesh.
- MAP_INDOX(1:N_MAP_FROM,1:3) contains the characteristics of the N_MAP_FROM elements forming the source mesh.
- MAP_XINIT(1:MAP_IDIM,1:N_NMAP_FROM) contains the initial coordinates of the nodes forming the source mesh.
- MAP_POSECR(1:N_MAP_FROM) contains the pointer into the internal variables of the elements forming the source mesh.
- MAP_ECR(:) contains the list of the internal variables of the elements forming the source mesh.

Other important arrays are:

- IN_SOURCE_ELEM(1:N_MAP_TO) contains the correspondence between the target and the source elements. That is, IN_SOURCE_ELEM(I) is equal to IEL_LOC (ranging from 1 to N_MAP_FROM) if the I-th target element centroid lies within the IEL_LOC-th source element. Otherwise, IN_SOURCE_ELEM(I) is equal to 0 (no correspondence) and an error message is raised if the `MATC` keyword was specified.
- IN_SOURCE_ELNOD(1:N_NMAP_TO) contains the correspondence between the target and the source nodes. That is, IN_SOURCE_ELNOD(J) is equal to IND_LOC (ranging from 1 to N_NMAP_FROM) if the J-th target node lies "exactly" (within a tiny tolerance) on the IND_LOC-th source node. It is equal to −IND_LOC (from −N_MAP_FROM to −1) if the J-th target node does not lie on any source node but it lies within the IND_LOC-th source *element* (an error message is raised if the `MATC` keyword was specified.) Otherwise, IN_SOURCE_ELNOD(J) is equal to 0 (no correspondence) and an error message is raised if the `MATC` keyword was specified.

3.2 Fast search of the mapping correspondence

The search for correspondence used to build up the data structure described in the previous paragraph is performed by a fast algorithm (bucket sorting.) The search algorithm is implemented in module M_FAST_SEARCH_GENERIC, which uses module M_MINMAXCOOR_GENERIC to build up the bounding box and the centroid of the elements involved.

The difference between M_MINMAXCOOR and M_MINMAXCOOR_GENERIC is that the former operates on all elements of the current mesh while the second operates only on the set of elements specified by the programmer when invoking the module's services, and is therefore more flexible.

The fast search grid is built automatically and in the current implementation no parameters associated to this grid are accessible to the user via input commands.

Note that all correspondences are established based on the *initial* configuration of both the source (MAP_XINIT) and the target (XINIT) mesh. The distinction between initial and current positions is irrelevant as long as all nodes involved are Eulerian (fixed in space), as it is assumed in the current implementation. However, this might become important when this limitation is removed in a forthcoming development.

4 Numerical examples

In this Section we present some numerical examples illustrating the use of the mapping algorithm.

4.1 Simple 2D tests

We start by some simple 2D academic examples just to test the correctness of the mapping algorithm in cases with matching meshes. The calculations performed are summarized in Table 1.

Test name	Comments	Final time [ms]	Steps	CPU [s]
MAPP00	Reference solution, monolithic run	80.0	69	0.05
MAPP01	First run, write map file at 50 ms	80.0	69	0.06
MAPP02	Second run, read map file at 50 ms	80.0	27	0.05
MAPP03	First run, add leading element	80.0	69	0.05
MAPP04	Second run, add trailing element	80.0	27	0.05
MAPP05	Second run, random numbering	4.0	2	0.00
MAPP06	Second run, random numbering	4.0	1	0.03

Table 1: Simple 2D numerical simulations.

4.1.1 Case MAPP00

This test is a simple ideal shock tube, discretized by 100 VFCCs in 2D (Q4VF elements), as shown in Fig. 1. The mesh definition is intentionally embedded in the EPX file so that the numbering of elements and nodes is perfectly regular.

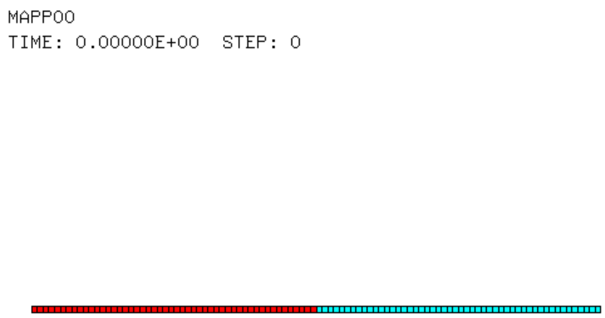
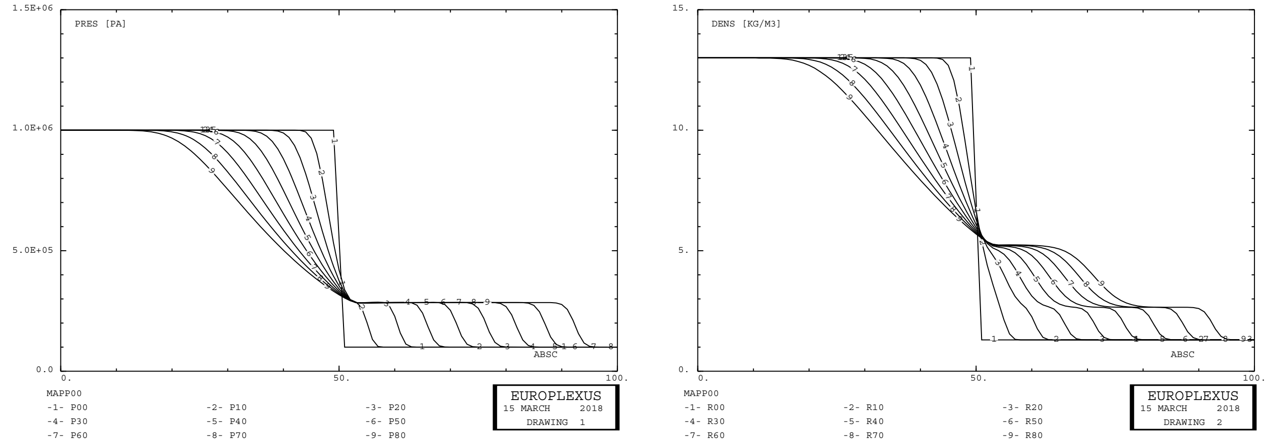


Figure 1: Geometry of test case MAPP00.

The results of this calculation will be used as a reference solution for the subsequent simulations using the mapping algorithm. The results in terms of fluid pressure and fluid density, represented by spatial distributions along the tube every 10 ms until 80 ms, are shown in Fig. 2.

Note that in this calculation, as well as in the following ones for this Section, the `OPTI STEP IO` command [1] is specified in the input file. This produces outputs (in particular the `ALIC` output file used for the post-processing) at the precisely chosen time stations (in this case exactly each 10.0 ms) rather than at approximate times. The code slightly adapts the time step in order to exactly the chosen time stations exactly. This will allow a perfectly accurate comparison of results (and the



(a) Fluid pressure

(b) Fluid density

Figure 2: Results of test case MAPP00.

detection of any bugs) in the following examples using the mapping. Note, however, that in practical large applications using the mapping algorithm, this the `STEP IO` option would not be strictly needed.

4.1.2 Case MAPP01

This is the first run of a simulation with mapping. The input is exactly the same as for the reference case MAPP00 but we add the request for the creation of a map file at 50.0 ms:

```
ECRI VFCC TFRE 10.E-3
     FICH ALIC TFRE 10.E-3
     FICH FORM MAPP OBJE LECT tous TERM TIME PROG 50.E-3 TERM
```

The map file will be formatted (`FORM`) and will use the default name (here `mapp01.map`.) All the elements in this mesh, in this case all 100 VFCCs, will be stored in the map file.

Results of this calculation (up to 80 ms) are identical to those of the reference case MAPP00, of course, and are not shown for brevity. The only difference with respect to MAPP00 is that a map file `mapp01.map` is written on the current directory. The contents of the map file (a pure text file in this case) is similar to the following snippet:

```
EUROPLEXUS GENERIC MAP FILE GENERATED ON 15/03/2018
STEP        42 TIME  5.000000000000E-02
IDIM         2
N_MAP_FROM :        100 LEN_NUMN :        400
   ELEMENT TYPE MTYP / NODES
         1  132    9
         1         2        103        102
         2  132    9
         2         3        104        103
         3  132    9
         3         4        105        104
 . . .
IEL:        100 IVFCC        100
  1.000000000000E+00  1.000000000000E+00  1.000000000000E+00  0.000000000000E+00
  1.797693134862+302  1.000000000000E+00
    4 SOL_UCONS_VFCC
  1.300000000000E+00  0.000000000000E+00  0.000000000000E+00  2.487562189055E+05
    0 SOL_UCONS_OLD_VFCC
    4 SOL_UCONS_INT_VFCC
  0.000000000000E+00  0.000000000000E+00  0.000000000000E+00  0.000000000000E+00
    0 UTRANS_VFCC
    0 UFLUID_VFCC
    1 UDEP_VFCC
  1.000000000000E+05
    0 UPRIM_VFCC
    0 SOURCE_VFCC
    0 T_UCDS
    0 RESI_VFCC
N_VFCC_1D_MAP_FROM :          0
```

4.1.3 Case MAPP02

This is the second run of a simulation with mapping. We use exactly the same mesh (same elements and nodes, same numbering) as in case MAPP01 for simplicity in this first example. The `INIT MAPP` command is used to read back the map file:

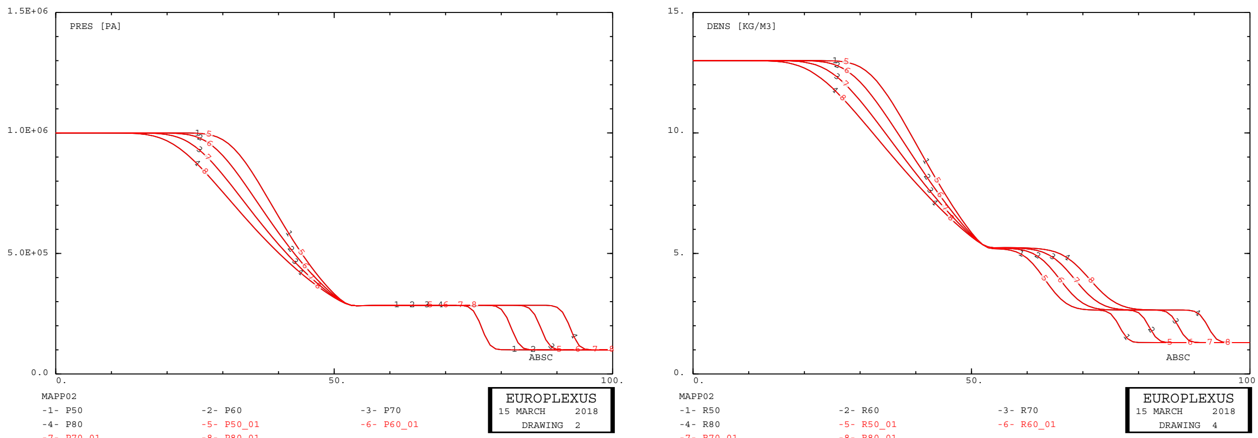
```
INIT MAPP FORM 'mapp01.map' MATC OBJE LECT tous TERM
```

We must declare the map file as formatted here (`FORM`) and specify its name (`'mapp01.map'`), otherwise the name by default would be used (`'mapp02.map'`), which does not exist. As target mesh we declare all elements, for simplicity in this first example.

Note that we declare that the target mesh matches the source mesh (`MATC` keyword.) The code then assumes that to each target element there must correspond one and only one source element (the comparison is based upon the positions of the element centroids), and that to each target node there must correspond one and only one source node (the comparison is based upon the positions of the nodes.) The node and element connectivity, i.e. the actual numbering of nodes and elements, *can be different* in the two meshes. A small tolerance is used in comparing centroid and node positions because, when using a formatted map file, the source coordinates cannot be transferred with full (double) precision via the map file. The tolerance used is 10 times the smallest real (Fortran single precision) number that can be represented by the machine, which should roughly corresponds to 6 significant digits on most computer architectures.

The code reads back the map file, sets the initial time of the calculation to the value (50.0 ms) that has been found on this file (thus overriding the `TINI` value contained in the EPX input file), maps the source solution from the map file to the target as "initial" conditions and then performs the simulation until the chosen final time of 80.0 ms.

The results of this calculation (black curves) are compared in Fig. 3 against the results of case MAPP01 (red curves), for the time instants between 50.0 and 80.0 ms (since, obviously, only these instants are available in the results file of the second run), showing excellent agreement. Each couple of curves is perfectly superposed so that only the red curves are visible.



(a) Fluid pressure

(b) Fluid density

Figure 3: Comparison of results of tests MAPP01 and MAPP02 for $t \geq 50$ ms.

4.1.4 Cases MAPP03 and MAPP04

These calculations are a repetition of cases MAPP01 and MAPP02, respectively, where we use a slightly different mesh. In case MAPP03 we add a leading node and a leading element (a fake PMAT) while in case MAPP04 we add a trailing node and a trailing element (also a fake PMAT.) In this way, the numbering of both elements and nodes is altered with respect to the previous cases, while still conserving perfect geometrical matching of the source and target meshes in terms of coordinates.

In the first run we must identify the fluid zone, that we want to use for the mapping (we can no longer use `tous` to choose all elements):

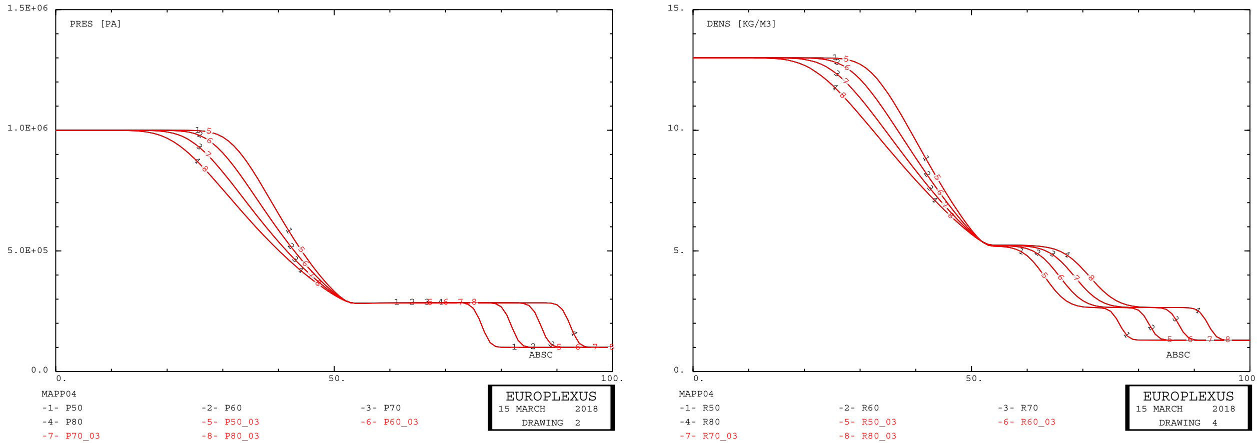
```
COMP GROU 4 'pm' LECT  1          TERM
            'hp' LECT  2 PAS 1  51 TERM
```

```
            'lp' LECT 52 PAS 1 101 TERM
            'fl' LECT  2 PAS 1 101 TERM
 . . .
ECRI VFCC TFRE 10.E-3
     FICH ALIC TFRE 10.E-3
     FICH FORM MAPP OBJE LECT fl TERM TIME PROG 50.E-3 TERM
```

And similarly in the second run we have:

```
COMP GROU 4 'hp' LECT   1 PAS 1  50 TERM
            'lp' LECT  51 PAS 1 100 TERM
            'fl' LECT   1 PAS 1 100 TERM
            'pm' LECT 101           TERM
 . . .
INIT MAPP FORM 'mapp03.map' MATC OBJE LECT fl TERM
```

The two solutions are compared in Fig. 4 and are in excellent agreement.



(a) Fluid pressure

(b) Fluid density

Figure 4: Comparison of results of tests MAPP03 and MAPP04 for $t \geq 50$ ms.

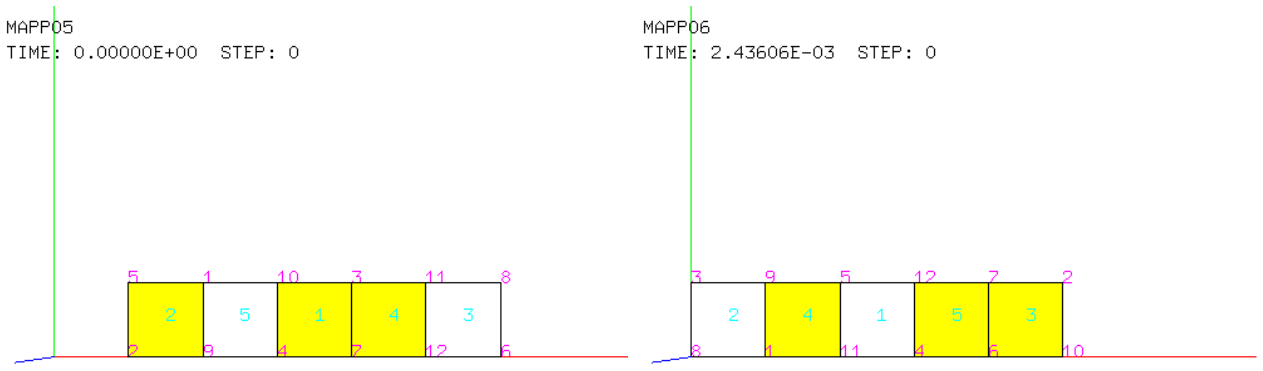
4.1.5 Cases MAPP05 and MAPP06

These tests use an extremely simple mesh with only 5 Q4VF VFCCs. However, the two meshes are spatially "offset" with respect to each other by one element, so that only four of the elements in each mesh do have a matching element in the other mesh. In addition, the connectivity (i.e. the numbering of nodes and elements) is completely random and different in the two cases. The models are shown in Fig. 5, including also the reference frame in order to highlight the offset between the two meshes.

The complete input files are compared side by side below:

```
MAPP05
ECHO
!CONV WIN
DPLA EULE
GEOM LIBR POIN 12 Q4VF 5 TERM
 2 1  1 0  4 1  3 0  1 1  6 0
 4 0  6 1  2 0  3 1  5 1  5 0
 7 3 10 4
 1 5 2 9
 12 6 8 11
 3 7 12 11
 9 4 10 1
COMP GROU 2 'hp' LECT 5 2 TERM
            'lp' LECT 4 3 1 TERM
    COUL ROUG LECT hp TERM
         TURQ LECT lp TERM
MATE GAZP RO 13. PINI 1.E6 GAMM 1.402 PREF 1.E5
              CV 713.3
              LECT hp TERM
    GAZP RO 1.3 PINI 1.E5 GAMM 1.402 PREF 1.E5
              CV 713.3
              LECT lp TERM
ECRI ECRO VFCC FREQ 1
    FICH FORM MAPP OBJE LECT 4 1 2 TERM NUPA LECT 1 TERM
```

```
OPTI NOTE LOG 1
    VFCC FCON 6
CALC TINI 0. TFIN 1.0 NMAX 2
FIN
MAPP06
ECHO
!CONV WIN
DPLA EULE
GEOM LIBR POIN 12 Q4VF 5 TERM
 1 0  5 1  0 1  3 0  2 1  4 0
 4 1  0 0  1 1  5 0  2 0  3 1
 4 12 5 11
 3 8 1 9
 6 10 2 7
 5 9 1 11
 7 12 4 6
COMP GROU 2 'hp' LECT 4 2 TERM
            'lp' LECT 5 3 1 TERM
    COUL ROUG LECT hp TERM
         TURQ LECT lp TERM
MATE GAZP RO 13. PINI 1.E6 GAMM 1.402 PREF 1.E5
              CV 713.3
              LECT hp TERM
    GAZP RO 1.3 PINI 1.E5 GAMM 1.402 PREF 1.E5
```



(a) Case MAPP05 (b) Case MAPP06

Figure 5: Models of tests MAPP05 and MAPP06.

```
         CV 713.3
         LECT 1p TERM
INIT MAPP FORM 'mapp05.map' MATC OBJE LECT 5 4 3 TERM
ECRI ECRO VFCC FREQ 1
OPTI NOTE LOG 1
     VFCC FCON 6
CALC TINI 0. TFIN 1.0 NMAX 1
FIN
```

Note that the two objects (source and target) used for the mapping involve only three of the four "common" elements to the two meshes. These are the elements highlighted in yellow in Fig. 5. Since these two mesh portions are fully matching as far as concerns the element centroids and the nodal coordinates (albeit with completely different numberings) we can still declare the target mesh as matching (MATC keyword.)

After running the two tests, it is verified that the source solution (which had been stored at step 1) is correctly mapped onto the target mesh.

4.2 Simple 3D tests

We now consider some simple 3D academic examples. The problem studied is the ideal shock tube already considered in Section 4.1. The calculations performed are summarized in Table 2.

Test name	Comments	Final time [ms]	Steps	CPU [s]
MAPP09	Reference solution, monolithic run	80.0	70	0.08
MAPP07	First run, write map file at 50 ms	80.0	70	0.09
MAPP08	Second run, read map file at 50 ms	80.0	27	0.05

Table 2: Simple 3D numerical simulations.

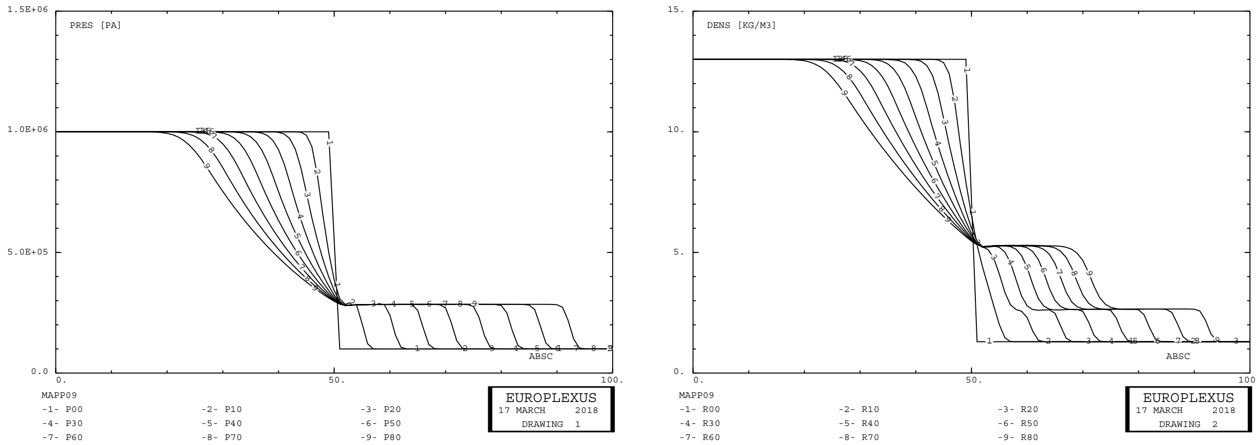
4.2.1 Case MAPP09

This is the monolithic 3D solution of the shock tube problem, using 100 8-node CUVF finite volumes. In addition to the change in spatial dimension (from 2 to 3), another difference of this test with respect to case MAPP00 is that here we use a full second-order in space and time solution for the VFCCs, while in case MAPP00 it was a first-order in space and time solution:

```
OPTI NOTE STEP IO LOG 1
     VFCC FCON 6
```

```
ORDR 2 ! order in space
OTPS 2 ! order in time
RECO 1
```

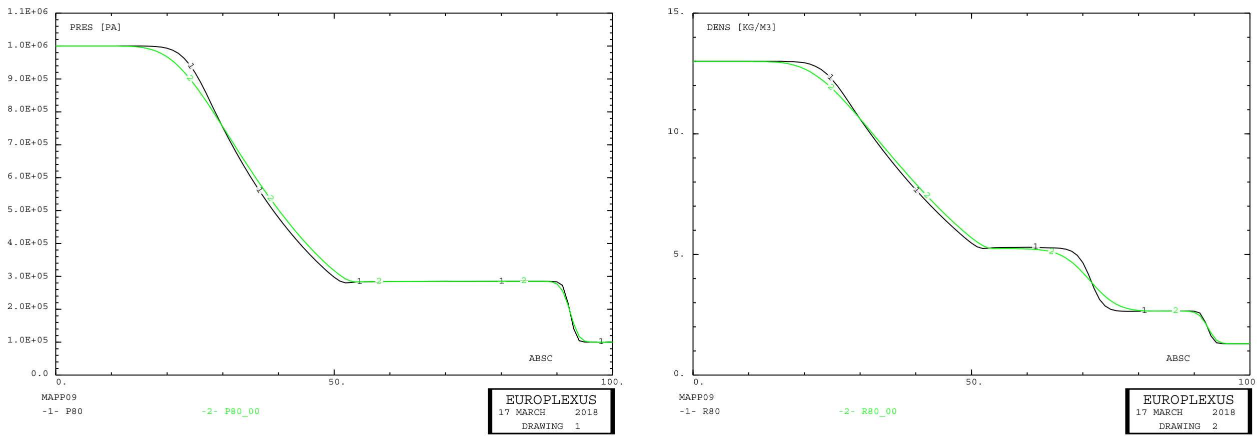
The results in terms of fluid pressure and fluid density, represented by spatial distributions along the tube every 10 ms until 80 ms, are shown in Fig. 6.



(a) Fluid pressure (b) Fluid density

Figure 6: Results of test case MAPP09.

Fig. 7 compares the solutions MAPP00 and MAPP09. The change in spatial dimension has no effect (as verified on other occasions) so the differences are due to the second order scheme used in the latter solution.



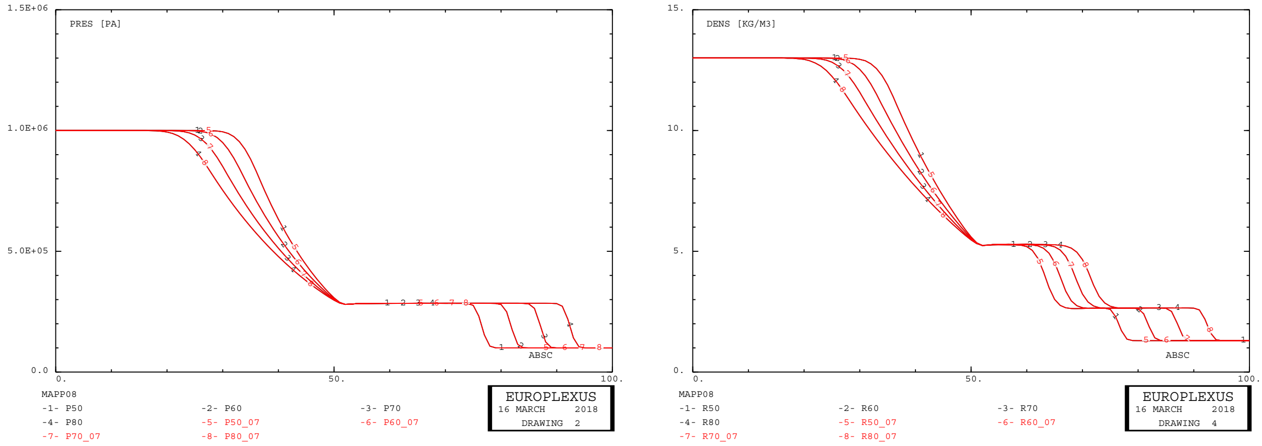
(a) Fluid pressure (b) Fluid density

Figure 7: Comparison of results of test case MAPP00 (first order) and MAPP09 (second order).

4.2.2 Cases MAPP07 and MAPP08

These tests show the split solution of the 3D shock tube problem (first and second run, respectively.) The results of test MAPP07 are of course identical to those of test MAPP09 (since we have only added the creation of the map file at 50 ms) and are not shown for brevity.

The results of case MAPP08 (black curves) are compared in Fig. 8 against the results of case MAPP07 (red curves), for the time instants between 50.0 and 80.0 ms, showing excellent agreement: the curves are superposed and only the red ones are visible.



(a) Fluid pressure (b) Fluid density

Figure 8: Comparison of results of tests MAPP07 and MAPP08 for $t \geq 50$ ms.

4.3 Simple 1D tests

We now consider some simple 1D academic examples equivalent to the 2D examples presented in Section 4.1. The calculations performed are summarized in Table 3.

Test name	Comments	Final time [ms]	Steps	CPU [s]
MAPP10	Reference solution, monolithic run	80.0	69	0.05
MAPP11	First run, write map file at 50 ms	80.0	69	0.06
MAPP12	Second run, read map file at 50 ms	80.0	27	0.05
MAPP17	First run, second order	80.0	69	0.03
MAPP18	Second run, second order	80.0	27	0.03

Table 3: Simple 1D numerical simulations.

4.3.1 Case MAPP10

This is a monolithic run, equivalent to case MAPP00 presented previously but busing the 1D mesh (100 TUVF volumes) shown in Fig. 9.

The results obtained are shown in Fig. 10 and are practically identical to those obtained in 2D, see Fig. 2.

4.3.2 Cases MAPP11 and MAPP12

These tests are similar to cases MAPP01 (first run) and MAPP02 (second run), respectively, but use the same 1D mesh as case MAPP10. Inputs (apart from the mesh definition) are practically identical to those of tests MAPP01 and MAPP02 and are not commented for brevity.

The results of tests MAPP11 (in red) and MAPP12 (in black) for $t \geq 50$ ms are compared in Fig. 11, showing excellent agreement (red curves superposed to the black curves).

4.3.3 Cases MAPP17 and MAPP18

These tests are similar to cases MAPP11 (first run) and MAPP12 (second run), respectively, but use second order in space and time finite volumes, like in cases MAPP07 and MAPP08.

No separate monolithic solution is previously obtained, unlike in previous examples. In fact, the solution MAPP17 is pursued until the final time of 80.0 ms and can be considered as a monolithic solution (reference), with the only addition of the creation of a map file which, as verified in the previous examples, has no influence on the solution itself. The results for $t \geq 50$ ms are compared in Fig. 12, showing excellent agreement (superposed red and black curves).

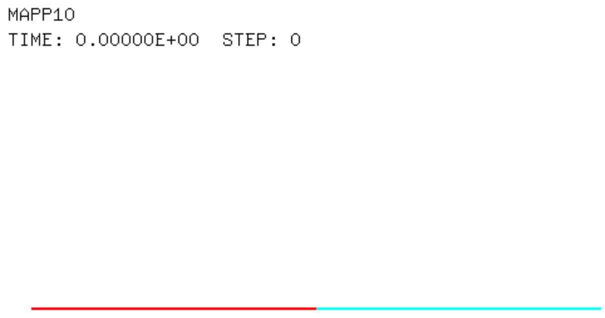
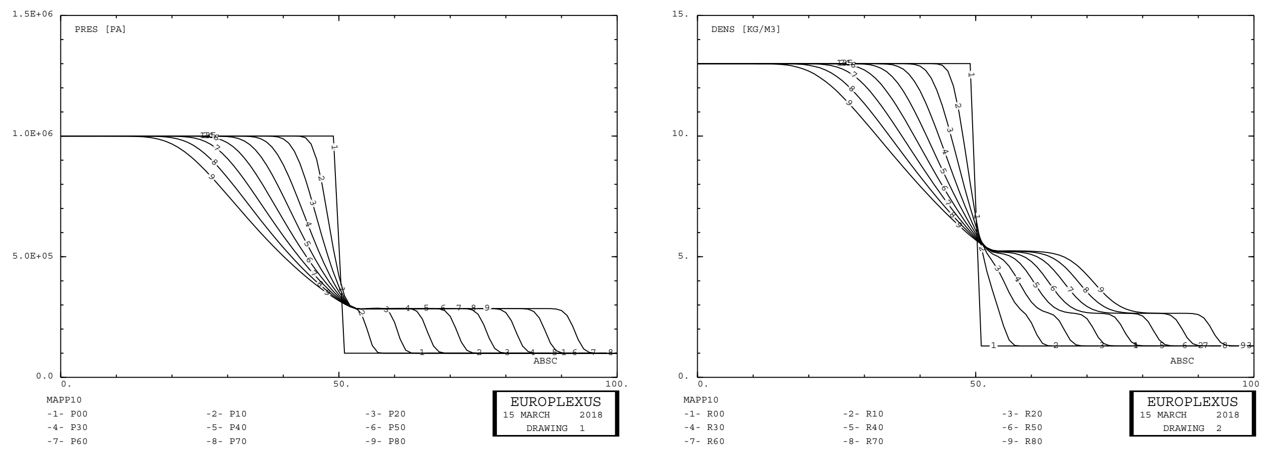


Figure 9: Geometry of test case MAPP10.



(a) Fluid pressure

(b) Fluid density

Figure 10: Results of test case MAPP10.

By comparing the results of case MAPP17 (second order) against those of case MAPP11 (first order), one can see no differences. In fact, it turns out [1] that, at the moment of this writing, *second order in space and in time is not currently implemented in 1D VFCCs*, so the `ORDR` and `OTPS` optional keywords are simply ignored by any 1D-VFCCs present in a calculation (however, these options do have an effect on 2D-3D VFCCs).

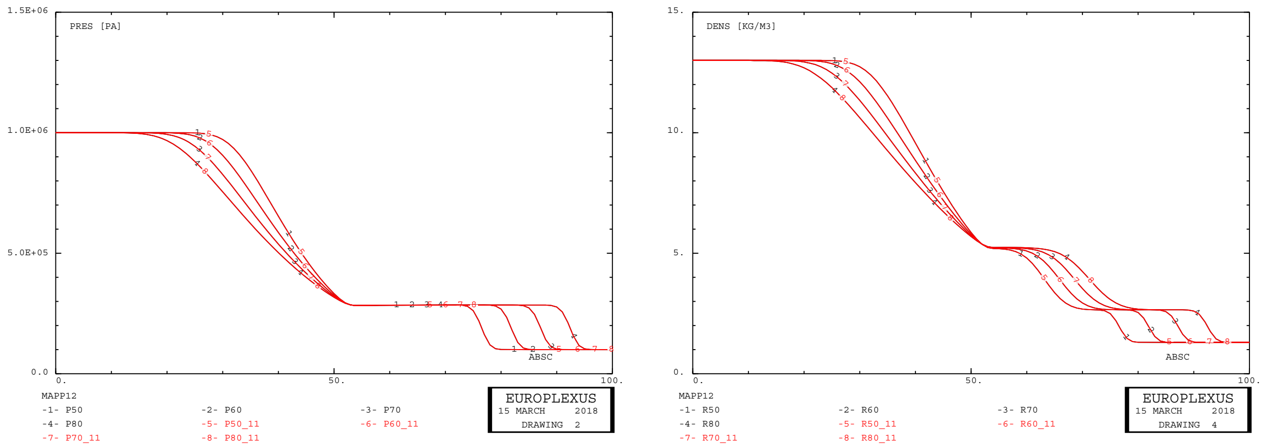
4.4 Simple combined 1D/3D tests

We now want to perform some simple tests containing a mixture of 3D and 1D finite volumes, which is more general and complex than having only either of the two types of volumes in a calculation. This will be also the case in the target NTNU shock tube applications.

The calculations performed are summarized in Table 4.

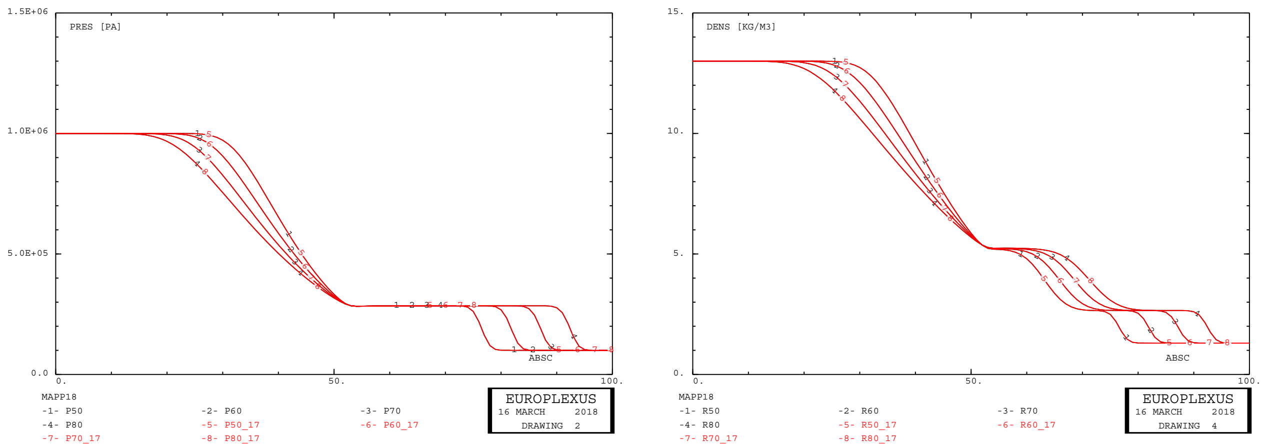
4.4.1 Case MAPP20

This test is inspired by case 1D3D14 of reference [4]. A shock tube is modelled, from left to right, by a 3D part (1200 CUVF), followed by a 1D part (1000 TUVF), followed again by a 3D part (1000



(a) Fluid pressure (b) Fluid density

Figure 11: Comparison of results of tests MAPP11 and MAPP12 for $t \geq 50$ ms.



(a) Fluid pressure (b) Fluid density

Figure 12: Comparison of results of tests MAPP17 and MAPP18 for $t \geq 50$ ms.

Test name	Comments	Final time [ms]	Steps	CPU [s]
MAPP20	Reference solution, monolithic run	20.0	1898	16.9
MAPP21	First run, write map file at 10 ms	20.0	1898	17.1
MAPP22	Second run, read map file at 10 ms	20.0	950	8.7

Table 4: Simple 1D/3D numerical simulations.

CUVF), as shown (not in scale) in the scheme of Fig. 13. All elements have a uniform size of 1 cm.

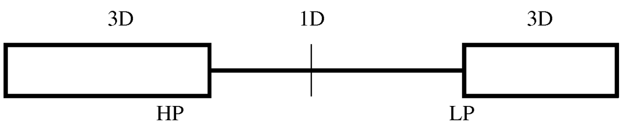
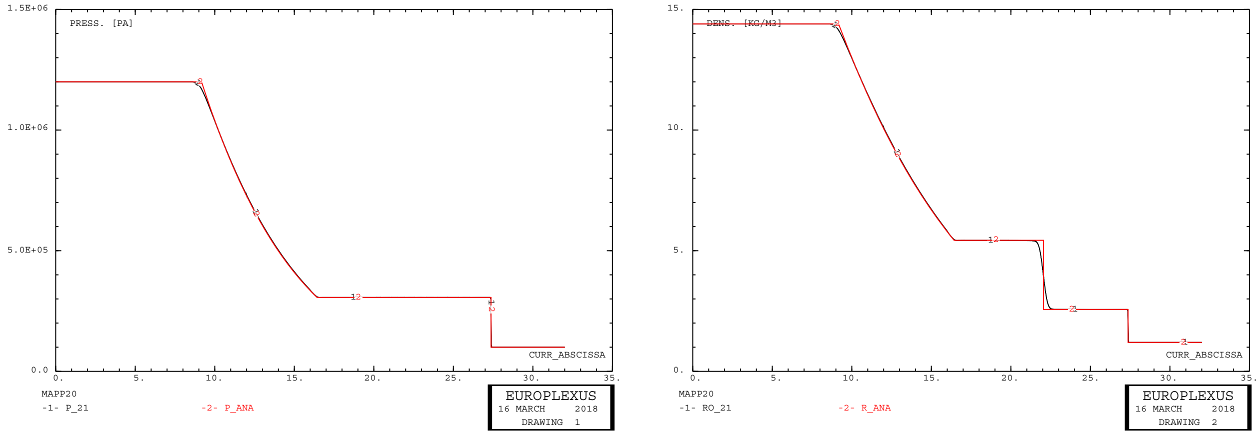


Figure 13: Mixed 1D-3D model used in test case MAPP20.

In order to connect the various parts of the model, two TUBM elements are used at the junctions between zones of different spatial dimension, see [4] for details. Unlike all previous test cases, the mesh is generated by Cast3m. This can at times lead to a pseudo-random numbering of elements and (in particular) of nodes. It is important to check that the mapping algorithm works well under such conditions.

In this test we obtain a monolithic solution, identical to that of [4], to serve as a reference. The solution in terms of pressure and density distributions along the tube at the final chosen time of 20.0 ms is presented in Fig. 14. The black curves are the numerical results and the red curves are the analytical solutions, which are also shown for comparison.



(a) Fluid pressure (b) Fluid density

Figure 14: Results of test case MAPP20.

4.4.2 Case MAPP21

This test is the first run of a split calculation. The input is identical to that of case MAPP20 but we add the request to generate a map file at 10 ms:

```
ECRI ECRO VFCC TFRE 1.E-3
!    NOPO NOEL
     FICH ALIC TFRE 1.E-3
     FICH FORM MAPP OBJE LECT hp3d lp3d hp1d lp1d TERM
          TIME PROG 10.E-3 TERM
```

Note that we specify both the 3D VFCCs (`hp3d`, `lp3d`) and the 1D VFCCs (`hp1d`, `lp1d`) in the `OBJE` definition, but we tentatively do *not* include the junction (*raccord*) elements TUBM. It will have to be verified *a posteriori* that this has no effect on the (second run) solution and is therefore actually unnecessary.

The results of this calculation are (obviously) identical to those of case MAPP20 and are not shown for brevity.

4.4.3 Case MAPP22

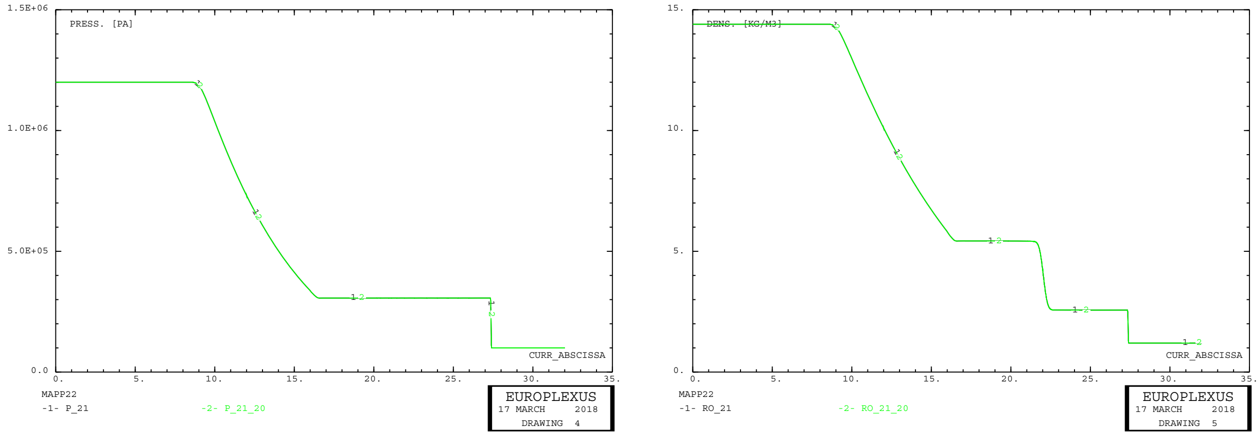
This is the second run. Again, the input is identical to that of case MAPP20 except for the command which triggers re-initialization from the map file:

```
INIT MAPP FORM 'mapp21.map' MATC OBJE LECT hp3d lp3d hp1d lp1d TERM
```

The results of this test (black curves) at the final time $t = 20.0$ ms are compared in Fig. 15 against those obtained in test MAPP21 (green curves), showing excellent agreement. This confirms that, indeed, *it is not necessary to include the junction elements* TUBM in the mapping file.

4.5 3D tests

We now consider tests involving a slightly more complex geometry than a simple shock tube. The calculations performed are summarized in Table 5.



(a) Fluid pressure (b) Fluid density

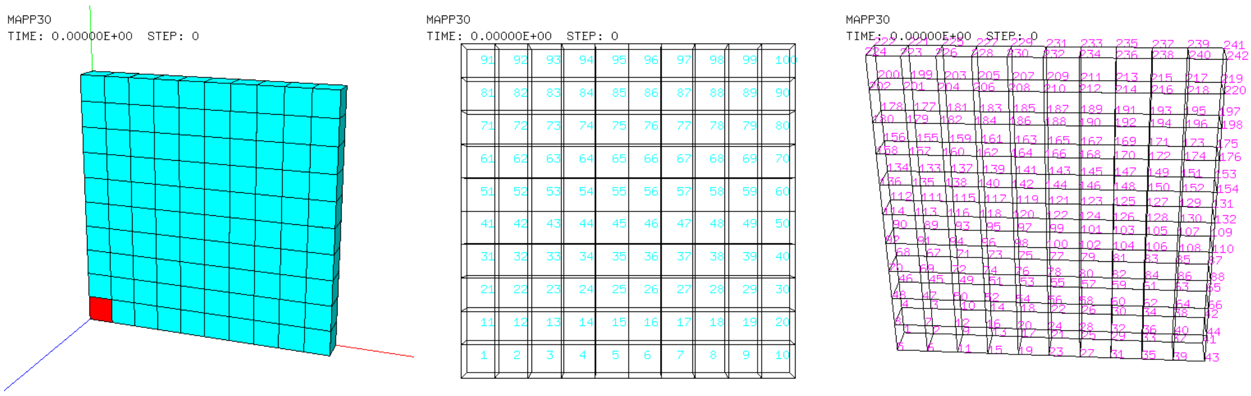
Figure 15: Comparison of results of tests MAPP21 and MAPP22 at $t = 20$ ms.

Test name	Comments	Final time [ms]	Steps	CPU [s]
MAPP30	Reference solution, monolithic run	30.0	49	0.08
MAPP31	First run, write map file at 3 ms	30.0	4	0.02
MAPP32	Second run, read map file at 3 ms	30.0	45	0.09

Table 5: More complex 3D numerical simulations.

4.5.1 Case MAPP30

This test studies an explosion in a square parallelepiped of fluid measuring $10 \times 10 \times 1$ units. This first run is used to obtain the monolithic reference solution and uses the complete model, shown in Fig. 16. The explosive (in red) is located at one corner of the fluid domain, whose walls are considered as rigid.

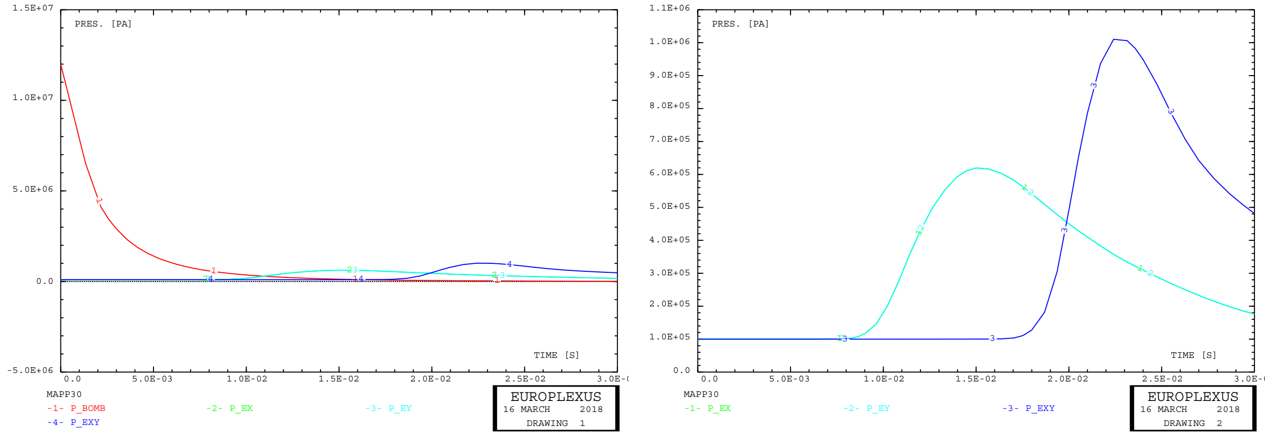


(a) Mesh (b) Elements (c) Nodes

Figure 16: Geometry for test case MAPP30.

The fluid pressure is recorded at the four corners of the fluid domain. They are shown in Fig. 17. The left part of the Figure shows all four pressure records. In the right part of the Figure, the bomb pressure record is removed so that the scale is more adequate for the other records.

From this solution, and also by visualizing pressure distributions at the various time steps (not shown for brevity), we find out that until 3.0 ms (step number 4 in this simulation) the perturbation caused by the bomb explosion remains confined within the "inner" $5 \times 5 \times 1$ sub-domain of the parallelepiped, that is the left-bottom quadrant of the parallelepiped, containing the bomb. The fluid conditions in the rest of the fluid domain are still completely unperturbed at this time.



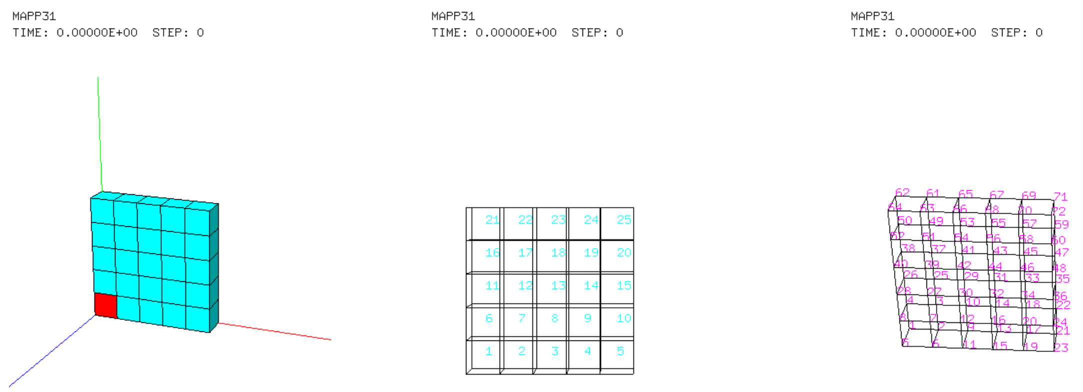
(a) All sensors (b) Without bomb sensor

Figure 17: Fluid pressures in tests MAPP30.

4.5.2 Case MAPP31

This is the first run of a split simulation. The mesh, shown in Fig. 18, includes only the left-bottom quadrant of the parallelepiped, containing the bomb. A map file is written at 3.0 ms and then the simulation is stopped. The entire fluid domain (i.e. the entire $5 \times 5 \times 1$ units fluid block) is designated as the source object for the mapping.

The mesh is generated by Cast3m and therefore the numbering of elements and nodes is substantially random, and radically different from the one (also made by Cast3m) of test MAPP30.



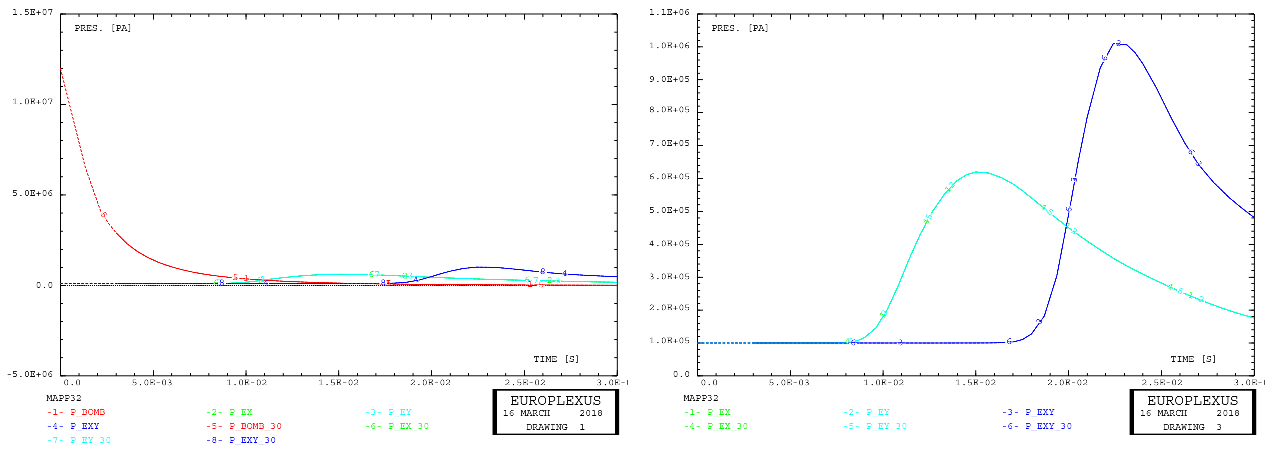
(a) Mesh (b) Elements (c) Nodes

Figure 18: Geometry for test case MAPP31.

4.5.3 Case MAPP32

This is the second part of the split run. The mesh includes the entire $10 \times 10 \times 1$ fluid domain, like in the monolithic solution MAPP30. The map file from the previous simulation is read back and used to re-initialize the solution (at $t = 3.0$ ms) in the $5 \times 5 \times 1$ fluid sub-domain. The calculation is then continued until 30 ms.

The results of this simulation (solid curves) are compared to those of the monolithic solution MAPP30 (dashed curves) in Fig. 19. They are virtually superposed, thus confirming the correct performance of the split solution strategy in this example.



(a) All sensors (b) Without bomb sensor

Figure 19: Comparison of results of tests MAPP30 and MAPP32.

4.6 NTNU shock tube tests

We will now apply the mapping model to some more realistic tests simulating the actual NTNU shock tube and described in reference [5]. In fact, the main goal of the present work was to provide a way to speed up and rationalize sets of parametric calculations like the ones presented in [5], by means of a calculation splitting technique. The calculations performed are summarized in Table 6.

The first two cases (VEGA51 and VEGA52) follow the same procedure used in the previous academic tests: a first complete monolithic run to obtain a complete reference solution and to produce a map file at an intermediate time, followed by a second run starting from the map file and computing the solution until the final time. This procedure allows thorough comparison of results and validation of the mapping technique, but is penalizing in terms of CPU time.

The second set of simulations (VEGA61 and VEGA62) illustrates a more typical and more CPU-efficient way of using the mapping technique in real practice. The first run uses only (the strictly necessary) part of the complete model, produces a map file at a certain intermediate time and then stops immediately. The second run uses the part of the complete model necessary for the second phase (which is different from the one used in the first phase), reads back the map file and runs the simulation until the final time. So, neither calculation ever computes the complete model that would be used in a monolithic simulation (such as VEGA51). Also, the time intervals of the two parts of the simulation are completely disjoint.

Test name	Comments	Initial time [ms]	Final time [ms]	Steps	CPU [s]
VEGA51	Reference solution, monolithic run	0.0	40.0	110 451	155 354
VEGA52	Second run, from map file	28.0	40.0	85 196	107 151
VEGA61	First run, write map file at 28 ms	0.0	28.0	23 627	20 389
VEGA62	Second run, read map file at 28 ms	28.0	40.0	85 196	107 365
VEGA53	Same as 51 but no `STEP IO`	0.0	10.0	22 271	41 325
VEGA63	Same as 61 but no `STEP IO`	0.0	10.0	20 322	20 023

Table 6: NTNU shock tube simulations.

4.6.1 Case VEGA51

This is a monolithic simulation in order to obtain a complete reference solution. The test is inspired by case VEGA45 of reference [5]. The mesh is identical to that of case VEGA45 and, as concerns the EPX input file, the following minor modifications are applied:

- The final time of the simulation is reduced from 80 ms to 40 ms.

- Fewer printouts and ALIC storages are requested.
- The STEP IO option is activated in order to achieve exact storage times (for an exact verification of the mapping).
- The production of a map file is requested at $t = 28$ ms:

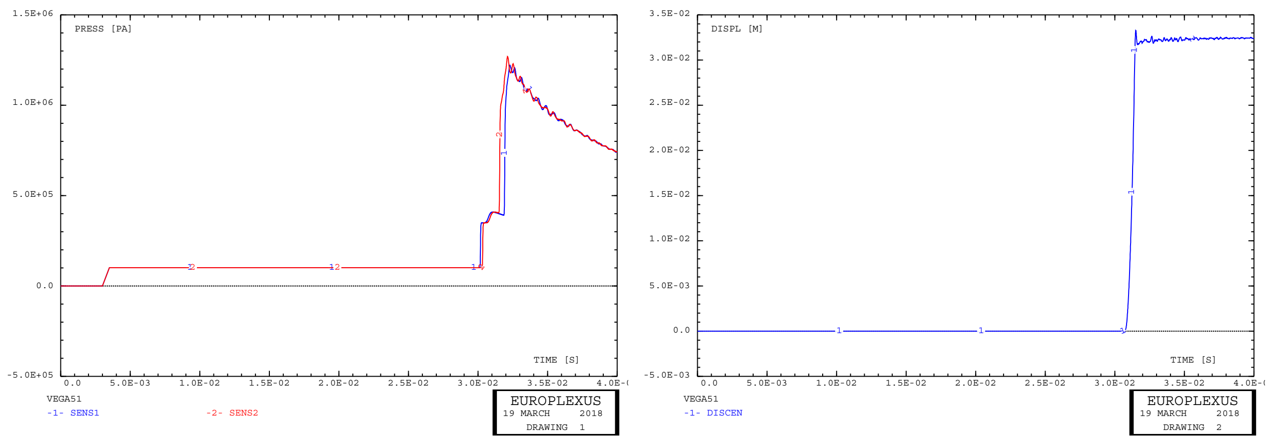
```
ECRI . . .
     FICH FORM MAPP OBJE LECT flui3d tubelp1 TERM
                    TIME PROG 28.0E-3 TERM
```

Based on results of the previous calculation VEGA45 of reference [5], we verified that at the chosen time for the map file creation ($t = 28$ ms) the shock wave has not yet reached the end of the 1D part of the shock tube model. The fluid in the 3D test region of the device and the specimen are still at complete rest at this time. So, as a general rule, the model part to be chosen for the mapping (flui3d and tubelp1) should contains all the parts of the model (more precisely, of the fluid model) that have been perturbed at the chosen mapping time.

A very important condition to be verified is that, at the moment of writing the mapping, the concerned parts of the model (here flui3d and tubelp1) are not currently in a refined adaptive state. In fact this first implementation of the mapping model cannot deal with adapted meshes.

More precisely, the mapped model parts may have been subjected to adaptivity at earlier (or later) times (and this is indeed the case for the fluid near the membranes in the present example), but *the mesh must be in a completely un-refined state when the map file is written.* This condition is satisfied in the present example because we completely erode the membranes (more precisely, the still surviving membrane fragments) at $t = 10$ ms by the OPTI FANT directive and, as a consequence, the fluid in the mapped part of the device is guaranteed to be completely un-refined at $t = 28$ ms when writing the map file.

Some results of this calculation are presented next. Fig. 20(a) shows the fluid pressures at sensors S1 and S2, while Fig. 20(b) shows the central displacement of the plate.



(a) Fluid pressures

(b) Plate displacement

Figure 20: Results of test VEGA51.

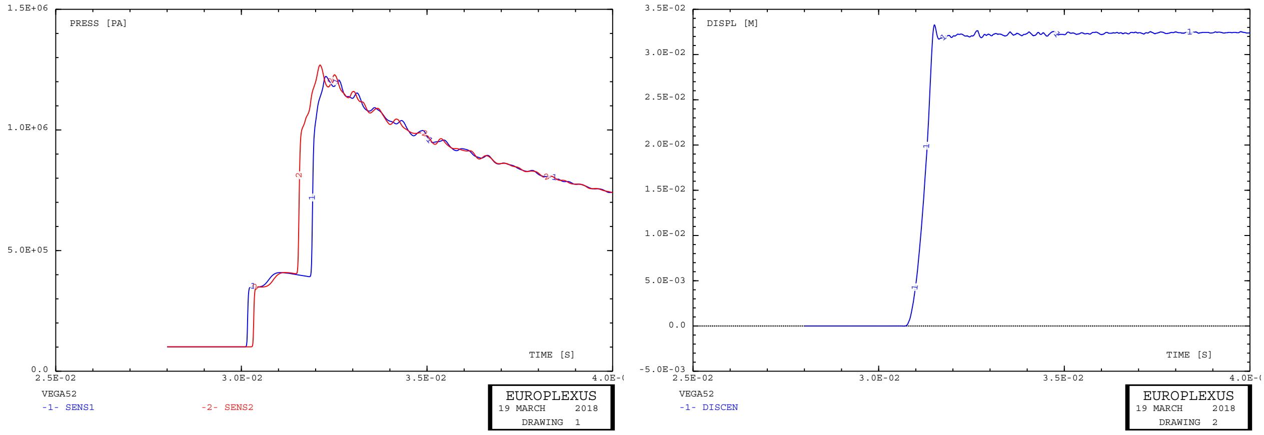
4.6.2 Case VEGA52

This test is a second calculation starting from the map file produced by test VEGA51 at $t = 28.0$ ms. The mesh file is the same as in case VEGA51 (complete model) but we remove (Gibiane oubl command) the membranes (mems), the associated pressure elements (pre) and any related models both from the Cast3m input file:

```
 . . .
opti echo 1;
opti rest form 'vega33.msh';
rest form;
list;
*
oubl mesh;
oubl pre;
oubl pre3;
oubl pre2;
oubl pre1;
oubl mems;
oubl mem3;
oubl mem2;
oubl mem1;
oubl mesh1;
*
list;
mesh = spec et devi et stub3d et rac3d1d et pface3d et face3d et
       flui3d et bout et fond;
tass mesh noop;
 . . .
```

and from the EPX file. Note also how the `mesh` object is reconstructed from the remaining parts.

Some results of this calculation are presented next. Fig. 21(a) shows the fluid pressures at sensors S1 and S2, while Fig. 21(b) shows the central displacement of the plate.

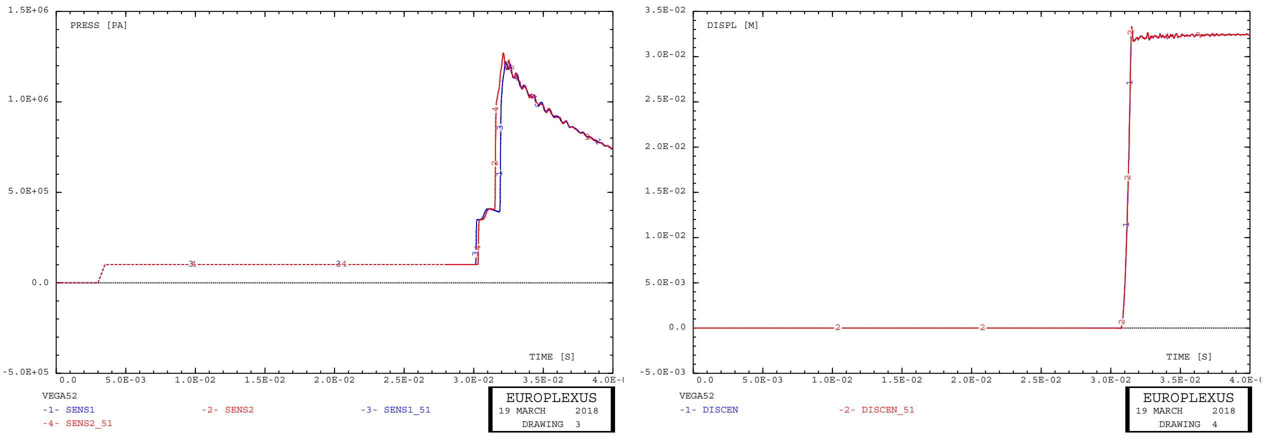


(a) Fluid pressures

(b) Plate displacement

Figure 21: Results of test VEGA52.

Fig. 22 compares the results of cases VEGA51 (dashed lines) and VEGA52 (solid lines). The curves are superposed so we may conclude that the mapping algorithm works well in this case. Fig. 23 presents the same comparison, but over a much shorter time window (between 28 and 33 ms), so as to better appreciate the correctness of the results.



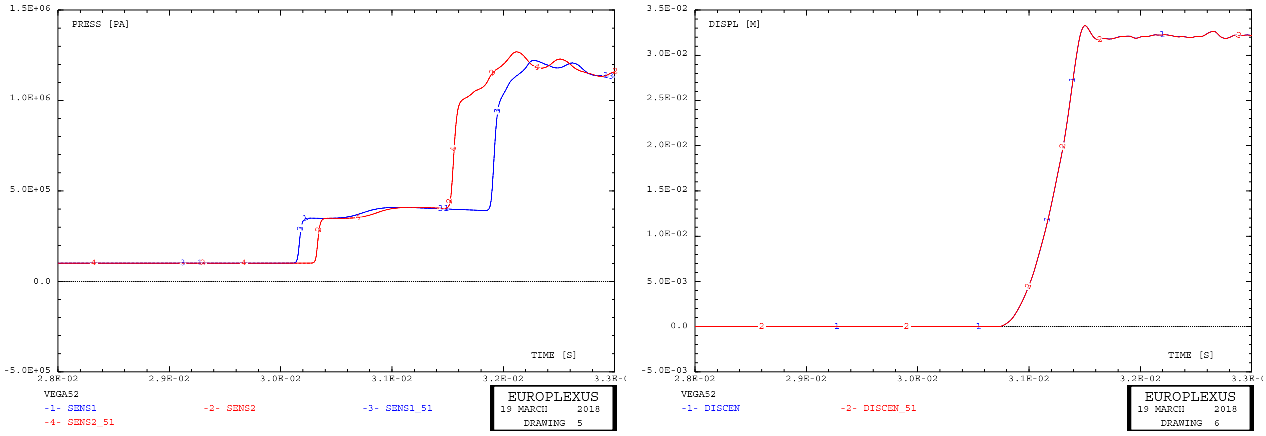
(a) Fluid pressures

(b) Plate displacement

Figure 22: Comparison of results of tests VEGA51 and VEGA52.

4.6.3 Case VEGA61

This is a first run of the shock tube problem where, for efficiency, we include only the driver, the firing sections with the membranes, and the entire 1D part of the tube. The test section is not present. We



(a) Fluid pressures

(b) Plate displacement

Figure 23: Comparison of results of tests VEGA51 and VEGA52 (zoom).

write a map file at $t = 28$ ms and then we immediately stop the calculation.

The mesh is similar to that of test case VEGA51 but we remove (`OUBL` Gibiane command) all the unnecessary geometrical objects definitions:

```
opti rest form 'vega33.msh';
rest form;
list;
oubl mesh;
oubl spec;
oubl etri3;
oubl equa4;
oubl epri6;
oubl ecub8;
oubl nplate;
oubl presur;
oubl lframeb;
oubl preplat;
oubl plate;
oubl uframe;
oubl devi;
oubl flui;
oubl tube;
oubl raclp;
oubl tubelp;
oubl tubelp3;
oubl abso;
oubl tank;
*
oubl stub3d;
oubl mesh1;
oubl pface3d;
oubl bout;
oubl fond;
oubl p13d;
oubl py;
oubl pz;
*
list;
mesh = flui3d et tubelp1 et rac3d1d et face3d et mems et pre;
tass mesh noop;
opti sauv form 'vega61.msh';
sauv form mesh;
*
opti trac psc ftra 'vega61_mesh.ps';
trac cach mesh;
*
fin;
```

The EPX input file is also simpler than that of case VEGA51. Note the command to produce the map file:

```
VEGA61
ECHO
!CONV win
CAST mesh
TRID ALE
EROS 1.0
DIME ADAP NPOI 100000
          Q4GS 20000
          CUVF 150000
          NVFI 200000
          CL3D 20000
          NPIN 20000
     ENDA
     JONC 475 ! Total n. of nodes in a TUBM juncton
     NALE 1 NBLE 1
     TERM
GEOM Q4GS mems
     CUVF flui3d
     TUVF tubelp1
     CL3D pre face3d
     TUBM rac3d1d
TERM
COMP EPAI 1.50E-3 LECT mems TERM
     DIAM DROI 0.1692568 LECT tubelp1 TERM
     RACC TUBM LECT rac3d1d  TERM
          NTUB LECT p1a    TERM DTUB 0.1692568
          FACE LECT face3d TERM COEF 1.0
     GROU 4 'fcoup1' LECT flui3d TERM
                     COND XB GT -16.405
                     COND XB LT -16.005
           !'S1' LECT tube TERM COND NEAR POIN -0.345 0.15 0.15
           !'S2' LECT tube TERM COND NEAR POIN -0.245 0.15 0.15
            'epar1' LECT tubelp1 TERM COND NEAR NODE LECT p1a TERM
            'epar2' LECT tubelp1 TERM COND NEAR NODE LECT p1d3 TERM
            'tubelpp' LECT tubelp1 DIFF epar1 epar2 TERM
     NGRO 7 'nmemi' LECT mems TERM
                   COND CYLI X1 -20 Y1 0 Z1 0 X2 20 Y2 0 Z2 0 R 0.1650
            'nmemo' LECT mems DIFF nmemi TERM
            'nsymy' LECT mems TERM COND Y LT 0.001
            'nsymz' LECT mems TERM COND Z LT 0.001
            'm1c'   LECT mem1 TERM COND NEAR POIN -16.335 0 0
            'm2c'   LECT mem2 TERM COND NEAR POIN -16.265 0 0
            'm3c'   LECT mem3 TERM COND NEAR POIN -16.195 0 0
     COUL TURQ LECT tubelp1 tra TERM
          VERT LECT fir2 TERM
          ROSE LECT fir1 TERM
          ROUG LECT driver TERM
          GR50 LECT mems TERM
          JAUN LECT pre TERM
ADAP THRS ECRO 3 TMIN 0.01 TMAX 0.4 MAXL 3
          LECT mems TERM
GRIL LAGR LECT mems TERM
FONC 1 TABL 5 0.0       0.0
              1.0E-3    1.0
              2.999E-3  1.0
              3.0E-3    0.0
              100.0E-3  0.0
MATE
    !LOI 1
     VM23 RO 1380 YOUN 2757.9E6 NU 0.495 ELAS 120.E6 ! "Melinex/Mylar/PET"
          FAIL PEPR LIMI 1.0
          TRAC 3 120.E6 0.04351
```

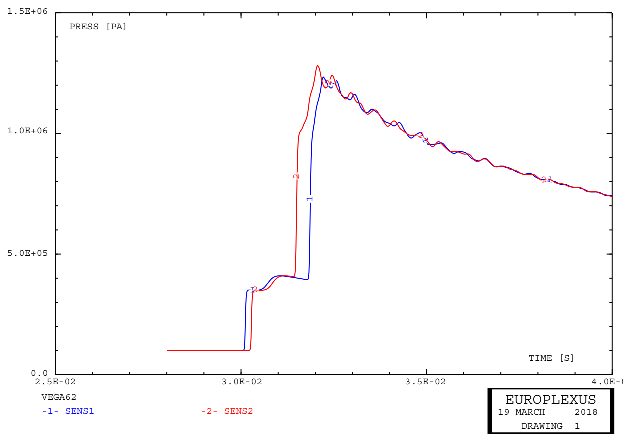
```
            180.E6 1.5
            230.E6 3.5
        LECT mems _q4gs TERM
   !LOI 2
    GAZP RO 46.517 GAMM 1.4 CV 719.286 PINI 39.147E5 PREF 1.011E5
        LECT none TERM
   !LOI 3
    GAZP RO 31.412 GAMM 1.4 CV 719.286 PINI 26.435E5 PREF 1.011E5
        LECT none TERM
   !LOI 4
    GAZP RO 16.307 GAMM 1.4 CV 719.286 PINI 13.723E5 PREF 1.011E5
        LECT none TERM
   !LOI 5
    GAZP RO 1.202 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
        LECT flui3d _cuvf TERM
   !LOI 6
    IMPE PIMP PRES 13.723E5 PREF 1.011E5 FONC 1
        LECT pre _cl3d TERM
    GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
        LECT epar1 epar2 TERM
    GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
        LECT rac3d1d tubelpp TERM
    PARO PSIL 0.02
        LECT tubelpp TERM
    MULT 8 9 LECT tubelpp TERM
    GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
        LECT _cuvf TERM
OPTI PINS ASN
LINK COUP SPLT NONE
    BLOQ 123 LECT nmemo TERM
    CONT SPLA NX 0 NY 1 NZ 0 LECT nsymy TERM
    CONT SPLA NX 0 NY 0 NZ 1 LECT nsymz TERM
LINK DECO
    PINB PENA SFAC 1.0
        BODY                           DMIN 0.003
            LECT mem1 TERM
        BODY                           DMIN 0.003
            LECT mem2 TERM
        BODY                           DMIN 0.003
            LECT mem3 TERM
    FLSW STRU LECT mems TERM
        FLUI LECT fcoup1 TERM
          R 0.014
          HGRI 0.016
          DGRI
          FACE
          BFLU 2 ! block if at least one node is in influence domain
          FSCP 1 ! couple in all directions
          ADAP LMAX 2 SCAL 2
INIT SKIP UPTO 3.E-3 VFCC
     ADAP IMAT TIME 3.E-3
               2 MATE 2 OBJE LECT flui3d TERM
                        INSI SURF LECT mem1 TERM
                !MATE 3 OBJE LECT flui3d TERM
                !       OUTS SURF LECT mem1 TERM
                !       INSI SURF LECT mem2 TERM
                 MATE 4 OBJE LECT flui3d TERM
                        OUTS SURF LECT mem2 TERM
                        INSI SURF LECT mem3 TERM
ECRI DEPL VITE ECRO FAIL TFRE 1.0E-3
          NOPO
          NOEL
     FICH SPLI ALIC FREQ 0 TFRE 0.D0
          TIME PROG 0.D0 PAS 1.0D-3 28.D-3 TERM
     FICH FORM MAPP OBJE LECT flui3d tubelp1 TERM
               TIME PROG 28.0E-3 TERM
OPTI NOTE CSTA 0.4
     STEP IO
     LOG 1
     JAUM
     LMST
     FANT 10e-3 LECT mems TERM
     PINS GRID DPIN 1.01
     VFCC FCON 6 ! hllc solver
          ORDR 2 ! order in space
          OTPS 2 ! order in time
          RECO 1 ! Not accepted by CAL_VFCC_1D
          NTIL
     ADAP RCON
     FLS  CUB8 2 ! For the inverse mapping
     QUAS STAT 1670 0.1 UPTO 5.0E-3
CALC TINI 0 TEND 28.0E-3
FIN
```

No results are presented for this test because the plate was not present and the S1 and S2 pressure sensors are not yet hit by the pressure wave at the chosen mapping (final, in this case) time of 28 ms.

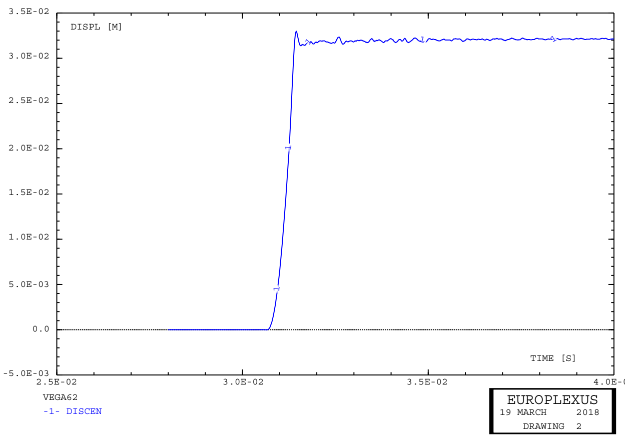
4.6.4 Case VEGA62

This test is a second calculation starting from the map file produced by test VEGA61 at $t = 28.0$ ms. The mesh is the same as in case VEGA51 but without the membranes and the associated pressure elements. Therefore, we may simply re-use the Cast3m and the EPX files of test VEGA52 by just changing the calculation name and the input map file, which should be `vega61.map` instead of `vega51.map`.

Some results of this calculation are presented next. Fig. 24(a) shows the fluid pressures at sensors S1 and S2, while Fig. 24(b) shows the central displacement of the plate.



(a) Fluid pressures



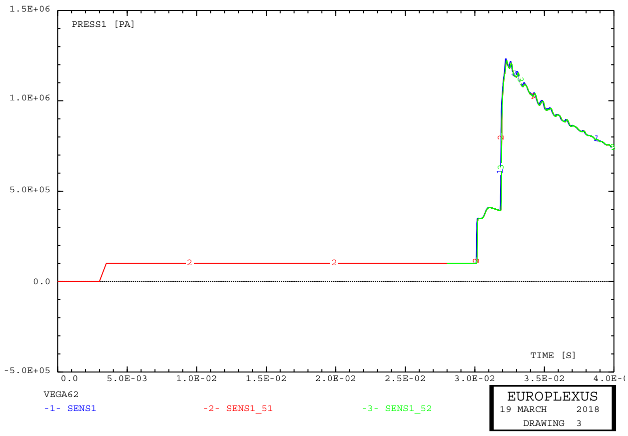
(b) Plate displacement

Figure 24: Results of test VEGA62.

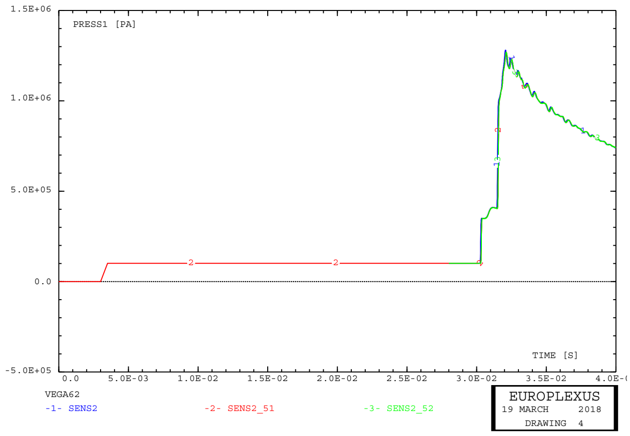
4.6.5 Comparison of results

In this Section we perform a comparison of the results of all previous calculations (whenever this is meaningful).

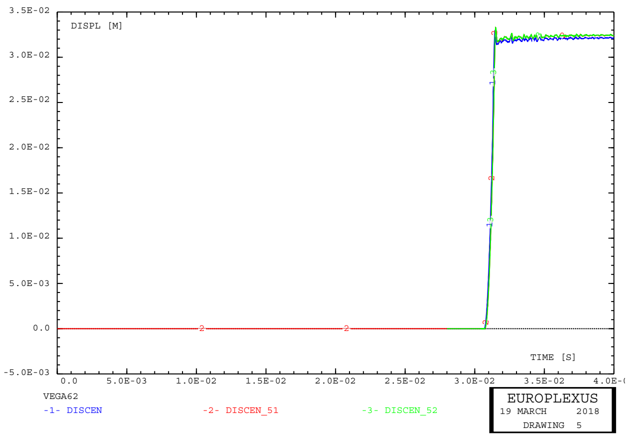
Fig. 25(a) compares the fluid pressures at sensor S1 while Fig. 25(b) compares the pressure at sensor S2. Finally, Fig. 25(c) compares the central displacement of the plate. The red curves correspond to test VEGA51 (i.e., to the monolithic reference solution), the green curves to case VEGA52 and the blue curves to case VEGA62.



(a) Pressure at S1



(b) Pressure at S2



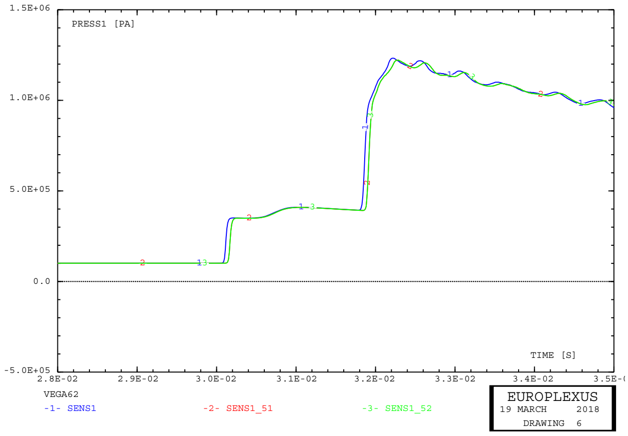
(c) Plate displavcement

Figure 25: Comparison of results of tests VEGA51, VEGA52 and VEGA62.

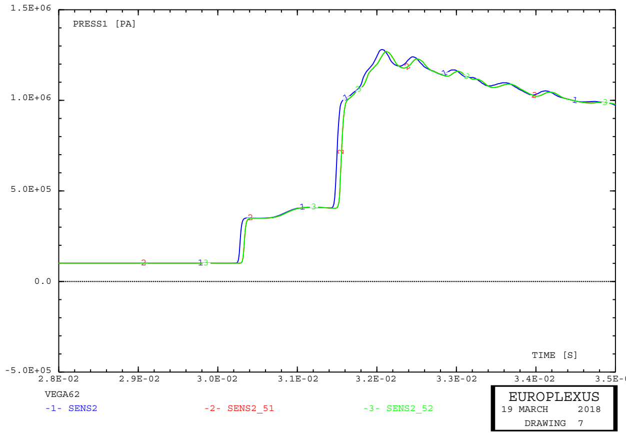
Fig. 26 presents the same results in detail over the time interval between 28 and 33 ms, which allows a better view of the (small) differences between the solutions. The solutions of cases VEGA51 and VEGA52 are in perfect agreement, while the solution of case VEGA62 appears to be shifted of about 0.05 ms, and presents also very slight differences in the peaks and oscillations. The reason for such discrepancies is under investigation.

One of the causes of the observed discrepancies could be a difference in the failure mechanism of the membranes. The membranes failure sequence in tests VEGA51 and VEGA61 is presented in Figs 27 and 28, respectively. There are some minor differences in the fragmentation and in the formation of debris.

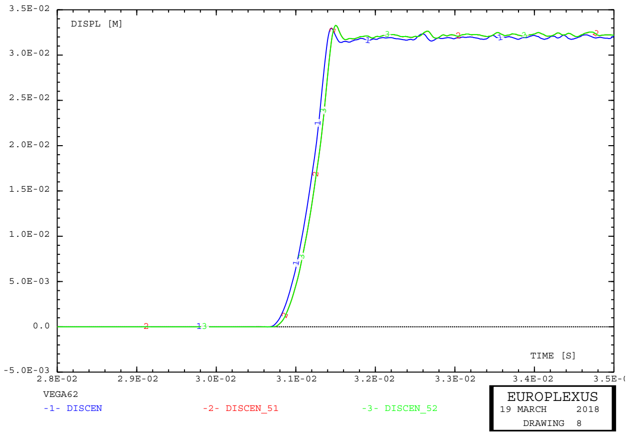
In order to better appreciate such differences, Figs. 29 and 30 show the failure sequence of the three membranes in tests VEGA51 and VEGA61, respectively, *visualized in the initial (undeformed) configuration* of each membrane. The three membranes have identical dimensions but they appear to be of slightly different size in these Figures since the point of view is the same in all pictures so that the distance from the eye to the membrane increases passing from the first, to the second and to the



(a) Pressure at S1



(b) Pressure at S2



(c) Plate displavcement

Figure 26: Comparison of results of tests VEGA51, VEGA52 and VEGA62 (zoom).

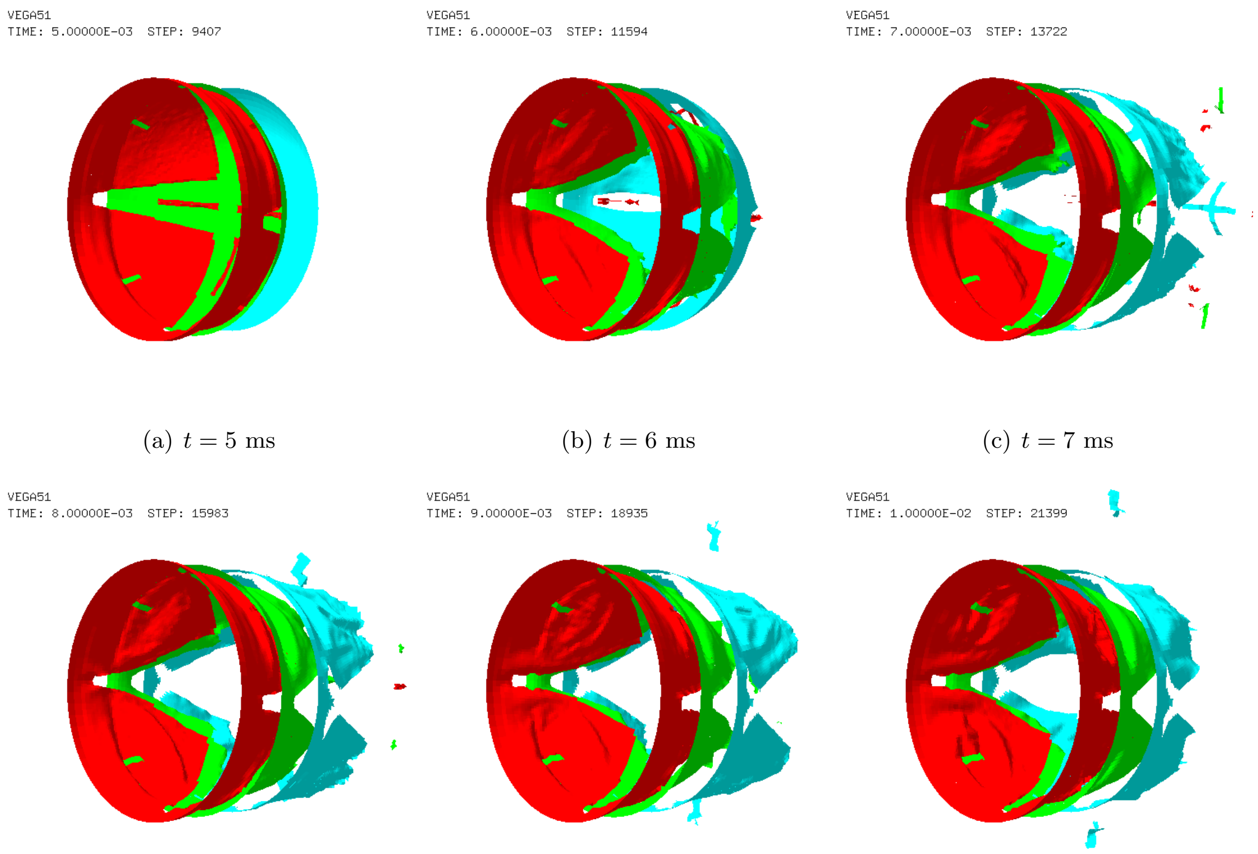
third membrane.

At 5 ms, only the first membrane has started to fail, while at 6 ms all three membranes have undergone some failure. Four petals are formed in the second and third membrane. In the first membrane, four main petals are formed, but an incipient failure is also observed that would lead to 8 petals if completed. As a matter of fact, in similar simulations reported in reference [5], e.g. in test case VEGA45 from which the present case VEGA51 was derived (with apparently only minor modifications in the input), eight completely formed petals are often produced in the first membrane (and only four in the other two). The reasons for this discrepancy are tentatively investigated in the next test cases.

4.6.6 Case VEGA53

By comparing the inputs of tests VEGA45 of reference [5] (8 petals in the first membrane) and the present case VEGA51 (only 4 fully formed petals in the first membrane), the only modification susceptible of modifying (though very slightly) the results is the use of the `STEP IO` option in the latter calculation. This option was used only to achieve a very precise comparison between solutions during the present validation process and would not be used in real applications. However, it is worthwhile to investigate its influence on the solution.

Fig. 31 shows the obtained membranes failure sequence and Fig. 32 shows the same sequence in the undeformed configuration. The result at 10 ms is missing (and therefore we plot that at 9.5 ms instead in Fig.32) simply because without the `STEP IO` option the code stores the results at a time slightly larger than the requested one (10.0002 ms in this case, i.e. at the first time value which is



(a) $t = 5$ ms (b) $t = 6$ ms (c) $t = 7$ ms

(d) $t = 8$ ms (e) $t = 9$ ms (f) $t = 10$ ms

Figure 27: Membranes failure sequence in tests VEGA51.

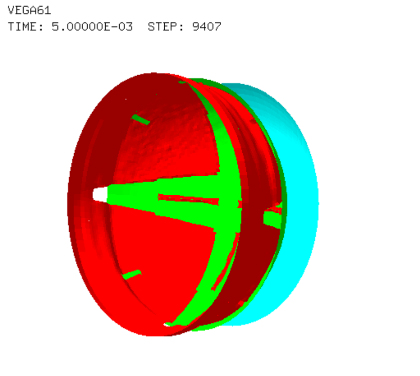
equal to *or larger than* the specified one), while the membranes are eroded at (exactly) 10 ms, so at the last storage time there are no membranes any more to draw.

We can see that in this solution eight full petals are indeed formed in the first membrane, starting from 6 ms. The reason for the observed discrepancy may only reside in the time history of the simulations. Fig. 33 compares the CPU times and the time increments (stability steps) of cases VEGA53 (in black) and VEGA51 (in red). Especially the second diagram, Fig. 33(b), is interesting in the present context. We see that the history of time increments is indeed quite different in the two solutions, in the period between 4.5 and 9.5 ms.

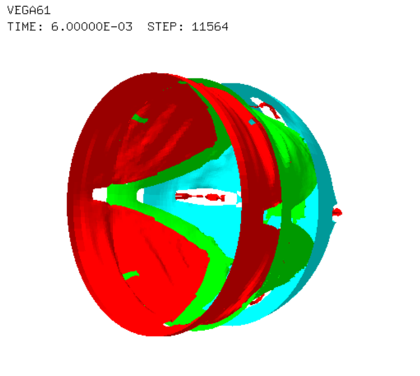
The sharp, and substantially random-like, reductions of stability step are due to some membrane elements near the advancing crack assuming weird shapes *without* reaching the failure and erosion limit (which in these simulations is set to `EROS 1.0`). This is unnecessarily penalizing in terms of CPU and it also has effects on the solution, as we are showing here, due to the high sensitivity of the failure and crack propagation process on the time increment used. Such elements should be eroded when they reach an unacceptable shape (e.g. based on a warping factor or aspect ratio) but this remains to be done.

4.6.7 Case VEGA63

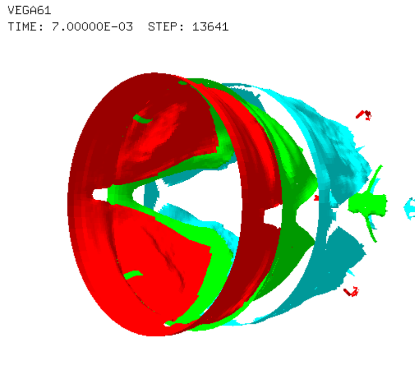
This is a repetition of test VEGA61 but without the `STEP IO` option. The membranes deformations are presented in Figs. 34 and 35 and indeed, eight fully formed petals are produced in the first membrane starting at 6 ms, like in case VEGA53. Finally, Fig. 36 comparse the time histories of the two simulations. The observations made in Section 4.6.6 on the influence of the time increment history are confirmed.



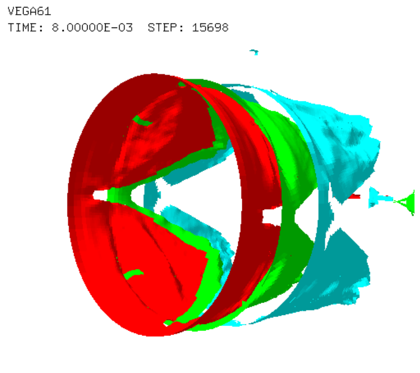
(a) $t = 5$ ms



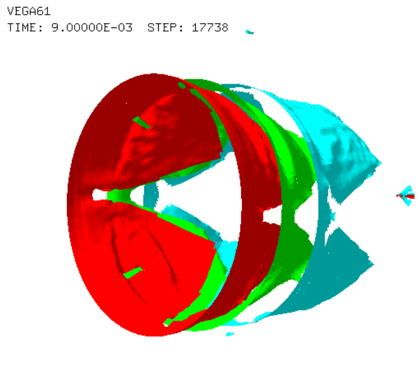
(b) $t = 6$ ms



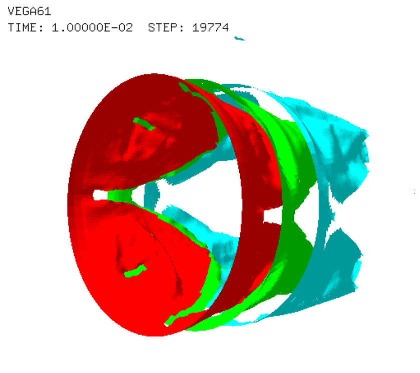
(c) $t = 7$ ms



(d) $t = 8$ ms



(e) $t = 9$ ms

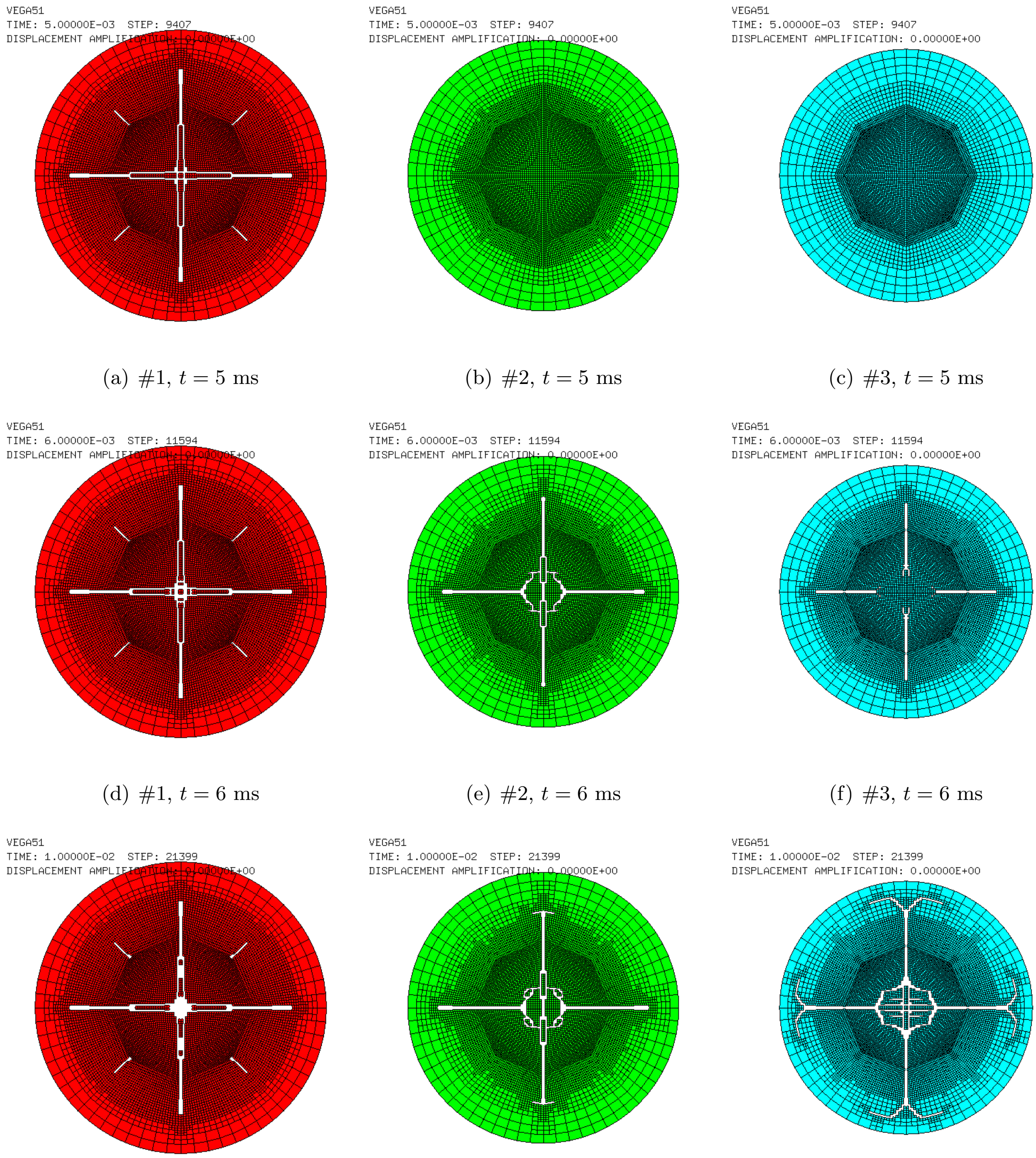


(f) $t = 10$ ms

Figure 28: Membranes failure sequence in tests VEGA61.

4.6.8 Comparison of first membrane failure patterns

The obtained failure patterns for the first membrane (in the un-deformed configuration) at 6.0 ms are summarized in Fig. 37 for direct comparison.

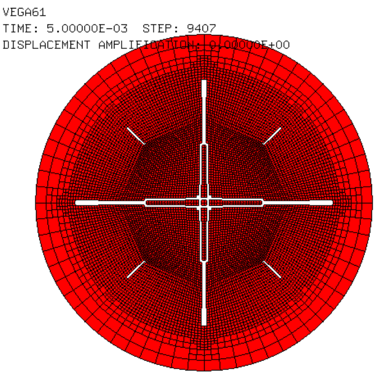


(a) #1, $t = 5$ ms (b) #2, $t = 5$ ms (c) #3, $t = 5$ ms

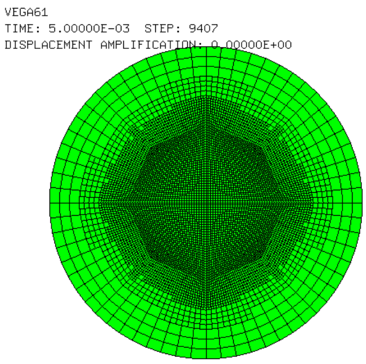
(d) #1, $t = 6$ ms (e) #2, $t = 6$ ms (f) #3, $t = 6$ ms

(g) #1, $t = 10$ ms (h) #2, $t = 10$ ms (i) #3, $t = 10$ ms

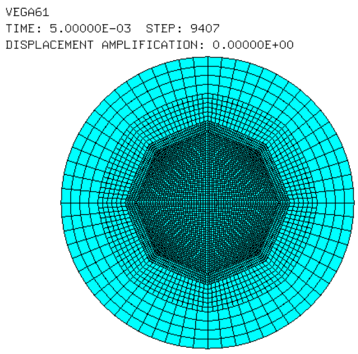
Figure 29: Undeformed membranes failure sequence in test VEGA51.



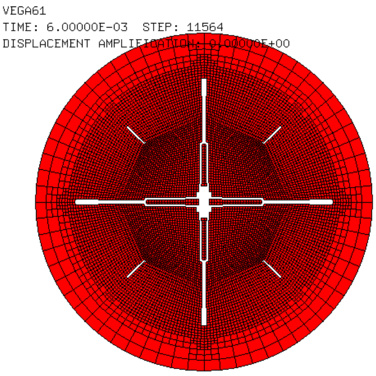
(a) #1, $t = 5$ ms



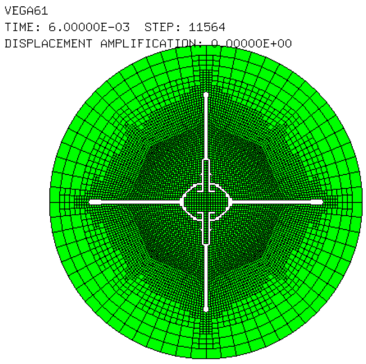
(b) #2, $t = 5$ ms



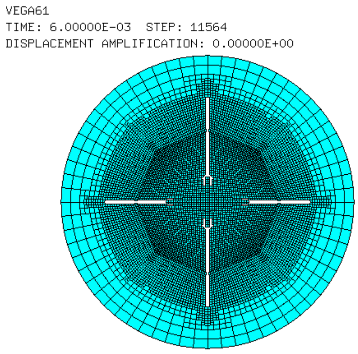
(c) #3, $t = 5$ ms



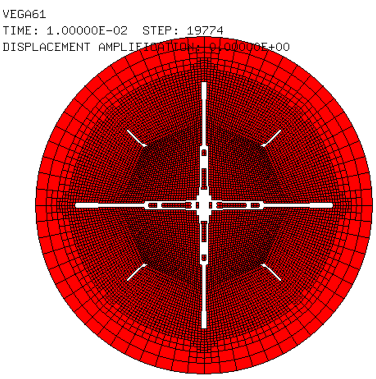
(d) #1, $t = 6$ ms



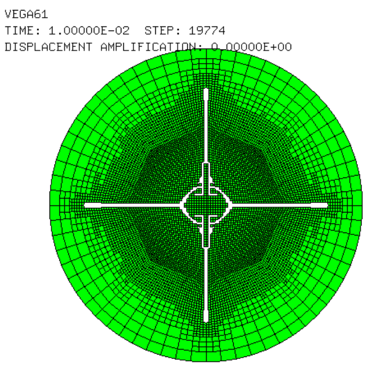
(e) #2, $t = 6$ ms



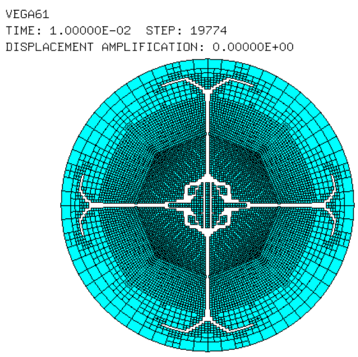
(f) #3, $t = 6$ ms



(g) #1, $t = 10$ ms

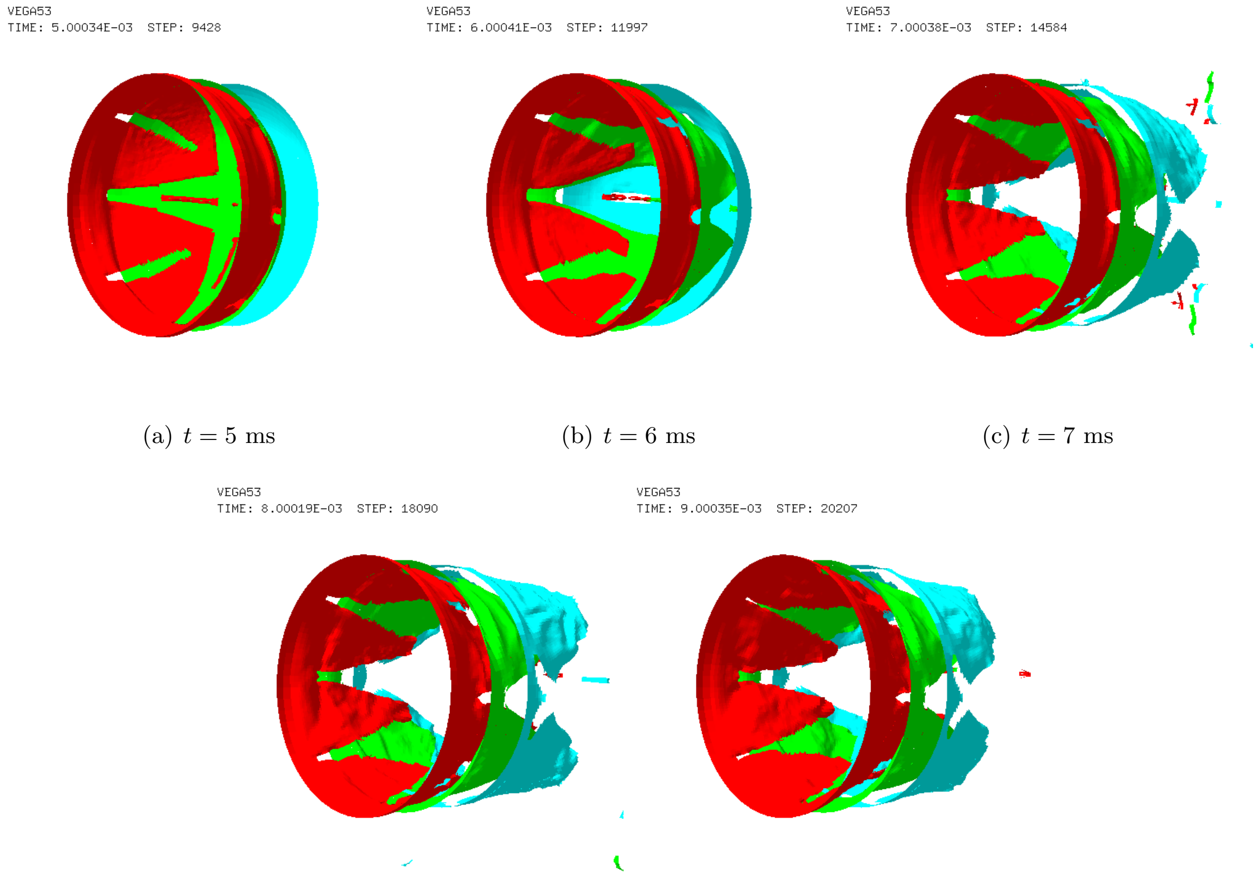


(h) #2, $t = 10$ ms



(i) #3, $t = 10$ ms

Figure 30: Undeformed membranes failure sequence in test VEGA61.



(a) $t = 5$ ms

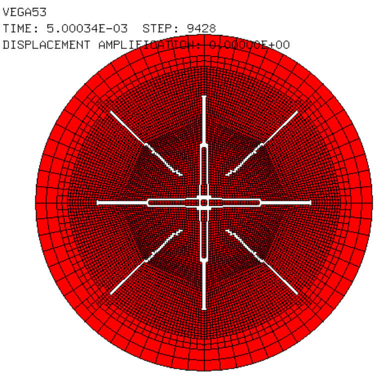
(b) $t = 6$ ms

(c) $t = 7$ ms

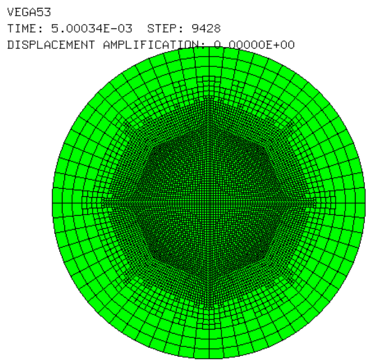
(d) $t = 8$ ms

(e) $t = 9$ ms

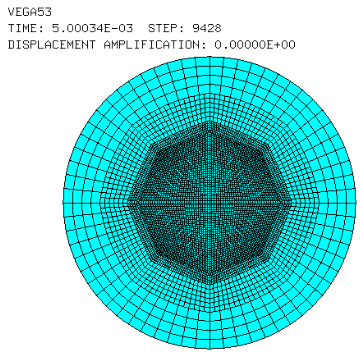
Figure 31: Membranes failure sequence in tests VEGA53.



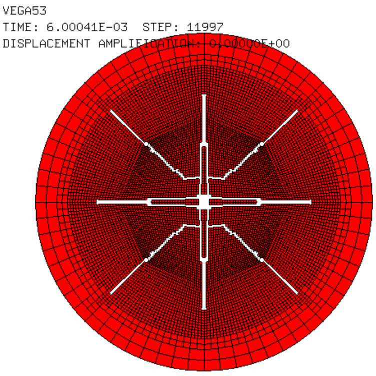
(a) #1, $t = 5$ ms



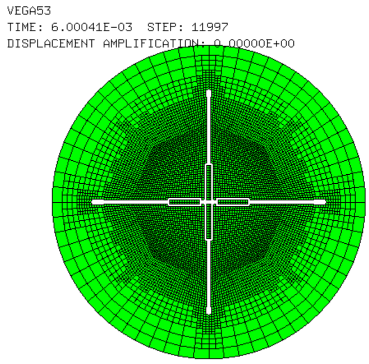
(b) #2, $t = 5$ ms



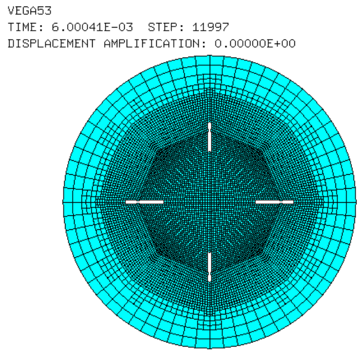
(c) #3, $t = 5$ ms



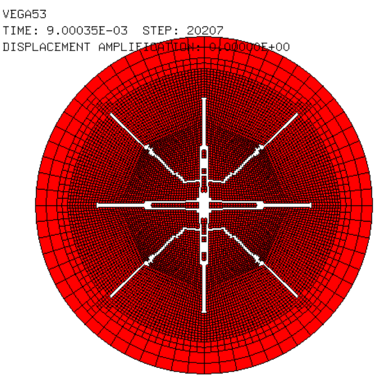
(d) #1, $t = 6$ ms



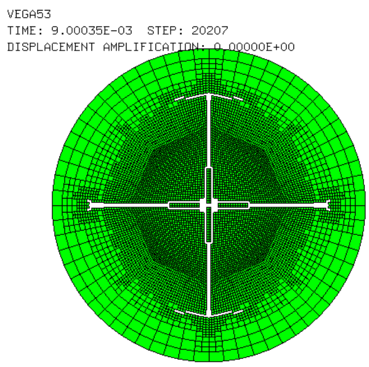
(e) #2, $t = 6$ ms



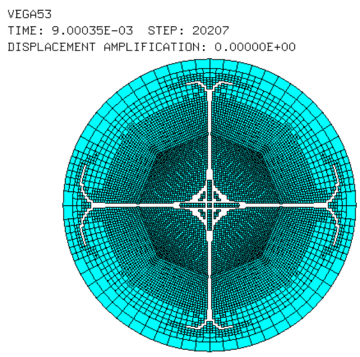
(f) #3, $t = 6$ ms



(g) #1, $t = 9.5$ ms

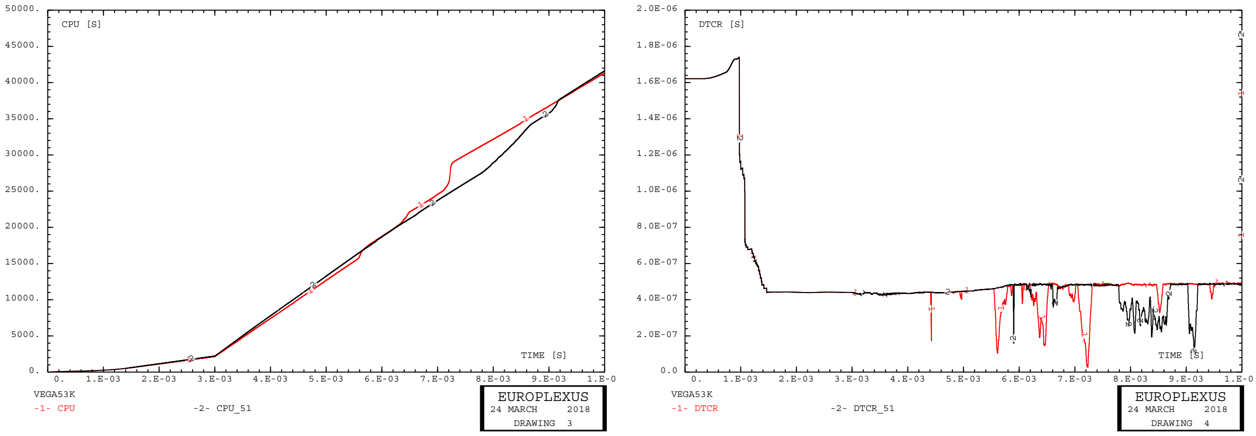


(h) #2, $t = 9.5$ ms



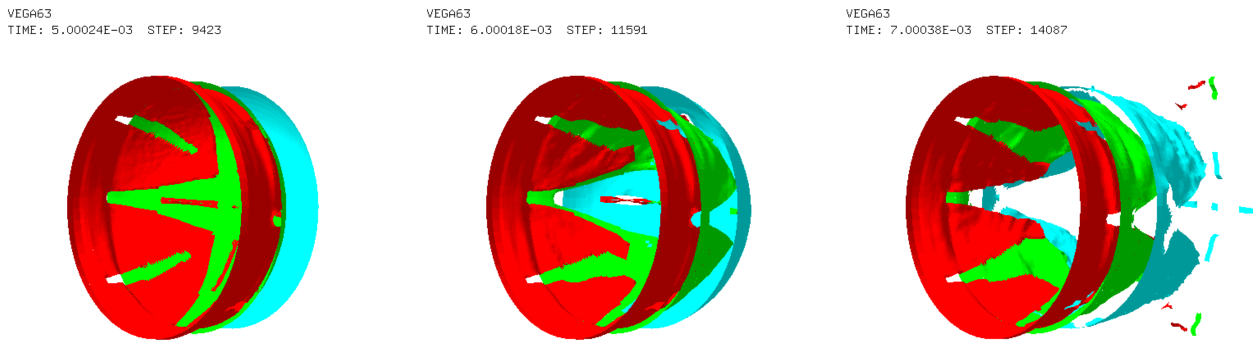
(i) #3, $t = 9.5$ ms

Figure 32: Undeformed membranes failure sequence in test VEGA53.

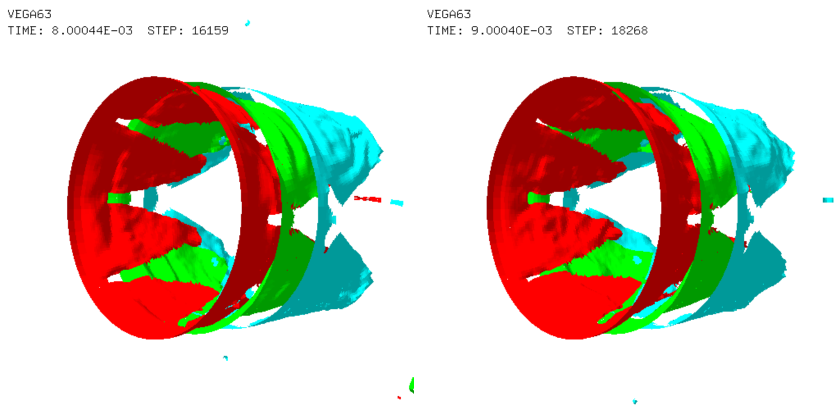


(a) Cpu time (b) Time increment

Figure 33: Comparison of calculation histories of tests VEGA51 and VEGA53.

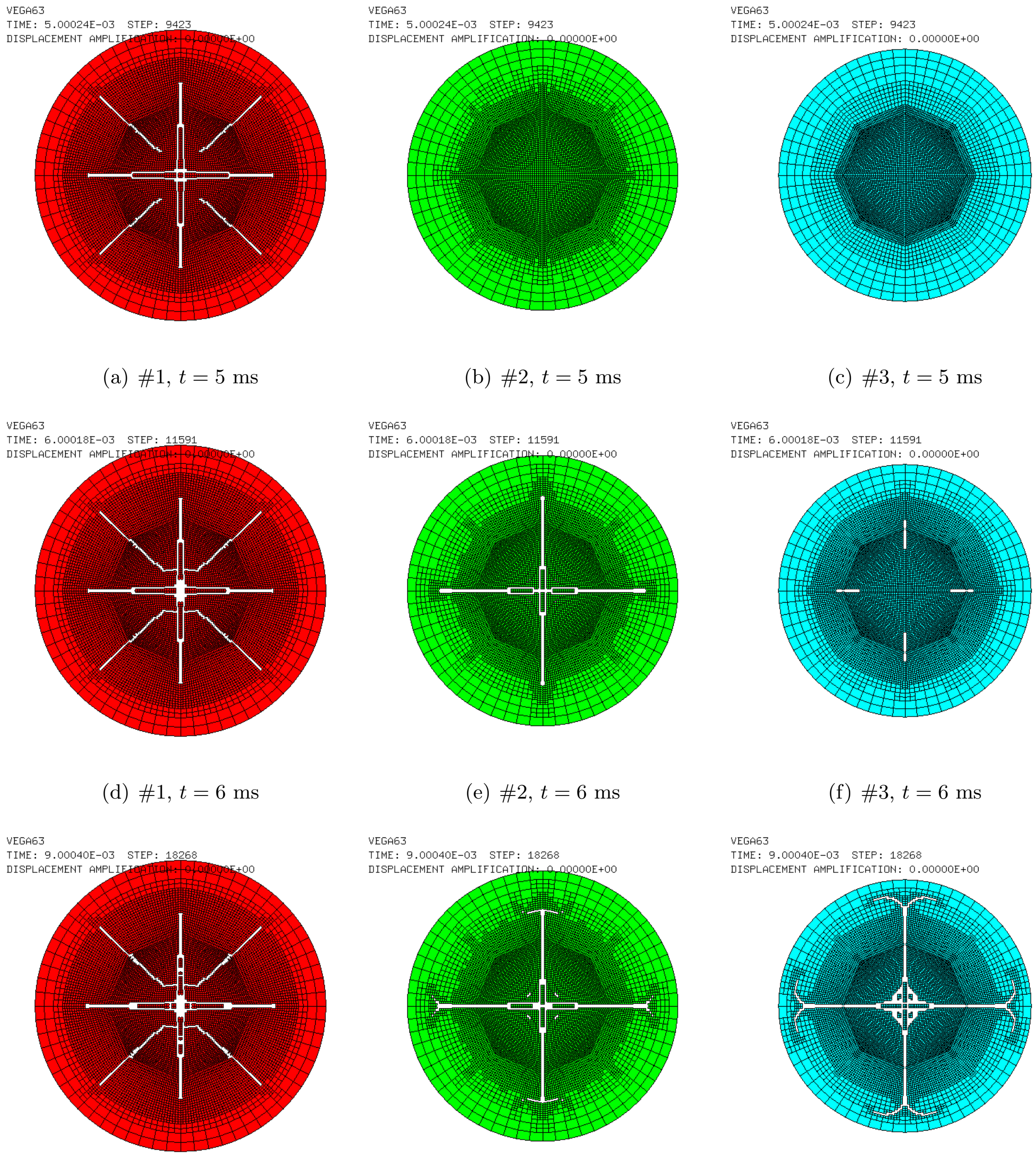


(a) $t = 5$ ms (b) $t = 6$ ms (c) $t = 7$ ms



(d) $t = 8$ ms (e) $t = 9$ ms

Figure 34: Membranes failure sequence in tests VEGA63.

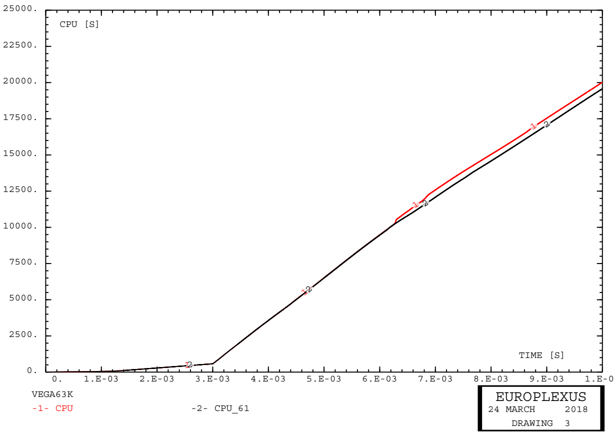


(a) #1, $t = 5$ ms (b) #2, $t = 5$ ms (c) #3, $t = 5$ ms

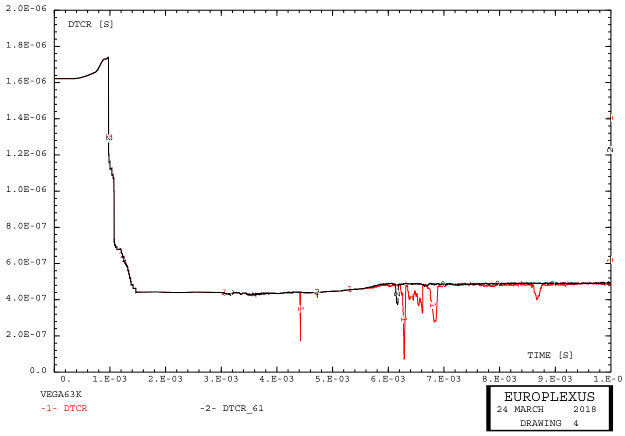
(d) #1, $t = 6$ ms (e) #2, $t = 6$ ms (f) #3, $t = 6$ ms

(g) #1, $t = 9.5$ ms (h) #2, $t = 9.5$ ms (i) #3, $t = 9.5$ ms

Figure 35: Undeformed membranes failure sequence in test VEGA63.

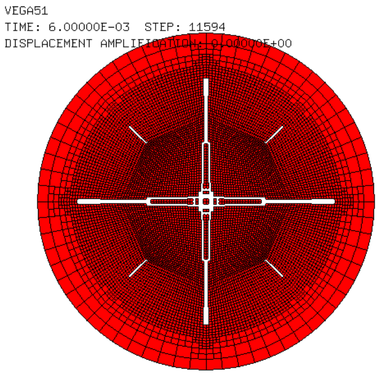


(a) Cpu time

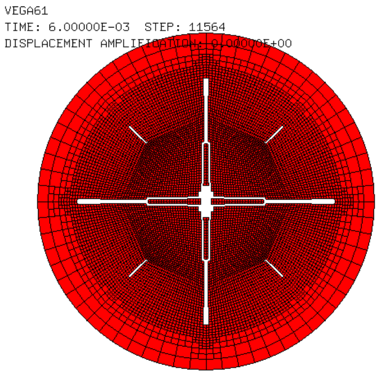


(b) Time increment

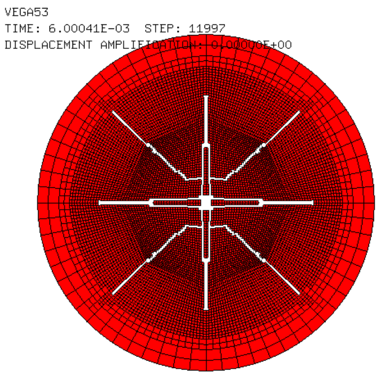
Figure 36: Comparison of calculation histories of tests VEGA61 and VEGA63.



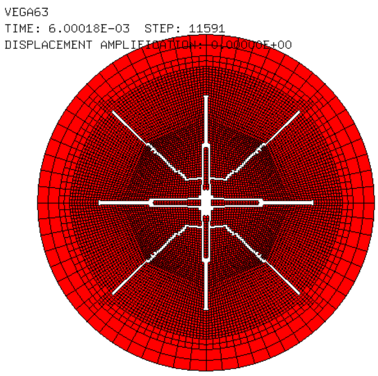
(a) VEGA51, $t = 6$ ms



(b) VEGA61, $t = 6$ ms



(c) VEGA53, $t = 6$ ms



(d) VEGA63, $t = 6$ ms

Figure 37: Undeformed membranes failure patterns at 6 ms in tests VEGA51 through VEGA63.

5 Practical notes

The notion of *time* and of *time step* in calculations using the mapping algorithm deserves some explanation.

In the current implementation of the model, during a second run the code reads back the time value t^{map} from the map file and uses it to reset the initial time t^{ini} specified by the user by the `TINI` keyword in the `CALC` directive, i.e. it poses:

$$t^{\text{ini}} = t^{\text{map}} \tag{1}$$

As a consequence, the value t^{ini} specified by the user is irrelevant although, for aesthetic (human input readability) reasons, it is suggested to specify a value of `TINI` (which is mandatory in any EPX input file) equal to that of the corresponding monolithic simulation (typically, but not always, equal to 0).

In this way, the times of both the first and a subsequent simulation will always coincide with the "real" (physical) times, as concerns the outputs and storages, any used time functions etc.

For the time step number, however, the convention is different. The step number is stored in the map file but it is *not* reused in a second calculation. A second calculation is always set to start from step 0, like any first calculation (irrespective of the value of `TINI` chosen, either 0 or not).

This is due to the fact that the "first" (or rather the 0-th) step is special in an explicit code such as EPX. During this step, some special operations have to be performed, which are not done during the successive steps. Therefore, the code is full of tests which perform (or skip) some operations in the particular case that the step counter (`NPAS`) has the value 0.

Since a "second" run, in the mapping terminology, is seen as just a "normal" run by EPX, only containing some special re-initialization of physical conditions, it is essential the the step number be 0 at the beginning of such a run, otherwise one would have to change a lot of tests in the code.

For this reason, the step number restarts from 0 during a second run with the mapping model and therefore time step numbers (at generated printouts, results storages etc.) will *not* correspond to those of a monolithic run (although *time* values will.)

References

[1] EUROPLEXUS User's Manual, on-line version: http://europlexus.jrc.ec.europa.eu.

[2] Cast3m Software: http://www-cast3m.cea.fr/.

[3] M. Larcher, F. Casadei, G. Solomos. Simulation of blast waves by using mapping technology in EUROPLEXUS. Technical Note, PUBSY No. JRC91102, EUR Report 26735 EN, 2014.

[4] F. Casadei, V. Aune, F. Daude, P. Galon, G. Valsamos, M. Larcher. Shock tube tests with coupled 1D-3D models in EUROPLEXUS. JRC Technical Report, PUBSY No. JRC101011, EUR Report 27890 EN, 2016.

[5] F. Casadei, G. Valsamos, M. Larcher, V. Aune. Characterization of a shock tube facility by EUROPLEXUS. JRC Technical Report, PUBSY No. JRCxxxxx, EUR Report yyyyy EN, 2018.

Appendix I — Input files

All the input files used in the previous Sections are listed below.

mapp00.epx

```
MAPP00
ECHO
!CONV WIN
DPLA EULE
GEOM LIBR POIN 202 Q4VF 100 TERM
 0 0   1 0   2 0   3 0   4 0   5 0   6 0   7 0   8 0   9 0   10 0
      11 0 12 0 13 0 14 0 15 0 16 0 17 0 18 0 19 0  20 0
      21 0 22 0 23 0 24 0 25 0 26 0 27 0 28 0 29 0  30 0
      31 0 32 0 33 0 34 0 35 0 36 0 37 0 38 0 39 0  40 0
      41 0 42 0 43 0 44 0 45 0 46 0 47 0 48 0 49 0  50 0
      51 0 52 0 53 0 54 0 55 0 56 0 57 0 58 0 59 0  60 0
      61 0 62 0 63 0 64 0 65 0 66 0 67 0 68 0 69 0  70 0
      71 0 72 0 73 0 74 0 75 0 76 0 77 0 78 0 79 0  80 0
      81 0 82 0 83 0 84 0 85 0 86 0 87 0 88 0 89 0  90 0
      91 0 92 0 93 0 94 0 95 0 96 0 97 0 98 0 99 0 100 0
 0 1   1 1   2 1   3 1   4 1   5 1   6 1   7 1   8 1   9 1   10 1
      11 1 12 1 13 1 14 1 15 1 16 1 17 1 18 1 19 1  20 1
      21 1 22 1 23 1 24 1 25 1 26 1 27 1 28 1 29 1  30 1
      31 1 32 1 33 1 34 1 35 1 36 1 37 1 38 1 39 1  40 1
      41 1 42 1 43 1 44 1 45 1 46 1 47 1 48 1 49 1  50 1
      51 1 52 1 53 1 54 1 55 1 56 1 57 1 58 1 59 1  60 1
      61 1 62 1 63 1 64 1 65 1 66 1 67 1 68 1 69 1  70 1
      71 1 72 1 73 1 74 1 75 1 76 1 77 1 78 1 79 1  80 1
      81 1 82 1 83 1 84 1 85 1 86 1 87 1 88 1 89 1  90 1
      91 1 92 1 93 1 94 1 95 1 96 1 97 1 98 1 99 1 100 1
   1   2 103 102
   2   3 104 103
   3   4 105 104
   4   5 106 105
   5   6 107 106
   6   7 108 107
   7   8 109 108
   8   9 110 109
   9  10 111 110
  10  11 112 111

  11  12 113 112
  12  13 114 113
  13  14 115 114
  14  15 116 115
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  16  17 118 117
  17  18 119 118
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  19  20 121 120
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  92  93 194 193
  93  94 195 194
  94  95 196 195
  95  96 197 196
  96  97 198 197
  97  98 199 198
  98  99 200 199
  99 100 201 200
 100 101 202 201
COMP GROU 2 'hp' LECT  1 PAS 1  50 TERM
            'lp' LECT 51 PAS 1 100 TERM
     COUL ROUG LECT hp TERM
          TURQ LECT lp TERM
MATE GAZP RO 13. PINI 1.E6 GAMM 1.402 PREF 1.E5
              CV 713.3
              LECT hp TERM
     GAZP RO 1.3 PINI 1.E5 GAMM 1.402 PREF 1.E5
              CV 713.3
              LECT lp TERM
ECRI VFCC TFRE 10.E-3
     FICH ALIC TFRE 10.E-3
OPTI NOTE STEP IO LOG 1
     VFCC FCON 6
CALC TINI 0. TFIN 80.E-3
SUIT
Post treatment
RESU ALIC GARD PSCR
SORT GRAP AXTE 1.0 'T [s]'
SCOU 1 'p00' ECRO COMP 1 T  0.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 2 'p10' ECRO COMP 1 T 10.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 3 'p20' ECRO COMP 1 T 20.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 4 'p30' ECRO COMP 1 T 30.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 5 'p40' ECRO COMP 1 T 40.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 6 'p50' ECRO COMP 1 T 50.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 7 'p60' ECRO COMP 1 T 60.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 8 'p70' ECRO COMP 1 T 70.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 9 'p80' ECRO COMP 1 T 80.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
TRAC 1 2 3 4 5 6 7 8 9 AXES 1.0 'PRES [PA]'
LIST 1 2 3 4 5 6 7 8 9 AXES 1.0 'PRES [PA]'
SCOU 11 'r00' ECRO COMP 2 T  0.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 12 'r10' ECRO COMP 2 T 10.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 13 'r20' ECRO COMP 2 T 20.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 14 'r30' ECRO COMP 2 T 30.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 15 'r40' ECRO COMP 2 T 40.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 16 'r50' ECRO COMP 2 T 50.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 17 'r60' ECRO COMP 2 T 60.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 18 'r70' ECRO COMP 2 T 70.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 19 'r80' ECRO COMP 2 T 80.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
TRAC 11 12 13 14 15 16 17 18 19 AXES 1.0 'DENS [KG/M3]'
LIST 11 12 13 14 15 16 17 18 19 AXES 1.0 'DENS [KG/M3]'
FIN
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mapp01.epx

```
MAPP01
ECHO
!CONV WIN
DPLA EULE
GEOM LIBR POIN 202 Q4VF 100 TERM
 0 0   1 0   2 0   3 0   4 0   5 0   6 0   7 0   8 0   9 0   10 0
      11 0 12 0 13 0 14 0 15 0 16 0 17 0 18 0 19 0  20 0
      21 0 22 0 23 0 24 0 25 0 26 0 27 0 28 0 29 0  30 0
      31 0 32 0 33 0 34 0 35 0 36 0 37 0 38 0 39 0  40 0
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    41 0 42 0 43 0 44 0 45 0 46 0 47 0 48 0 49 0  50 0
    51 0 52 0 53 0 54 0 55 0 56 0 57 0 58 0 59 0  60 0
    61 0 62 0 63 0 64 0 65 0 66 0 67 0 68 0 69 0  70 0
    71 0 72 0 73 0 74 0 75 0 76 0 77 0 78 0 79 0  80 0
    81 0 82 0 83 0 84 0 85 0 86 0 87 0 88 0 89 0  90 0
    91 0 92 0 93 0 94 0 95 0 96 0 97 0 98 0 99 0 100 0
0 1  1 1  2 1  3 1  4 1  5 1  6 1  7 1  8 1  9 1  10 1
    11 1 12 1 13 1 14 1 15 1 16 1 17 1 18 1 19 1  20 1
    21 1 22 1 23 1 24 1 25 1 26 1 27 1 28 1 29 1  30 1
    31 1 32 1 33 1 34 1 35 1 36 1 37 1 38 1 39 1  40 1
    41 1 42 1 43 1 44 1 45 1 46 1 47 1 48 1 49 1  50 1
    51 1 52 1 53 1 54 1 55 1 56 1 57 1 58 1 59 1  60 1
    61 1 62 1 63 1 64 1 65 1 66 1 67 1 68 1 69 1  70 1
    71 1 72 1 73 1 74 1 75 1 76 1 77 1 78 1 79 1  80 1
    81 1 82 1 83 1 84 1 85 1 86 1 87 1 88 1 89 1  90 1
    91 1 92 1 93 1 94 1 95 1 96 1 97 1 98 1 99 1 100 1
  1   2 103 102
  2   3 104 103
  3   4 105 104
  4   5 106 105
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  7   8 109 108
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 13  14 115 114
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 92  93 194 193
 93  94 195 194
 94  95 196 195
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 96  97 198 197
 97  98 199 198
 98  99 200 199
 99 100 201 200
100 101 202 201
COMP GROU 2 'hp' LECT  1 PAS 1  50 TERM
            'lp' LECT 51 PAS 1 100 TERM
     COUL ROUG LECT hp TERM
          TURQ LECT lp TERM
MATE GAZP RO 13. PINI 1.E6 GAMM 1.402 PREF 1.E5
               CV 713.3
               LECT hp TERM
     GAZP RO 1.3 PINI 1.E5 GAMM 1.402 PREF 1.E5
               CV 713.3
               LECT lp TERM
ECRI VFCC TFRE 10.E-3
     FICH ALIC TFRE 10.E-3
     FICH FORM MAPP OBJE LECT tous TERM TIME PROG 50.E-3 TERM
OPTI NOTE STEP IO LOG 1
     VFCC FCON 6
CALC TINI 0. TFIN 80.E-3
SUIT
Post treatment
RESU ALIC GARD PSCR
SORT GRAP AXTE 1.0 'T [s]'
SCOU 1 'p00' ECRO COMP 1 T  0.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 2 'p10' ECRO COMP 1 T 10.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 3 'p20' ECRO COMP 1 T 20.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 4 'p30' ECRO COMP 1 T 30.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 5 'p40' ECRO COMP 1 T 40.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 6 'p50' ECRO COMP 1 T 50.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 7 'p60' ECRO COMP 1 T 60.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 8 'p70' ECRO COMP 1 T 70.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 9 'p80' ECRO COMP 1 T 80.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
TRAC 1 2 3 4 5 6 7 8 9 AXES 1.0 'PRES [PA]'
LIST 1 2 3 4 5 6 7 8 9 AXES 1.0 'PRES [PA]'
SCOU 11 'r00' ECRO COMP 2 T  0.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 12 'r10' ECRO COMP 2 T 10.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 13 'r20' ECRO COMP 2 T 20.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 14 'r30' ECRO COMP 2 T 30.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 15 'r40' ECRO COMP 2 T 40.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 16 'r50' ECRO COMP 2 T 50.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 17 'r60' ECRO COMP 2 T 60.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 18 'r70' ECRO COMP 2 T 70.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 19 'r80' ECRO COMP 2 T 80.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
TRAC 11 12 13 14 15 16 17 18 19 AXES 1.0 'DENS [KG/M3]'
LIST 11 12 13 14 15 16 17 18 19 AXES 1.0 'DENS [KG/M3]'
FIN
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mapp02.epx

```
MAPP02
ECHO
!CONV WIN
DPLA EULE
GEOM LIBR POIN 202 Q4VF 100 TERM
 0 0  1 0  2 0  3 0  4 0  5 0  6 0  7 0  8 0  9 0  10 0
    11 0 12 0 13 0 14 0 15 0 16 0 17 0 18 0 19 0  20 0
    21 0 22 0 23 0 24 0 25 0 26 0 27 0 28 0 29 0  30 0
    31 0 32 0 33 0 34 0 35 0 36 0 37 0 38 0 39 0  40 0
    41 0 42 0 43 0 44 0 45 0 46 0 47 0 48 0 49 0  50 0
    51 0 52 0 53 0 54 0 55 0 56 0 57 0 58 0 59 0  60 0
    61 0 62 0 63 0 64 0 65 0 66 0 67 0 68 0 69 0  70 0
    71 0 72 0 73 0 74 0 75 0 76 0 77 0 78 0 79 0  80 0
    81 0 82 0 83 0 84 0 85 0 86 0 87 0 88 0 89 0  90 0
    91 0 92 0 93 0 94 0 95 0 96 0 97 0 98 0 99 0 100 0
 0 1  1 1  2 1  3 1  4 1  5 1  6 1  7 1  8 1  9 1  10 1
    11 1 12 1 13 1 14 1 15 1 16 1 17 1 18 1 19 1  20 1
    21 1 22 1 23 1 24 1 25 1 26 1 27 1 28 1 29 1  30 1
    31 1 32 1 33 1 34 1 35 1 36 1 37 1 38 1 39 1  40 1
    41 1 42 1 43 1 44 1 45 1 46 1 47 1 48 1 49 1  50 1
    51 1 52 1 53 1 54 1 55 1 56 1 57 1 58 1 59 1  60 1
    61 1 62 1 63 1 64 1 65 1 66 1 67 1 68 1 69 1  70 1
    71 1 72 1 73 1 74 1 75 1 76 1 77 1 78 1 79 1  80 1
    81 1 82 1 83 1 84 1 85 1 86 1 87 1 88 1 89 1  90 1
    91 1 92 1 93 1 94 1 95 1 96 1 97 1 98 1 99 1 100 1
  1   2 103 102
  2   3 104 103
  3   4 105 104
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  5   6 107 106
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  7   8 109 108
  8   9 110 109
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 86  87 188 187
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 89  90 191 190
 90  91 192 191

 91  92 193 192
 92  93 194 193
 93  94 195 194
 94  95 196 195
 95  96 197 196
 96  97 198 197
 97  98 199 198
 98  99 200 199
 99 100 201 200
100 101 202 201
COMP GROU 2 'hp' LECT  1 PAS 1  50 TERM
            'lp' LECT 51 PAS 1 100 TERM
     COUL ROUG LECT hp TERM
          TURQ LECT lp TERM
MATE GAZP RO 13. PINI 1.E6 GAMM 1.402 PREF 1.E5
               CV 713.3
               LECT hp TERM
     GAZP RO 1.3 PINI 1.E5 GAMM 1.402 PREF 1.E5
               CV 713.3
               LECT lp TERM
INIT MAPP FORM 'mapp01.map' MATC OBJE LECT tous TERM
ECRI VFCC TFRE 10.E-3
     FICH ALIC TFRE 10.E-3
!    FICH FORM MAPP OBJE LECT tous TERM TIME PROG 50.E-3 TERM
OPTI NOTE STEP IO LOG 1
     VFCC FCON 6
CALC TINI 0. TFIN 80.E-3
SUIT
Post treatment
RESU ALIC GARD PSCR
SORT GRAP AXTE 1.0 'T [s]'
SCOU 6 'p50' ECRO COMP 1 T 50.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 7 'p60' ECRO COMP 1 T 60.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 8 'p70' ECRO COMP 1 T 70.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 9 'p80' ECRO COMP 1 T 80.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
RCOU 106 'p50' FICH 'mapp01.pun' RENA 'p50_01'
RCOU 107 'p60' FICH 'mapp01.pun' RENA 'p60_01'
RCOU 108 'p70' FICH 'mapp01.pun' RENA 'p70_01'
RCOU 109 'p80' FICH 'mapp01.pun' RENA 'p80_01'
TRAC          6 7 8 9 AXES 1.0 'PRES [PA]'
LIST          6 7 8 9 AXES 1.0 'PRES [PA]'
TRAC 6 7 8 9 106 107 108 109 AXES 1.0 'PRES [PA]'
COLO NOIR NOIR NOIR NOIR ROUG ROUG ROUG ROUG
SCOU 16 'r50' ECRO COMP 2 T 50.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 17 'r60' ECRO COMP 2 T 60.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 18 'r70' ECRO COMP 2 T 70.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 19 'r80' ECRO COMP 2 T 80.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
RCOU 116 'r50' FICH 'mapp01.pun' RENA 'r50_01'
RCOU 117 'r60' FICH 'mapp01.pun' RENA 'r60_01'
RCOU 118 'r70' FICH 'mapp01.pun' RENA 'r70_01'
RCOU 119 'r80' FICH 'mapp01.pun' RENA 'r80_01'
TRAC                16 17 18 19 AXES 1.0 'DENS [KG/M3]'
LIST                16 17 18 19 AXES 1.0 'DENS [KG/M3]'
TRAC 16 17 18 19 116 117 118 119 AXES 1.0 'DENS [KG/M3]'
COLO NOIR NOIR NOIR NOIR ROUG ROUG ROUG ROUG
FIN
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mapp03.epx

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MAPP03
ECHO
!CONV WIN
DPLA EULE
GEOM LIBR POIN 203 PMAT 1 Q4VF 100 TERM
 -0.5 0.5
 0 0  1 0  2 0  3 0  4 0  5 0  6 0  7 0  8 0  9 0  10 0
     11 0 12 0 13 0 14 0 15 0 16 0 17 0 18 0 19 0  20 0
     21 0 22 0 23 0 24 0 25 0 26 0 27 0 28 0 29 0  30 0
     31 0 32 0 33 0 34 0 35 0 36 0 37 0 38 0 39 0  40 0
     41 0 42 0 43 0 44 0 45 0 46 0 47 0 48 0 49 0  50 0
     51 0 52 0 53 0 54 0 55 0 56 0 57 0 58 0 59 0  60 0
     61 0 62 0 63 0 64 0 65 0 66 0 67 0 68 0 69 0  70 0
     71 0 72 0 73 0 74 0 75 0 76 0 77 0 78 0 79 0  80 0
     81 0 82 0 83 0 84 0 85 0 86 0 87 0 88 0 89 0  90 0
     91 0 92 0 93 0 94 0 95 0 96 0 97 0 98 0 99 0 100 0
 0 1  1 1  2 1  3 1  4 1  5 1  6 1  7 1  8 1  9 1  10 1
     11 1 12 1 13 1 14 1 15 1 16 1 17 1 18 1 19 1  20 1
     21 1 22 1 23 1 24 1 25 1 26 1 27 1 28 1 29 1  30 1
     31 1 32 1 33 1 34 1 35 1 36 1 37 1 38 1 39 1  40 1
     41 1 42 1 43 1 44 1 45 1 46 1 47 1 48 1 49 1  50 1
     51 1 52 1 53 1 54 1 55 1 56 1 57 1 58 1 59 1  60 1
     61 1 62 1 63 1 64 1 65 1 66 1 67 1 68 1 69 1  70 1
     71 1 72 1 73 1 74 1 75 1 76 1 77 1 78 1 79 1  80 1
     81 1 82 1 83 1 84 1 85 1 86 1 87 1 88 1 89 1  90 1
     91 1 92 1 93 1 94 1 95 1 96 1 97 1 98 1 99 1 100 1
   1
   2   3 104 103
   3   4 105 104
   4   5 106 105
   5   6 107 106
   6   7 108 107
   7   8 109 108
   8   9 110 109
   9  10 111 110
  10  11 112 111

  11  12 113 112
  12  13 114 113
  13  14 115 114
  14  15 116 115
  15  16 117 116
  16  17 118 117
  17  18 119 118
  18  19 120 119
  19  20 121 120
  20  21 122 121

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  22  23 124 123
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  25  26 127 126
  26  27 128 127
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  38  39 140 139
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  40  41 142 141

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  45  46 147 146
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  56  57 158 157
  57  58 159 158
  58  59 160 159
  59  60 161 160
  60  61 162 161

  61  62 163 162
  62  63 164 163
  63  64 165 164
  64  65 166 165
  65  66 167 166
  66  67 168 167
  67  68 169 168
  68  69 170 169
  69  70 171 170
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  71  72 173 172
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  74  75 176 175
  75  76 177 176
  76  77 178 177
  77  78 179 178
  78  79 180 179
  79  80 181 180
  80  81 182 181

  81  82 183 182
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  84  85 186 185
  85  86 187 186
  86  87 188 187
  87  88 189 188
  88  89 190 189
  89  90 191 190
  90  91 192 191

  91  92 193 192
  92  93 194 193
  93  94 195 194
  94  95 196 195
  95  96 197 196
  96  97 198 197
  97  98 199 198
  98  99 200 199
  99 100 201 200
 100 101 202 201

 101 102 203 202
COMP GROU 4 'pm' LECT  1           TERM
            'hp' LECT  2 PAS 1  51 TERM
            'lp' LECT 52 PAS 1 101 TERM
            'fl' LECT  2 PAS 1 101 TERM
     EPAI 0.01 LECT pm TERM
     COUL NOIR LECT pm TERM
          ROUG LECT hp TERM
          TURQ LECT lp TERM
MATE GAZP RO 13. PINI 1.E6 GAMM 1.402 PREF 1.E5
              CV 713.3
              LECT hp TERM
     GAZP RO 1.3 PINI 1.E5 GAMM 1.402 PREF 1.E5
              CV 713.3
              LECT lp TERM
     MASS 0.0 LECT pm TERM
ECRI VFCC TFRE 10.E-3
     FICH ALIC TFRE 10.E-3
     FICH FORM MAPP OBJE LECT fl TERM TIME PROG 50.E-3 TERM
OPTI NOTE STEP IO LOG 1
     VFCC FCON 6
CALC TINI 0. TFIN 80.E-3
SUIT
Post treatment
RESU ALIC GARD PSCR
SORT GRAP AXTE 1.0 'T [s]'
SCOU 1 'p00' ECRO COMP 1 T  0.E-3 SAXE 1.0 'ABSC' LECT 2 PAS 1 102 TERM
SCOU 2 'p10' ECRO COMP 1 T 10.E-3 SAXE 1.0 'ABSC' LECT 2 PAS 1 102 TERM
SCOU 3 'p20' ECRO COMP 1 T 20.E-3 SAXE 1.0 'ABSC' LECT 2 PAS 1 102 TERM
SCOU 4 'p30' ECRO COMP 1 T 30.E-3 SAXE 1.0 'ABSC' LECT 2 PAS 1 102 TERM
SCOU 5 'p40' ECRO COMP 1 T 40.E-3 SAXE 1.0 'ABSC' LECT 2 PAS 1 102 TERM
SCOU 6 'p50' ECRO COMP 1 T 50.E-3 SAXE 1.0 'ABSC' LECT 2 PAS 1 102 TERM
SCOU 7 'p60' ECRO COMP 1 T 60.E-3 SAXE 1.0 'ABSC' LECT 2 PAS 1 102 TERM
SCOU 8 'p70' ECRO COMP 1 T 70.E-3 SAXE 1.0 'ABSC' LECT 2 PAS 1 102 TERM
SCOU 9 'p80' ECRO COMP 1 T 80.E-3 SAXE 1.0 'ABSC' LECT 2 PAS 1 102 TERM
TRAC 1 2 3 4 5 6 7 8 9 AXES 1.0 'PRES [PA]'
LIST 1 2 3 4 5 6 7 8 9 AXES 1.0 'PRES [PA]'
SCOU 11 'r00' ECRO COMP 2 T  0.E-3 SAXE 1.0 'ABSC' LECT 2 PAS 1 102 TERM
SCOU 12 'r10' ECRO COMP 2 T 10.E-3 SAXE 1.0 'ABSC' LECT 2 PAS 1 102 TERM
SCOU 13 'r20' ECRO COMP 2 T 20.E-3 SAXE 1.0 'ABSC' LECT 2 PAS 1 102 TERM
SCOU 14 'r30' ECRO COMP 2 T 30.E-3 SAXE 1.0 'ABSC' LECT 2 PAS 1 102 TERM
SCOU 15 'r40' ECRO COMP 2 T 40.E-3 SAXE 1.0 'ABSC' LECT 2 PAS 1 102 TERM
SCOU 16 'r50' ECRO COMP 2 T 50.E-3 SAXE 1.0 'ABSC' LECT 2 PAS 1 102 TERM
SCOU 17 'r60' ECRO COMP 2 T 60.E-3 SAXE 1.0 'ABSC' LECT 2 PAS 1 102 TERM
SCOU 18 'r70' ECRO COMP 2 T 70.E-3 SAXE 1.0 'ABSC' LECT 2 PAS 1 102 TERM
SCOU 19 'r80' ECRO COMP 2 T 80.E-3 SAXE 1.0 'ABSC' LECT 2 PAS 1 102 TERM
TRAC 11 12 13 14 15 16 17 18 19 AXES 1.0 'DENS [KG/M3]'
LIST 11 12 13 14 15 16 17 18 19 AXES 1.0 'DENS [KG/M3]'
FIN
```

mapp04.epx

```
MAPP04
ECHO
!CONV WIN
DPLA EULE
GEOM LIBR POIN 203 Q4VF 100 PMAT 1 TERM
 0 0  1 0  2 0  3 0  4 0  5 0  6 0  7 0  8 0  9 0  10 0
     11 0 12 0 13 0 14 0 15 0 16 0 17 0 18 0 19 0  20 0
     21 0 22 0 23 0 24 0 25 0 26 0 27 0 28 0 29 0  30 0
     31 0 32 0 33 0 34 0 35 0 36 0 37 0 38 0 39 0  40 0
     41 0 42 0 43 0 44 0 45 0 46 0 47 0 48 0 49 0  50 0
     51 0 52 0 53 0 54 0 55 0 56 0 57 0 58 0 59 0  60 0
     61 0 62 0 63 0 64 0 65 0 66 0 67 0 68 0 69 0  70 0
     71 0 72 0 73 0 74 0 75 0 76 0 77 0 78 0 79 0  80 0
     81 0 82 0 83 0 84 0 85 0 86 0 87 0 88 0 89 0  90 0
     91 0 92 0 93 0 94 0 95 0 96 0 97 0 98 0 99 0 100 0
 0 1  1 1  2 1  3 1  4 1  5 1  6 1  7 1  8 1  9 1  10 1
     11 1 12 1 13 1 14 1 15 1 16 1 17 1 18 1 19 1  20 1
     21 1 22 1 23 1 24 1 25 1 26 1 27 1 28 1 29 1  30 1
     31 1 32 1 33 1 34 1 35 1 36 1 37 1 38 1 39 1  40 1
     41 1 42 1 43 1 44 1 45 1 46 1 47 1 48 1 49 1  50 1
     51 1 52 1 53 1 54 1 55 1 56 1 57 1 58 1 59 1  60 1
     61 1 62 1 63 1 64 1 65 1 66 1 67 1 68 1 69 1  70 1
     71 1 72 1 73 1 74 1 75 1 76 1 77 1 78 1 79 1  80 1
     81 1 82 1 83 1 84 1 85 1 86 1 87 1 88 1 89 1  90 1
     91 1 92 1 93 1 94 1 95 1 96 1 97 1 98 1 99 1 100 1
 -0.5 0.5
   1   2 103 102
   2   3 104 103
   3   4 105 104
   4   5 106 105
   5   6 107 106
   6   7 108 107
   7   8 109 108
   8   9 110 109
   9  10 111 110
  10  11 112 111

  11  12 113 112
  12  13 114 113
  13  14 115 114
  14  15 116 115
  15  16 117 116
  16  17 118 117
  17  18 119 118
  18  19 120 119
  19  20 121 120
  20  21 122 121

  21  22 123 122
  22  23 124 123
  23  24 125 124
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  25  26 127 126
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  27  28 129 128
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  29  30 131 130
  30  31 132 131

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  32  33 134 133
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  37  38 139 138
  38  39 140 139
  39  40 141 140
  40  41 142 141
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  41  42 143 142
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  89  90 191 190
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  92  93 194 193
  93  94 195 194
  94  95 196 195
  95  96 197 196
  96  97 198 197
  97  98 199 198
  98  99 200 199
  99 100 201 200
 100 101 202 201

 203
COMP GROU 4 'hp' LECT   1 PAS 1  50 TERM
            'lp' LECT  51 PAS 1 100 TERM
            'fl' LECT   1 PAS 1 100 TERM
            'pm' LECT 101          TERM
     EPAI 0.01 LECT pm TERM
     COUL ROUG LECT hp TERM
          TURQ LECT lp TERM
          NOIR LECT pm TERM
MATE GAZP RO 13. PINI 1.E6 GAMM 1.402 PREF 1.E5
              CV 713.3
              LECT hp TERM
     GAZP RO 1.3 PINI 1.E5 GAMM 1.402 PREF 1.E5
              CV 713.3
              LECT lp TERM
     MASS 0.0 LECT pm TERM
INIT MAPP FORM 'mapp03.map' MATC OBJE LECT fl TERM
ECRI VFCC TFRE 10.E-3
     FICH ALIC TFRE 10.E-3
!    FICH FORM MAPP OBJE LECT fl TERM TIME PROG 50.E-3 TERM
OPTI NOTE STEP IO LOG 1
     VFCC FCON 6
CALC TINI 0. TFIN 80.E-3
SUIT
Post treatment
RESU ALIC GARD PSCR
SORT GRAP AXTE 1.0 'T [s]'
SCOU 6 'p50' ECRO COMP 1 T 50.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 7 'p60' ECRO COMP 1 T 60.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 8 'p70' ECRO COMP 1 T 70.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 9 'p80' ECRO COMP 1 T 80.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
RCOU 106 'p50' FICH 'mapp03.pun' RENA 'p50_03'
RCOU 107 'p60' FICH 'mapp03.pun' RENA 'p60_03'
RCOU 108 'p70' FICH 'mapp03.pun' RENA 'p70_03'
RCOU 109 'p80' FICH 'mapp03.pun' RENA 'p80_03'
TRAC           6 7 8 9 AXES 1.0 'PRES [PA]'
LIST           6 7 8 9 AXES 1.0 'PRES [PA]'
TRAC 6 7 8 9 106 107 108 109 AXES 1.0 'PRES [PA]'
COLO NOIR NOIR NOIR NOIR ROUG ROUG ROUG ROUG
SCOU 15 'r40' ECRO COMP 2 T 40.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 16 'r50' ECRO COMP 2 T 50.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 17 'r60' ECRO COMP 2 T 60.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 18 'r70' ECRO COMP 2 T 70.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 19 'r80' ECRO COMP 2 T 80.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
RCOU 116 'r50' FICH 'mapp03.pun' RENA 'r50_03'
RCOU 117 'r60' FICH 'mapp03.pun' RENA 'r60_03'
RCOU 118 'r70' FICH 'mapp03.pun' RENA 'r70_03'
RCOU 119 'r80' FICH 'mapp03.pun' RENA 'r80_03'
TRAC                16 17 18 19 AXES 1.0 'DENS [KG/M3]'
LIST                16 17 18 19 AXES 1.0 'DENS [KG/M3]'
TRAC 16 17 18 19 116 117 118 119 AXES 1.0 'DENS [KG/M3]'
COLO NOIR NOIR NOIR NOIR ROUG ROUG ROUG ROUG
FIN
```

mapp05.epx

```
MAPP05
ECHO
!CONV WIN
DPLA EULE
GEOM LIBR POIN 12 Q4VF 5 TERM
 2 1  1 0  4 1  3 0  1 1  6 0
 4 0  6 1  2 0  3 1  5 1  5 0
 7 3 10 4
 1 5 2 9
 12 6 8 11
 3 7 12 11
 9 4 10 1
COMP GROU 2 'hp' LECT 5 2 TERM
            'lp' LECT 4 3 1 TERM
     COUL ROUG LECT hp TERM
          TURQ LECT lp TERM
MATE GAZP RO 13. PINI 1.E6 GAMM 1.402 PREF 1.E5
              CV 713.3
              LECT hp TERM
     GAZP RO 1.3 PINI 1.E5 GAMM 1.402 PREF 1.E5
              CV 713.3
              LECT lp TERM
ECRI ECRO VFCC FREQ 1
     FICH FORM MAPP OBJE LECT 4 1 2 TERM NUPA LECT 1 TERM
OPTI NOTE LOG 1
     VFCC FCON 6
CALC TINI 0. TFIN 1.0 NMAX 2
FIN
```

mapp06.epx

```
MAPP06
ECHO
!CONV WIN
DPLA EULE
GEOM LIBR POIN 12 Q4VF 5 TERM
 1 0  5 1  0 1  3 0  2 1  4 0
 4 1  0 0  1 1  5 0  2 0  3 1
 4 12 5 11
 3 8 1 9
 6 10 2 7
 5 9 1 11
 7 12 4 6
COMP GROU 2 'hp' LECT 4 2 TERM
            'lp' LECT 5 3 1 TERM
     COUL ROUG LECT hp TERM
          TURQ LECT lp TERM
MATE GAZP RO 13. PINI 1.E6 GAMM 1.402 PREF 1.E5
              CV 713.3
              LECT hp TERM
     GAZP RO 1.3 PINI 1.E5 GAMM 1.402 PREF 1.E5
              CV 713.3
              LECT lp TERM
INIT MAPP FORM 'mapp05.map' MATC OBJE LECT 5 4 3 TERM
ECRI ECRO VFCC FREQ 1
OPTI NOTE LOG 1
     VFCC FCON 6
CALC TINI 0. TFIN 1.0 NMAX 1
FIN
```

mapp07.epx

```
MAPP07
ECHO
!CONV WIN
TRID EULE
GEOM LIBR POIN 404 CUVF 100 TERM
 0 0 0  1 0 0  2 0 0  3 0 0  4 0 0  5 0 0
        6 0 0  7 0 0  8 0 0  9 0 0 10 0 0
       11 0 0 12 0 0 13 0 0 14 0 0 15 0 0
       16 0 0 17 0 0 18 0 0 19 0 0 20 0 0
       21 0 0 22 0 0 23 0 0 24 0 0 25 0 0
       26 0 0 27 0 0 28 0 0 29 0 0 30 0 0
       31 0 0 32 0 0 33 0 0 34 0 0 35 0 0
       36 0 0 37 0 0 38 0 0 39 0 0 40 0 0
       41 0 0 42 0 0 43 0 0 44 0 0 45 0 0
       46 0 0 47 0 0 48 0 0 49 0 0 50 0 0
       51 0 0 52 0 0 53 0 0 54 0 0 55 0 0
       56 0 0 57 0 0 58 0 0 59 0 0 60 0 0
       61 0 0 62 0 0 63 0 0 64 0 0 65 0 0
       66 0 0 67 0 0 68 0 0 69 0 0 70 0 0
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       71 0 0 72 0 0 73 0 0 74 0 0 75 0 0
       76 0 0 77 0 0 78 0 0 79 0 0 80 0 0
       81 0 0 82 0 0 83 0 0 84 0 0 85 0 0
       86 0 0 87 0 0 88 0 0 89 0 0 90 0 0
       91 0 0 92 0 0 93 0 0 94 0 0 95 0 0
       96 0 0 97 0 0 98 0 0 99 0 0 100 0 0
0 1 0  1 1 0  2 1 0  3 1 0  4 1 0  5 1 0
        6 1 0  7 1 0  8 1 0  9 1 0 10 1 0
       11 1 0 12 1 0 13 1 0 14 1 0 15 1 0
       16 1 0 17 1 0 18 1 0 19 1 0 20 1 0
       21 1 0 22 1 0 23 1 0 24 1 0 25 1 0
       26 1 0 27 1 0 28 1 0 29 1 0 30 1 0
       31 1 0 32 1 0 33 1 0 34 1 0 35 1 0
       36 1 0 37 1 0 38 1 0 39 1 0 40 1 0
       41 1 0 42 1 0 43 1 0 44 1 0 45 1 0
       46 1 0 47 1 0 48 1 0 49 1 0 50 1 0
       51 1 0 52 1 0 53 1 0 54 1 0 55 1 0
       56 1 0 57 1 0 58 1 0 59 1 0 60 1 0
       61 1 0 62 1 0 63 1 0 64 1 0 65 1 0
       66 1 0 67 1 0 68 1 0 69 1 0 70 1 0
       71 1 0 72 1 0 73 1 0 74 1 0 75 1 0
       76 1 0 77 1 0 78 1 0 79 1 0 80 1 0
       81 1 0 82 1 0 83 1 0 84 1 0 85 1 0
       86 1 0 87 1 0 88 1 0 89 1 0 90 1 0
       91 1 0 92 1 0 93 1 0 94 1 0 95 1 0
       96 1 0 97 1 0 98 1 0 99 1 0 100 1 0
0 0 1  1 0 1  2 0 1  3 0 1  4 0 1  5 0 1
        6 0 1  7 0 1  8 0 1  9 0 1 10 0 1
       11 0 1 12 0 1 13 0 1 14 0 1 15 0 1
       16 0 1 17 0 1 18 0 1 19 0 1 20 0 1
       21 0 1 22 0 1 23 0 1 24 0 1 25 0 1
       26 0 1 27 0 1 28 0 1 29 0 1 30 0 1
       31 0 1 32 0 1 33 0 1 34 0 1 35 0 1
       36 0 1 37 0 1 38 0 1 39 0 1 40 0 1
       41 0 1 42 0 1 43 0 1 44 0 1 45 0 1
       46 0 1 47 0 1 48 0 1 49 0 1 50 0 1
       51 0 1 52 0 1 53 0 1 54 0 1 55 0 1
       56 0 1 57 0 1 58 0 1 59 0 1 60 0 1
       61 0 1 62 0 1 63 0 1 64 0 1 65 0 1
       66 0 1 67 0 1 68 0 1 69 0 1 70 0 1
       71 0 1 72 0 1 73 0 1 74 0 1 75 0 1
       76 0 1 77 0 1 78 0 1 79 0 1 80 0 1
       81 0 1 82 0 1 83 0 1 84 0 1 85 0 1
       86 0 1 87 0 1 88 0 1 89 0 1 90 0 1
       91 0 1 92 0 1 93 0 1 94 0 1 95 0 1
       96 0 1 97 0 1 98 0 1 99 0 1 100 0 1
0 1 1  1 1 1  2 1 1  3 1 1  4 1 1  5 1 1
        6 1 1  7 1 1  8 1 1  9 1 1 10 1 1
       11 1 1 12 1 1 13 1 1 14 1 1 15 1 1
       16 1 1 17 1 1 18 1 1 19 1 1 20 1 1
       21 1 1 22 1 1 23 1 1 24 1 1 25 1 1
       26 1 1 27 1 1 28 1 1 29 1 1 30 1 1
       31 1 1 32 1 1 33 1 1 34 1 1 35 1 1
       36 1 1 37 1 1 38 1 1 39 1 1 40 1 1
       41 1 1 42 1 1 43 1 1 44 1 1 45 1 1
       46 1 1 47 1 1 48 1 1 49 1 1 50 1 1
       51 1 1 52 1 1 53 1 1 54 1 1 55 1 1
       56 1 1 57 1 1 58 1 1 59 1 1 60 1 1
       61 1 1 62 1 1 63 1 1 64 1 1 65 1 1
       66 1 1 67 1 1 68 1 1 69 1 1 70 1 1
       71 1 1 72 1 1 73 1 1 74 1 1 75 1 1
       76 1 1 77 1 1 78 1 1 79 1 1 80 1 1
       81 1 1 82 1 1 83 1 1 84 1 1 85 1 1
       86 1 1 87 1 1 88 1 1 89 1 1 90 1 1
       91 1 1 92 1 1 93 1 1 94 1 1 95 1 1
       96 1 1 97 1 1 98 1 1 99 1 1 100 1 1

   1    2 103 102 203 204 305 304
   2    3 104 103 204 205 306 305
   3    4 105 104 205 206 307 306
   4    5 106 105 206 207 308 307
   5    6 107 106 207 208 309 308
   6    7 108 107 208 209 310 309
   7    8 109 108 209 210 311 310
   8    9 110 109 210 211 312 311
   9   10 111 110 211 212 313 312
  10   11 112 111 212 213 314 313
  11   12 113 112 213 214 315 314
  12   13 114 113 214 215 316 315
  13   14 115 114 215 216 317 316
  14   15 116 115 216 217 318 317
  15   16 117 116 217 218 319 318
  16   17 118 117 218 219 320 319
  17   18 119 118 219 220 321 320
  18   19 120 119 220 221 322 321
  19   20 121 120 221 222 323 322
  20   21 122 121 222 223 324 323
  21   22 123 122 223 224 325 324
  22   23 124 123 224 225 326 325
  23   24 125 124 225 226 327 326
  24   25 126 125 226 227 328 327
  25   26 127 126 227 228 329 328
  26   27 128 127 228 229 330 329
  27   28 129 128 229 230 331 330
  28   29 130 129 230 231 332 331
  29   30 131 130 231 232 333 332
  30   31 132 131 232 233 334 333
  31   32 133 132 233 234 335 334
  32   33 134 133 234 235 336 335
  33   34 135 134 235 236 337 336
  34   35 136 135 236 237 338 337
  35   36 137 136 237 238 339 338
  36   37 138 137 238 239 340 339
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  37   38 139 138 239 240 341 340
  38   39 140 139 240 241 342 341
  39   40 141 140 241 242 343 342
  40   41 142 141 242 243 344 343
  41   42 143 142 243 244 345 344
  42   43 144 143 244 245 346 345
  43   44 145 144 245 246 347 346
  44   45 146 145 246 247 348 347
  45   46 147 146 247 248 349 348
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  48   49 150 149 250 251 352 351
  49   50 151 150 251 252 353 352
  50   51 152 151 252 253 354 353
  51   52 153 152 253 254 355 354
  52   53 154 153 254 255 356 355
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  55   56 157 156 257 258 359 358
  56   57 158 157 258 259 360 359
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  61   62 163 162 263 264 365 364
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  63   64 165 164 265 266 367 366
  64   65 166 165 266 267 368 367
  65   66 167 166 267 268 369 368
  66   67 168 167 268 269 370 369
  67   68 169 168 269 270 371 370
  68   69 170 169 270 271 372 371
  69   70 171 170 271 272 373 372
  70   71 172 171 272 273 374 373
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  72   73 174 173 274 275 376 375
  73   74 175 174 275 276 377 376
  74   75 176 175 276 277 378 377
  75   76 177 176 277 278 379 378
  76   77 178 177 278 279 380 379
  77   78 179 178 279 280 381 380
  78   79 180 179 280 281 382 381
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  89   90 191 190 291 292 393 392
  90   91 192 191 292 293 394 393
  91   92 193 192 293 294 395 394
  92   93 194 193 294 295 396 395
  93   94 195 194 295 296 397 396
  94   95 196 195 296 297 398 397
  95   96 197 196 297 298 399 398
  96   97 198 197 298 299 400 399
  97   98 199 198 299 300 401 400
  98   99 200 199 300 301 402 401
  99  100 201 200 301 302 403 402
 100  101 202 201 302 303 404 403

COMP GROU 2 'hp' LECT  1 PAS 1  50 TERM
             'lp' LECT 51 PAS 1 100 TERM
     COUL ROUG LECT hp TERM
          TURQ LECT lp TERM
MATE GAZP RO 13. PINI 1.E6 GAMM 1.402 PREF 1.E5
               CV 713.3
               LECT hp TERM
     GAZP RO 1.3 PINI 1.E5 GAMM 1.402 PREF 1.E5
               CV 713.3
               LECT lp TERM
ECRI VFCC TFRE 10.E-3
     FICH ALIC TFRE 10.E-3
     FICH FORM MAPP OBJE LECT tous TERM TIME PROG 50.E-3 TERM
OPTI NOTE STEP IO LOG 1
     VFCC FCON 6
          ORDR 2 ! order in space
          OTPS 2 ! order in time
          RECO 1
CALC TINI 0. TFIN 80.E-3
SUIT
Post treatment
RESU ALIC GARD PSCR
SORT GRAP AXTE 1.0 'T [s]'
SCOU 1 'p00' ECRO COMP 1 T  0.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 2 'p10' ECRO COMP 1 T 10.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 3 'p20' ECRO COMP 1 T 20.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 4 'p30' ECRO COMP 1 T 30.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 5 'p40' ECRO COMP 1 T 40.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 6 'p50' ECRO COMP 1 T 50.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 7 'p60' ECRO COMP 1 T 60.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 8 'p70' ECRO COMP 1 T 70.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 9 'p80' ECRO COMP 1 T 80.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
TRAC 1 2 3 4 5 6 7 8 9 AXES 1.0 'PRES [PA]'
LIST 1 2 3 4 5 6 7 8 9 AXES 1.0 'PRES [PA]'
SCOU 11 'r00' ECRO COMP 2 T  0.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 12 'r10' ECRO COMP 2 T 10.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 13 'r20' ECRO COMP 2 T 20.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 14 'r30' ECRO COMP 2 T 30.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
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```
SCOU 15 ’r40’ ECRO COMP 2 T 40.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 16 ’r50’ ECRO COMP 2 T 50.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 17 ’r60’ ECRO COMP 2 T 60.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 18 ’r70’ ECRO COMP 2 T 70.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 19 ’r80’ ECRO COMP 2 T 80.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
TRAC 11 12 13 14 15 16 17 18 19 AXES 1.0 ’DENS [KG/M3]’
LIST 11 12 13 14 15 16 17 18 19 AXES 1.0 ’DENS [KG/M3]’
FIN
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mapp08.epx

```
MAPP08
ECHO
!CONV WIN
TRID EULE
GEOM LIBR POIN 404 CUVF 100 TERM
 0 0 0  1 0 0  2 0 0  3 0 0  4 0 0  5 0 0
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       11 0 0 12 0 0 13 0 0 14 0 0 15 0 0
       16 0 0 17 0 0 18 0 0 19 0 0 20 0 0
       21 0 0 22 0 0 23 0 0 24 0 0 25 0 0
       26 0 0 27 0 0 28 0 0 29 0 0 30 0 0
       31 0 0 32 0 0 33 0 0 34 0 0 35 0 0
       36 0 0 37 0 0 38 0 0 39 0 0 40 0 0
       41 0 0 42 0 0 43 0 0 44 0 0 45 0 0
       46 0 0 47 0 0 48 0 0 49 0 0 50 0 0
       51 0 0 52 0 0 53 0 0 54 0 0 55 0 0
       56 0 0 57 0 0 58 0 0 59 0 0 60 0 0
       61 0 0 62 0 0 63 0 0 64 0 0 65 0 0
       66 0 0 67 0 0 68 0 0 69 0 0 70 0 0
       71 0 0 72 0 0 73 0 0 74 0 0 75 0 0
       76 0 0 77 0 0 78 0 0 79 0 0 80 0 0
       81 0 0 82 0 0 83 0 0 84 0 0 85 0 0
       86 0 0 87 0 0 88 0 0 89 0 0 90 0 0
       91 0 0 92 0 0 93 0 0 94 0 0 95 0 0
       96 0 0 97 0 0 98 0 0 99 0 0 100 0 0
 0 1 0  1 1 0  2 1 0  3 1 0  4 1 0  5 1 0
        6 1 0  7 1 0  8 1 0  9 1 0 10 1 0
       11 1 0 12 1 0 13 1 0 14 1 0 15 1 0
       16 1 0 17 1 0 18 1 0 19 1 0 20 1 0
       21 1 0 22 1 0 23 1 0 24 1 0 25 1 0
       26 1 0 27 1 0 28 1 0 29 1 0 30 1 0
       31 1 0 32 1 0 33 1 0 34 1 0 35 1 0
       36 1 0 37 1 0 38 1 0 39 1 0 40 1 0
       41 1 0 42 1 0 43 1 0 44 1 0 45 1 0
       46 1 0 47 1 0 48 1 0 49 1 0 50 1 0
       51 1 0 52 1 0 53 1 0 54 1 0 55 1 0
       56 1 0 57 1 0 58 1 0 59 1 0 60 1 0
       61 1 0 62 1 0 63 1 0 64 1 0 65 1 0
       66 1 0 67 1 0 68 1 0 69 1 0 70 1 0
       71 1 0 72 1 0 73 1 0 74 1 0 75 1 0
       76 1 0 77 1 0 78 1 0 79 1 0 80 1 0
       81 1 0 82 1 0 83 1 0 84 1 0 85 1 0
       86 1 0 87 1 0 88 1 0 89 1 0 90 1 0
       91 1 0 92 1 0 93 1 0 94 1 0 95 1 0
       96 1 0 97 1 0 98 1 0 99 1 0 100 1 0
 0 0 1  1 0 1  2 0 1  3 0 1  4 0 1  5 0 1
        6 0 1  7 0 1  8 0 1  9 0 1 10 0 1
       11 0 1 12 0 1 13 0 1 14 0 1 15 0 1
       16 0 1 17 0 1 18 0 1 19 0 1 20 0 1
       21 0 1 22 0 1 23 0 1 24 0 1 25 0 1
       26 0 1 27 0 1 28 0 1 29 0 1 30 0 1
       31 0 1 32 0 1 33 0 1 34 0 1 35 0 1
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       61 0 1 62 0 1 63 0 1 64 0 1 65 0 1
       66 0 1 67 0 1 68 0 1 69 0 1 70 0 1
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       76 0 1 77 0 1 78 0 1 79 0 1 80 0 1
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       86 0 1 87 0 1 88 0 1 89 0 1 90 0 1
       91 0 1 92 0 1 93 0 1 94 0 1 95 0 1
       96 0 1 97 0 1 98 0 1 99 0 1 100 0 1
 0 1 1  1 1 1  2 1 1  3 1 1  4 1 1  5 1 1
        6 1 1  7 1 1  8 1 1  9 1 1 10 1 1
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       16 1 1 17 1 1 18 1 1 19 1 1 20 1 1
       21 1 1 22 1 1 23 1 1 24 1 1 25 1 1
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       86 1 1 87 1 1 88 1 1 89 1 1 90 1 1
       91 1 1 92 1 1 93 1 1 94 1 1 95 1 1
       96 1 1 97 1 1 98 1 1 99 1 1 100 1 1

   1   2 103 102 203 204 305 304
   2   3 104 103 204 205 306 305
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   4   5 106 105 206 207 308 307
   5   6 107 106 207 208 309 308
   6   7 108 107 208 209 310 309
   7   8 109 108 209 210 311 310
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  19  20 121 120 221 222 323 322
  20  21 122 121 222 223 324 323
  21  22 123 122 223 224 325 324
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  70  71 172 171 272 273 374 373
  71  72 173 172 273 274 375 374
  72  73 174 173 274 275 376 375
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  92  93 194 193 294 295 396 395
  93  94 195 194 295 296 397 396
  94  95 196 195 296 297 398 397
  95  96 197 196 297 298 399 398
  96  97 198 197 298 299 400 399
  97  98 199 198 299 300 401 400
  98  99 200 199 300 301 402 401
  99 100 201 200 301 302 403 402
 100 101 202 201 302 303 404 403

COMP GROU 2 ’hp’ LECT  1 PAS 1  50 TERM
            ’lp’ LECT 51 PAS 1 100 TERM
     COUL ROUG LECT hp TERM
          TURQ LECT lp TERM
MATE GAZP RO 13. PINI 1.E6 GAMM 1.402 PREF 1.E5
              CV 713.3
```

```
             LECT hp TERM
     GAZP RO 1.3 PINI 1.E5 GAMM 1.402 PREF 1.E5
             CV 713.3
             LECT lp TERM
INIT MAPP FORM 'mapp07.map' MATC OBJE LECT tous TERM
ECRI VFCC TFRE 10.E-3
     FICH ALIC TFRE 10.E-3
!    FICH FORM MAPP OBJE LECT tous TERM TIME PROG 50.E-3 TERM
OPTI NOTE STEP IO LOG 1
     VFCC FCON 6
          ORDR 2 ! order in space
          OTPS 2 ! order in time
          RECO 1
CALC TINI 0. TFIN 80.E-3
SUIT
Post treatment
RESU ALIC GARD PSCR
SORT GRAP AXTE 1.0 'T [s]'
SCOU 6 'p50' ECRO COMP 1 T 50.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 7 'p60' ECRO COMP 1 T 60.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 8 'p70' ECRO COMP 1 T 70.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 9 'p80' ECRO COMP 1 T 80.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
RCOU 106 'p50' FICH 'mapp07.pun' RENA 'p50_07'
RCOU 107 'p60' FICH 'mapp07.pun' RENA 'p60_07'
RCOU 108 'p70' FICH 'mapp07.pun' RENA 'p70_07'
RCOU 109 'p80' FICH 'mapp07.pun' RENA 'p80_07'
TRAC           6 7 8 9 AXES 1.0 'PRES [PA]'
LIST           6 7 8 9 AXES 1.0 'PRES [PA]'
TRAC 6 7 8 9 106 107 108 109 AXES 1.0 'PRES [PA]'
COLO NOIR NOIR NOIR NOIR ROUG ROUG ROUG ROUG
SCOU 16 'r50' ECRO COMP 2 T 50.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 17 'r60' ECRO COMP 2 T 60.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 18 'r70' ECRO COMP 2 T 70.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 19 'r80' ECRO COMP 2 T 80.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
RCOU 116 'r50' FICH 'mapp07.pun' RENA 'r50_07'
RCOU 117 'r60' FICH 'mapp07.pun' RENA 'r60_07'
RCOU 118 'r70' FICH 'mapp07.pun' RENA 'r70_07'
RCOU 119 'r80' FICH 'mapp07.pun' RENA 'r80_07'
TRAC                16 17 18 19 AXES 1.0 'DENS [KG/M3]'
LIST                16 17 18 19 AXES 1.0 'DENS [KG/M3]'
TRAC 16 17 18 19 116 117 118 119 AXES 1.0 'DENS [KG/M3]'
COLO NOIR NOIR NOIR NOIR ROUG ROUG ROUG ROUG
FIN
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mapp09.epx

```
MAPP09
ECHO
!CONV WIN
TRID EULE
GEOM LIBR POIN 404 CUVF 100 TERM
 0 0 0  1 0 0  2 0 0  3 0 0  4 0 0  5 0 0
        6 0 0  7 0 0  8 0 0  9 0 0 10 0 0
       11 0 0 12 0 0 13 0 0 14 0 0 15 0 0
       16 0 0 17 0 0 18 0 0 19 0 0 20 0 0
       21 0 0 22 0 0 23 0 0 24 0 0 25 0 0
       26 0 0 27 0 0 28 0 0 29 0 0 30 0 0
       31 0 0 32 0 0 33 0 0 34 0 0 35 0 0
       36 0 0 37 0 0 38 0 0 39 0 0 40 0 0
       41 0 0 42 0 0 43 0 0 44 0 0 45 0 0
       46 0 0 47 0 0 48 0 0 49 0 0 50 0 0
       51 0 0 52 0 0 53 0 0 54 0 0 55 0 0
       56 0 0 57 0 0 58 0 0 59 0 0 60 0 0
       61 0 0 62 0 0 63 0 0 64 0 0 65 0 0
       66 0 0 67 0 0 68 0 0 69 0 0 70 0 0
       71 0 0 72 0 0 73 0 0 74 0 0 75 0 0
       76 0 0 77 0 0 78 0 0 79 0 0 80 0 0
       81 0 0 82 0 0 83 0 0 84 0 0 85 0 0
       86 0 0 87 0 0 88 0 0 89 0 0 90 0 0
       91 0 0 92 0 0 93 0 0 94 0 0 95 0 0
       96 0 0 97 0 0 98 0 0 99 0 0 100 0 0
 0 1 0  1 1 0  2 1 0  3 1 0  4 1 0  5 1 0
        6 1 0  7 1 0  8 1 0  9 1 0 10 1 0
       11 1 0 12 1 0 13 1 0 14 1 0 15 1 0
       16 1 0 17 1 0 18 1 0 19 1 0 20 1 0
       21 1 0 22 1 0 23 1 0 24 1 0 25 1 0
       26 1 0 27 1 0 28 1 0 29 1 0 30 1 0
       31 1 0 32 1 0 33 1 0 34 1 0 35 1 0
       36 1 0 37 1 0 38 1 0 39 1 0 40 1 0
       41 1 0 42 1 0 43 1 0 44 1 0 45 1 0
       46 1 0 47 1 0 48 1 0 49 1 0 50 1 0
       51 1 0 52 1 0 53 1 0 54 1 0 55 1 0
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       76 1 0 77 1 0 78 1 0 79 1 0 80 1 0
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       86 1 0 87 1 0 88 1 0 89 1 0 90 1 0
       91 1 0 92 1 0 93 1 0 94 1 0 95 1 0
       96 1 0 97 1 0 98 1 0 99 1 0 100 1 0
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       11 0 1 12 0 1 13 0 1 14 0 1 15 0 1
       16 0 1 17 0 1 18 0 1 19 0 1 20 0 1
       21 0 1 22 0 1 23 0 1 24 0 1 25 0 1
       26 0 1 27 0 1 28 0 1 29 0 1 30 0 1
       31 0 1 32 0 1 33 0 1 34 0 1 35 0 1
       36 0 1 37 0 1 38 0 1 39 0 1 40 0 1
       41 0 1 42 0 1 43 0 1 44 0 1 45 0 1
       46 0 1 47 0 1 48 0 1 49 0 1 50 0 1
       51 0 1 52 0 1 53 0 1 54 0 1 55 0 1
       56 0 1 57 0 1 58 0 1 59 0 1 60 0 1
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       66 0 1 67 0 1 68 0 1 69 0 1 70 0 1
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       86 0 1 87 0 1 88 0 1 89 0 1 90 0 1
       91 0 1 92 0 1 93 0 1 94 0 1 95 0 1
       96 0 1 97 0 1 98 0 1 99 0 1 100 0 1
 0 1 1  1 1 1  2 1 1  3 1 1  4 1 1  5 1 1
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       16 1 1 17 1 1 18 1 1 19 1 1 20 1 1
       21 1 1 22 1 1 23 1 1 24 1 1 25 1 1
       26 1 1 27 1 1 28 1 1 29 1 1 30 1 1
       31 1 1 32 1 1 33 1 1 34 1 1 35 1 1
       36 1 1 37 1 1 38 1 1 39 1 1 40 1 1
       41 1 1 42 1 1 43 1 1 44 1 1 45 1 1
       46 1 1 47 1 1 48 1 1 49 1 1 50 1 1
       51 1 1 52 1 1 53 1 1 54 1 1 55 1 1
       56 1 1 57 1 1 58 1 1 59 1 1 60 1 1
       61 1 1 62 1 1 63 1 1 64 1 1 65 1 1
       66 1 1 67 1 1 68 1 1 69 1 1 70 1 1
       71 1 1 72 1 1 73 1 1 74 1 1 75 1 1
       76 1 1 77 1 1 78 1 1 79 1 1 80 1 1
       81 1 1 82 1 1 83 1 1 84 1 1 85 1 1
       86 1 1 87 1 1 88 1 1 89 1 1 90 1 1
       91 1 1 92 1 1 93 1 1 94 1 1 95 1 1
       96 1 1 97 1 1 98 1 1 99 1 1 100 1 1

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  3    4 105 104 205 206 307 306
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  6    7 108 107 208 209 310 309
  7    8 109 108 209 210 311 310
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  9   10 111 110 211 212 313 312
 10   11 112 111 212 213 314 313
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 13   14 115 114 215 216 317 316
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 22   23 124 123 224 225 326 325
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 26   27 128 127 228 229 330 329
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 40   41 142 141 242 243 344 343
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 42   43 144 143 244 245 346 345
 43   44 145 144 245 246 347 346
 44   45 146 145 246 247 348 347
 45   46 147 146 247 248 349 348
 46   47 148 147 248 249 350 349
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 49   50 151 150 251 252 353 352
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 51   52 153 152 253 254 355 354
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 65   66 167 166 267 268 369 368
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 69   70 171 170 271 272 373 372
 70   71 172 171 272 273 374 373
 71   72 173 172 273 274 375 374
 72   73 174 173 274 275 376 375
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  86  87 188 187 288 289 390 389
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  88  89 190 189 290 291 392 391
  89  90 191 190 291 292 393 392
  90  91 192 191 292 293 394 393
  91  92 193 192 293 294 395 394
  92  93 194 193 294 295 396 395
  93  94 195 194 295 296 397 396
  94  95 196 195 296 297 398 397
  95  96 197 196 297 298 399 398
  96  97 198 197 298 299 400 399
  97  98 199 198 299 300 401 400
  98  99 200 199 300 301 402 401
  99 100 201 200 301 302 403 402
 100 101 202 201 302 303 404 403

COMP GROU 2 'hp' LECT  1 PAS 1  50 TERM
            'lp' LECT 51 PAS 1 100 TERM
     COUL ROUG LECT hp TERM
          TURQ LECT lp TERM
MATE GAZP RO 13. PINI 1.E6 GAMM 1.402 PREF 1.E5
               CV 713.3
               LECT hp TERM
     GAZP RO 1.3 PINI 1.E5 GAMM 1.402 PREF 1.E5
               CV 713.3
               LECT lp TERM
ECRI VFCC TFRE 10.E-3
     FICH ALIC TFRE 10.E-3
OPTI NOTE STEP IO LOG 1
     VFCC FCON 6
          ORDR 2 ! order in space
          OTPS 2 ! order in time
          RECO 1
CALC TINI 0. TFIN 80.E-3
SUIT
Post treatment
RESU ALIC GARD PSCR
SORT GRAP AXTE 1.0 'T [s]'
SCOU 1 'p00' ECRO COMP 1 T  0.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 2 'p10' ECRO COMP 1 T 10.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 3 'p20' ECRO COMP 1 T 20.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 4 'p30' ECRO COMP 1 T 30.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 5 'p40' ECRO COMP 1 T 40.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 6 'p50' ECRO COMP 1 T 50.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 7 'p60' ECRO COMP 1 T 60.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 8 'p70' ECRO COMP 1 T 70.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 9 'p80' ECRO COMP 1 T 80.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
TRAC 1 2 3 4 5 6 7 8 9 AXES 1.0 'PRES [PA]'
LIST 1 2 3 4 5 6 7 8 9 AXES 1.0 'PRES [PA]'
SCOU 11 'r00' ECRO COMP 2 T  0.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 12 'r10' ECRO COMP 2 T 10.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 13 'r20' ECRO COMP 2 T 20.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 14 'r30' ECRO COMP 2 T 30.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 15 'r40' ECRO COMP 2 T 40.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 16 'r50' ECRO COMP 2 T 50.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 17 'r60' ECRO COMP 2 T 60.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 18 'r70' ECRO COMP 2 T 70.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 19 'r80' ECRO COMP 2 T 80.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
TRAC 11 12 13 14 15 16 17 18 19 AXES 1.0 'DENS [KG/M3]'
LIST 11 12 13 14 15 16 17 18 19 AXES 1.0 'DENS [KG/M3]'
FIN
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mapp09b.epx

```
MAPP09B
RESU ALIC 'mapp09.ali' GARD PSCR
SORT GRAP AXTE 1.0 'T [s]'
SCOU  9 'p80' ECRO COMP 1 T 80.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 19 'r80' ECRO COMP 2 T 80.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
RCOU 109 'p80' FICH 'mapp00.pun' RENA 'p80_00'
RCOU 119 'r80' FICH 'mapp00.pun' RENA 'r80_00'
TRAC 9 109 AXES 1.0 'PRES [PA]'
COLO NOIR VERT
TRAC 19 119 AXES 1.0 'DENS [KG/M3]'
COLO NOIR VERT
FIN
```

mapp10.epx

```
MAPP10
ECHO
!CONV WIN
TRID EULE
GEOM LIBR POIN 101 TUVF 100 TERM
 0 0 0  1 0 0  2 0 0  3 0 0  4 0 0  5 0 0
        6 0 0  7 0 0  8 0 0  9 0 0  10 0 0
     11 0 0 12 0 0 13 0 0 14 0 0 15 0 0
     16 0 0 17 0 0 18 0 0 19 0 0  20 0 0
     21 0 0 22 0 0 23 0 0 24 0 0 25 0 0
     26 0 0 27 0 0 28 0 0 29 0 0  30 0 0
     31 0 0 32 0 0 33 0 0 34 0 0 35 0 0
     36 0 0 37 0 0 38 0 0 39 0 0  40 0 0
     41 0 0 42 0 0 43 0 0 44 0 0 45 0 0
     46 0 0 47 0 0 48 0 0 49 0 0  50 0 0
     51 0 0 52 0 0 53 0 0 54 0 0 55 0 0
     56 0 0 57 0 0 58 0 0 59 0 0  60 0 0
     61 0 0 62 0 0 63 0 0 64 0 0 65 0 0
     66 0 0 67 0 0 68 0 0 69 0 0  70 0 0
     71 0 0 72 0 0 73 0 0 74 0 0 75 0 0
     76 0 0 77 0 0 78 0 0 79 0 0  80 0 0
     81 0 0 82 0 0 83 0 0 84 0 0 85 0 0
     86 0 0 87 0 0 88 0 0 89 0 0  90 0 0
     91 0 0 92 0 0 93 0 0 94 0 0 95 0 0
     96 0 0 97 0 0 98 0 0 99 0 0 100 0 0
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  97  98
  98  99
  99 100
 100 101
COMP GROU 2 ’hp’ LECT  1 PAS 1  50 TERM
            ’lp’ LECT 51 PAS 1 100 TERM
     DIAM DROI 0.1 LECT tous TERM
     COUL ROUG LECT hp TERM
          TURQ LECT lp TERM
MATE GAZP RO 13. PINI 1.E6 GAMM 1.402 PREF 1.E5
               CV 713.3
               LECT hp TERM
     GAZP RO 1.3 PINI 1.E5 GAMM 1.402 PREF 1.E5
               CV 713.3
               LECT lp TERM
ECRI VFCC TFRE 10.E-3
     FICH ALIC TFRE 10.E-3
OPTI NOTE STEP IO LOG 1
     VFCC FCON 6
CALC TINI 0. TFIN 80.E-3
SUIT
Post treatment
RESU ALIC GARD PSCR
SORT GRAP AXTE 1.0 ’T [s]’
SCOU 1 ’p00’ ECRO COMP 1 T  0.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 2 ’p10’ ECRO COMP 1 T 10.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 3 ’p20’ ECRO COMP 1 T 20.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 4 ’p30’ ECRO COMP 1 T 30.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 5 ’p40’ ECRO COMP 1 T 40.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 6 ’p50’ ECRO COMP 1 T 50.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 7 ’p60’ ECRO COMP 1 T 60.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 8 ’p70’ ECRO COMP 1 T 70.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 9 ’p80’ ECRO COMP 1 T 80.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
TRAC 1 2 3 4 5 6 7 8 9 AXES 1.0 ’PRES [PA]’
SCOU 11 ’r00’ ECRO COMP 2 T  0.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 12 ’r10’ ECRO COMP 2 T 10.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 13 ’r20’ ECRO COMP 2 T 20.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 14 ’r30’ ECRO COMP 2 T 30.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 15 ’r40’ ECRO COMP 2 T 40.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 16 ’r50’ ECRO COMP 2 T 50.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 17 ’r60’ ECRO COMP 2 T 60.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 18 ’r70’ ECRO COMP 2 T 70.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 19 ’r80’ ECRO COMP 2 T 80.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
TRAC 11 12 13 14 15 16 17 18 19 AXES 1.0 ’DENS [KG/M3]’
FIN
```

mapp11.epx

```
MAPP11
ECHO
!CONV WIN
TRID EULE
GEOM LIBR POIN 101 TUVF 100 TERM
 0 0 0  1 0 0  2 0 0  3 0 0  4 0 0  5 0 0
        6 0 0  7 0 0  8 0 0  9 0 0  10 0 0
       11 0 0 12 0 0 13 0 0 14 0 0 15 0 0
       16 0 0 17 0 0 18 0 0 19 0 0  20 0 0
       21 0 0 22 0 0 23 0 0 24 0 0 25 0 0
       26 0 0 27 0 0 28 0 0 29 0 0  30 0 0
       31 0 0 32 0 0 33 0 0 34 0 0 35 0 0
       36 0 0 37 0 0 38 0 0 39 0 0  40 0 0
       41 0 0 42 0 0 43 0 0 44 0 0 45 0 0
       46 0 0 47 0 0 48 0 0 49 0 0  50 0 0
       51 0 0 52 0 0 53 0 0 54 0 0 55 0 0
       56 0 0 57 0 0 58 0 0 59 0 0  60 0 0
       61 0 0 62 0 0 63 0 0 64 0 0 65 0 0
       66 0 0 67 0 0 68 0 0 69 0 0  70 0 0
       71 0 0 72 0 0 73 0 0 74 0 0 75 0 0
       76 0 0 77 0 0 78 0 0 79 0 0  80 0 0
       81 0 0 82 0 0 83 0 0 84 0 0 85 0 0
       86 0 0 87 0 0 88 0 0 89 0 0  90 0 0
       91 0 0 92 0 0 93 0 0 94 0 0 95 0 0
       96 0 0 97 0 0 98 0 0 99 0 0 100 0 0
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   3   4
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  93  94
  94  95
  95  96
  96  97
  97  98
  98  99
  99 100
 100 101
COMP GROU 2 ’hp’ LECT  1 PAS 1  50 TERM
            ’lp’ LECT 51 PAS 1 100 TERM
```

```
     DIAM DROI 0.1 LECT tous TERM
     COUL ROUG LECT hp TERM
          TURQ LECT lp TERM
MATE GAZP RO 13. PINI 1.E6 GAMM 1.402 PREF 1.E5
               CV 713.3
               LECT hp TERM
     GAZP RO 1.3 PINI 1.E5 GAMM 1.402 PREF 1.E5
               CV 713.3
               LECT lp TERM
ECRI VFCC TFRE 10.E-3
     FICH ALIC TFRE 10.E-3
     FICH FORM MAPP OBJE LECT tous TERM TIME PROG 50.E-3 TERM
OPTI NOTE STEP IO LOG 1
     VFCC FCON 6
CALC TINI 0. TFIN 80.E-3
SUIT
Post treatment
RESU ALIC GARD PSCR
SORT GRAP AXTE 1.0 'T [s]'
SCOU 1 'p00' ECRO COMP 1 T  0.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 2 'p10' ECRO COMP 1 T 10.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 3 'p20' ECRO COMP 1 T 20.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 4 'p30' ECRO COMP 1 T 30.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 5 'p40' ECRO COMP 1 T 40.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 6 'p50' ECRO COMP 1 T 50.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 7 'p60' ECRO COMP 1 T 60.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 8 'p70' ECRO COMP 1 T 70.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 9 'p80' ECRO COMP 1 T 80.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
TRAC 1 2 3 4 5 6 7 8 9 AXES 1.0 'PRES [PA]'
LIST 1 2 3 4 5 6 7 8 9 AXES 1.0 'PRES [PA]'
SCOU 11 'r00' ECRO COMP 2 T  0.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 12 'r10' ECRO COMP 2 T 10.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 13 'r20' ECRO COMP 2 T 20.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 14 'r30' ECRO COMP 2 T 30.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 15 'r40' ECRO COMP 2 T 40.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 16 'r50' ECRO COMP 2 T 50.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 17 'r60' ECRO COMP 2 T 60.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 18 'r70' ECRO COMP 2 T 70.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 19 'r80' ECRO COMP 2 T 80.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
TRAC 11 12 13 14 15 16 17 18 19 AXES 1.0 'DENS [KG/M3]'
LIST 11 12 13 14 15 16 17 18 19 AXES 1.0 'DENS [KG/M3]'
FIN
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mapp12.epx

```
MAPP12
ECHO
!CONV WIN
TRID EULE
GEOM LIBR POIN 101 TUVF 100 TERM
 0 0 0  1 0 0  2 0 0  3 0 0  4 0 0  5 0 0
        6 0 0  7 0 0  8 0 0  9 0 0  10 0 0
       11 0 0 12 0 0 13 0 0 14 0 0 15 0 0
       16 0 0 17 0 0 18 0 0 19 0 0  20 0 0
       21 0 0 22 0 0 23 0 0 24 0 0 25 0 0
       26 0 0 27 0 0 28 0 0 29 0 0  30 0 0
       31 0 0 32 0 0 33 0 0 34 0 0 35 0 0
       36 0 0 37 0 0 38 0 0 39 0 0  40 0 0
       41 0 0 42 0 0 43 0 0 44 0 0 45 0 0
       46 0 0 47 0 0 48 0 0 49 0 0  50 0 0
       51 0 0 52 0 0 53 0 0 54 0 0 55 0 0
       56 0 0 57 0 0 58 0 0 59 0 0  60 0 0
       61 0 0 62 0 0 63 0 0 64 0 0 65 0 0
       66 0 0 67 0 0 68 0 0 69 0 0  70 0 0
       71 0 0 72 0 0 73 0 0 74 0 0 75 0 0
       76 0 0 77 0 0 78 0 0 79 0 0  80 0 0
       81 0 0 82 0 0 83 0 0 84 0 0 85 0 0
       86 0 0 87 0 0 88 0 0 89 0 0  90 0 0
       91 0 0 92 0 0 93 0 0 94 0 0 95 0 0
       96 0 0 97 0 0 98 0 0 99 0 0 100 0 0
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   4   5
   5   6
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  95  96
  96  97
  97  98
  98  99
  99 100
 100 101
COMP GROU 2 'hp' LECT  1 PAS 1  50 TERM
            'lp' LECT 51 PAS 1 100 TERM
     DIAM DROI 0.1 LECT tous TERM
     COUL ROUG LECT hp TERM
          TURQ LECT lp TERM
MATE GAZP RO 13. PINI 1.E6 GAMM 1.402 PREF 1.E5
               CV 713.3
               LECT hp TERM
     GAZP RO 1.3 PINI 1.E5 GAMM 1.402 PREF 1.E5
               CV 713.3
               LECT lp TERM
INIT MAPP FORM 'mapp11.map' MATC OBJE LECT tous TERM
ECRI VFCC TFRE 10.E-3
     FICH ALIC TFRE 10.E-3
!    FICH FORM MAPP OBJE LECT tous TERM TIME PROG 50.E-3 TERM
OPTI NOTE STEP IO LOG 1
     VFCC FCON 6
CALC TINI 0. TFIN 80.E-3
SUIT
Post treatment
RESU ALIC GARD PSCR
SORT GRAP AXTE 1.0 'T [s]'
SCOU 6 'p50' ECRO COMP 1 T 50.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 7 'p60' ECRO COMP 1 T 60.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 8 'p70' ECRO COMP 1 T 70.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
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SCOU 9 ’p80’ ECRO COMP 1 T 80.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
RCOU 106 ’p50’ FICH ’mapp11.pun’ RENA ’p50_11’
RCOU 107 ’p60’ FICH ’mapp11.pun’ RENA ’p60_11’
RCOU 108 ’p70’ FICH ’mapp11.pun’ RENA ’p70_11’
RCOU 109 ’p80’ FICH ’mapp11.pun’ RENA ’p80_11’
TRAC          6 7 8 9 AXES 1.0 ’PRES [PA]’
LIST          6 7 8 9 AXES 1.0 ’PRES [PA]’
TRAC 6 7 8 9 106 107 108 109 AXES 1.0 ’PRES [PA]’
COLO NOIR NOIR NOIR NOIR ROUG ROUG ROUG ROUG
SCOU 16 ’r50’ ECRO COMP 2 T 50.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 17 ’r60’ ECRO COMP 2 T 60.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 18 ’r70’ ECRO COMP 2 T 70.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 19 ’r80’ ECRO COMP 2 T 80.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
RCOU 116 ’r50’ FICH ’mapp11.pun’ RENA ’r50_11’
RCOU 117 ’r60’ FICH ’mapp11.pun’ RENA ’r60_11’
RCOU 118 ’r70’ FICH ’mapp11.pun’ RENA ’r70_11’
RCOU 119 ’r80’ FICH ’mapp11.pun’ RENA ’r80_11’
TRAC                16 17 18 19 AXES 1.0 ’DENS [KG/M3]’
LIST                16 17 18 19 AXES 1.0 ’DENS [KG/M3]’
TRAC 16 17 18 19 116 117 118 119 AXES 1.0 ’DENS [KG/M3]’
COLO NOIR NOIR NOIR NOIR ROUG ROUG ROUG ROUG
FIN
```

mapp16.epx

```
MAPP16
ECHO
!CONV WIN
TRID EULE
GEOM LIBR POIN 101 TUVF 100 TERM
 0 0 0  1 0 0  2 0 0  3 0 0  4 0 0  5 0 0
        6 0 0  7 0 0  8 0 0  9 0 0  10 0 0
       11 0 0 12 0 0 13 0 0 14 0 0 15 0 0
       16 0 0 17 0 0 18 0 0 19 0 0  20 0 0
       21 0 0 22 0 0 23 0 0 24 0 0 25 0 0
       26 0 0 27 0 0 28 0 0 29 0 0  30 0 0
       31 0 0 32 0 0 33 0 0 34 0 0 35 0 0
       36 0 0 37 0 0 38 0 0 39 0 0  40 0 0
       41 0 0 42 0 0 43 0 0 44 0 0 45 0 0
       46 0 0 47 0 0 48 0 0 49 0 0  50 0 0
       51 0 0 52 0 0 53 0 0 54 0 0 55 0 0
       56 0 0 57 0 0 58 0 0 59 0 0  60 0 0
       61 0 0 62 0 0 63 0 0 64 0 0 65 0 0
       66 0 0 67 0 0 68 0 0 69 0 0  70 0 0
       71 0 0 72 0 0 73 0 0 74 0 0 75 0 0
       76 0 0 77 0 0 78 0 0 79 0 0  80 0 0
       81 0 0 82 0 0 83 0 0 84 0 0 85 0 0
       86 0 0 87 0 0 88 0 0 89 0 0  90 0 0
       91 0 0 92 0 0 93 0 0 94 0 0 95 0 0
       96 0 0 97 0 0 98 0 0 99 0 0 100 0 0
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  95  96
  96  97
  97  98
  98  99
  99 100
 100 101
COMP GROU 2 ’hp’ LECT  1 PAS 1  50 TERM
            ’lp’ LECT 51 PAS 1 100 TERM
     DIAM DROI 0.1 LECT tous TERM
     COUL ROUG LECT hp TERM
          TURQ LECT lp TERM
MATE GAZP RO 13. PINI 1.E6 GAMM 1.402 PREF 1.E5
             CV 713.3
             LECT hp TERM
     GAZP RO 1.3 PINI 1.E5 GAMM 1.402 PREF 1.E5
             CV 713.3
             LECT lp TERM
ECRI VFCC TFRE 10.E-3
     FICH ALIC TFRE 10.E-3
!    FICH FORM MAPP OBJE LECT tous TERM TIME PROG 50.E-3 TERM
OPTI NOTE STEP IO LOG 1
     VFCC FCON 6
          ORDR 2 ! order in space
          OTPS 2 ! order in time
!         RECO 1 ! Not accepted by CAL_VFCC_1D
CALC TINI 0. TFIN 80.E-3
SUIT
Post treatment
RESU ALIC GARD PSCR
SORT GRAP AXTE 1.0 ’T [s]’
SCOU 1 ’p00’ ECRO COMP 1 T  0.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 2 ’p10’ ECRO COMP 1 T 10.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 3 ’p20’ ECRO COMP 1 T 20.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 4 ’p30’ ECRO COMP 1 T 30.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 5 ’p40’ ECRO COMP 1 T 40.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 6 ’p50’ ECRO COMP 1 T 50.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 7 ’p60’ ECRO COMP 1 T 60.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 8 ’p70’ ECRO COMP 1 T 70.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 9 ’p80’ ECRO COMP 1 T 80.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
TRAC 1 2 3 4 5 6 7 8 9 AXES 1.0 ’PRES [PA]’
LIST 1 2 3 4 5 6 7 8 9 AXES 1.0 ’PRES [PA]’
SCOU 11 ’r00’ ECRO COMP 2 T  0.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 12 ’r10’ ECRO COMP 2 T 10.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 13 ’r20’ ECRO COMP 2 T 20.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 14 ’r30’ ECRO COMP 2 T 30.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 15 ’r40’ ECRO COMP 2 T 40.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 16 ’r50’ ECRO COMP 2 T 50.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 17 ’r60’ ECRO COMP 2 T 60.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 18 ’r70’ ECRO COMP 2 T 70.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
SCOU 19 ’r80’ ECRO COMP 2 T 80.E-3 SAXE 1.0 ’ABSC’ LECT 1 PAS 1 101 TERM
TRAC 11 12 13 14 15 16 17 18 19 AXES 1.0 ’DENS [KG/M3]’
```

```
LIST 11 12 13 14 15 16 17 18 19 AXES 1.0 'DENS [KG/M3]'
FIN
```

mapp17.epx

```
MAPP17
ECHO
!CONV WIN
TRID EULE
GEOM LIBR POIN 101 TUVF 100 TERM
 0 0 0  1 0 0  2 0 0  3 0 0  4 0 0  5 0 0
        6 0 0  7 0 0  8 0 0  9 0 0  10 0 0
       11 0 0 12 0 0 13 0 0 14 0 0 15 0 0
       16 0 0 17 0 0 18 0 0 19 0 0  20 0 0
       21 0 0 22 0 0 23 0 0 24 0 0 25 0 0
       26 0 0 27 0 0 28 0 0 29 0 0  30 0 0
       31 0 0 32 0 0 33 0 0 34 0 0 35 0 0
       36 0 0 37 0 0 38 0 0 39 0 0  40 0 0
       41 0 0 42 0 0 43 0 0 44 0 0 45 0 0
       46 0 0 47 0 0 48 0 0 49 0 0  50 0 0
       51 0 0 52 0 0 53 0 0 54 0 0 55 0 0
       56 0 0 57 0 0 58 0 0 59 0 0  60 0 0
       61 0 0 62 0 0 63 0 0 64 0 0 65 0 0
       66 0 0 67 0 0 68 0 0 69 0 0  70 0 0
       71 0 0 72 0 0 73 0 0 74 0 0 75 0 0
       76 0 0 77 0 0 78 0 0 79 0 0  80 0 0
       81 0 0 82 0 0 83 0 0 84 0 0 85 0 0
       86 0 0 87 0 0 88 0 0 89 0 0  90 0 0
       91 0 0 92 0 0 93 0 0 94 0 0 95 0 0
       96 0 0 97 0 0 98 0 0 99 0 0 100 0 0
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  95  96
  96  97
  97  98
  98  99
  99 100
 100 101
COMP GROU 2 'hp' LECT  1 PAS 1  50 TERM
            'lp' LECT 51 PAS 1 100 TERM
     DIAM DROI 0.1 LECT tous TERM
     COUL ROUG LECT hp TERM
          TURQ LECT lp TERM
MATE GAZP RO 13. PINI 1.E6 GAMM 1.402 PREF 1.E5
               CV 713.3
               LECT hp TERM
     GAZP RO 1.3 PINI 1.E5 GAMM 1.402 PREF 1.E5
               CV 713.3
               LECT lp TERM
ECRI VFCC TFRE 10.E-3
     FICH ALIC TFRE 10.E-3
     FICH FORM MAPP OBJE LECT tous TERM TIME PROG 50.E-3 TERM
OPTI NOTE STEP IO LOG 1
     VFCC FCON 6
          ORDR 2 ! order in space
          OTPS 2 ! order in time
          RECO 1
CALC TINI 0. TFIN 80.E-3
SUIT
Post treatment
RESU ALIC GARD PSCR
SORT GRAP AXTE 1.0 'T [s]'
SCOU 1 'p00' ECRO COMP 1 T  0.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 2 'p10' ECRO COMP 1 T 10.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 3 'p20' ECRO COMP 1 T 20.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 4 'p30' ECRO COMP 1 T 30.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 5 'p40' ECRO COMP 1 T 40.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 6 'p50' ECRO COMP 1 T 50.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 7 'p60' ECRO COMP 1 T 60.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 8 'p70' ECRO COMP 1 T 70.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 9 'p80' ECRO COMP 1 T 80.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
TRAC 1 2 3 4 5 6 7 8 9 AXES 1.0 'PRES [PA]'
LIST 1 2 3 4 5 6 7 8 9 AXES 1.0 'PRES [PA]'
SCOU 11 'r00' ECRO COMP 2 T  0.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 12 'r10' ECRO COMP 2 T 10.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 13 'r20' ECRO COMP 2 T 20.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 14 'r30' ECRO COMP 2 T 30.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 15 'r40' ECRO COMP 2 T 40.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 16 'r50' ECRO COMP 2 T 50.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 17 'r60' ECRO COMP 2 T 60.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 18 'r70' ECRO COMP 2 T 70.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 19 'r80' ECRO COMP 2 T 80.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
TRAC 11 12 13 14 15 16 17 18 19 AXES 1.0 'DENS [KG/M3]'
LIST 11 12 13 14 15 16 17 18 19 AXES 1.0 'DENS [KG/M3]'
FIN
```

mapp18.epx

```
MAPP18
ECHO
!CONV WIN
TRID EULE
GEOM LIBR POIN 101 TUVF 100 TERM
 0 0 0  1 0 0  2 0 0  3 0 0  4 0 0  5 0 0
        6 0 0  7 0 0  8 0 0  9 0 0  10 0 0
       11 0 0 12 0 0 13 0 0 14 0 0 15 0 0
       16 0 0 17 0 0 18 0 0 19 0 0  20 0 0
       21 0 0 22 0 0 23 0 0 24 0 0 25 0 0
       26 0 0 27 0 0 28 0 0 29 0 0  30 0 0
       31 0 0 32 0 0 33 0 0 34 0 0 35 0 0
       36 0 0 37 0 0 38 0 0 39 0 0  40 0 0
```

```
     41 0 0 42 0 0 43 0 0 44 0 0 45 0 0
     46 0 0 47 0 0 48 0 0 49 0 0  50 0 0
     51 0 0 52 0 0 53 0 0 54 0 0 55 0 0
     56 0 0 57 0 0 58 0 0 59 0 0  60 0 0
     61 0 0 62 0 0 63 0 0 64 0 0 65 0 0
     66 0 0 67 0 0 68 0 0 69 0 0  70 0 0
     71 0 0 72 0 0 73 0 0 74 0 0 75 0 0
     76 0 0 77 0 0 78 0 0 79 0 0  80 0 0
     81 0 0 82 0 0 83 0 0 84 0 0 85 0 0
     86 0 0 87 0 0 88 0 0 89 0 0  90 0 0
     91 0 0 92 0 0 93 0 0 94 0 0 95 0 0
     96 0 0 97 0 0 98 0 0 99 0 0 100 0 0
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 93  94
 94  95
 95  96
 96  97
 97  98
 98  99
 99 100
100 101
COMP GROU 2 'hp' LECT  1 PAS 1  50 TERM
            'lp' LECT 51 PAS 1 100 TERM
     DIAM DROI 0.1 LECT tous TERM
     COUL ROUG LECT hp TERM
          TURQ LECT lp TERM
MATE GAZP RO 13. PINI 1.E6 GAMM 1.402 PREF 1.E5
             CV 713.3
             LECT hp TERM
     GAZP RO 1.3 PINI 1.E5 GAMM 1.402 PREF 1.E5
             CV 713.3
             LECT lp TERM
INIT MAPP FORM 'mapp11.map' MATC OBJE LECT tous TERM
ECRI VFCC TFRE 10.E-3
     FICH ALIC TFRE 10.E-3
!    FICH FORM MAPP OBJE LECT tous TERM TIME PROG 50.E-3 TERM
OPTI NOTE STEP IO LOG 1
     VFCC FCON 6
          ORDR 2 ! order in space
          OTPS 2 ! order in time
          RECO 1
CALC TINI 0. TFIN 80.E-3
SUIT
Post treatment
RESU ALIC GARD PSCR
SORT GRAP AXTE 1.0 'T [s]'
SCOU 6 'p50' ECRO COMP 1 T 50.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 7 'p60' ECRO COMP 1 T 60.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 8 'p70' ECRO COMP 1 T 70.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 9 'p80' ECRO COMP 1 T 80.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
RCOU 106 'p50' FICH 'mapp17.pun' RENA 'p50_17'
RCOU 107 'p60' FICH 'mapp17.pun' RENA 'p60_17'
RCOU 108 'p70' FICH 'mapp17.pun' RENA 'p70_17'
RCOU 109 'p80' FICH 'mapp17.pun' RENA 'p80_17'
TRAC           6 7 8 9 AXES 1.0 'PRES [PA]'
LIST           6 7 8 9 AXES 1.0 'PRES [PA]'
TRAC 6 7 8 9 106 107 108 109 AXES 1.0 'PRES [PA]'
COLO NOIR NOIR NOIR NOIR ROUG ROUG ROUG ROUG
SCOU 16 'r50' ECRO COMP 2 T 50.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 17 'r60' ECRO COMP 2 T 60.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 18 'r70' ECRO COMP 2 T 70.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
SCOU 19 'r80' ECRO COMP 2 T 80.E-3 SAXE 1.0 'ABSC' LECT 1 PAS 1 101 TERM
RCOU 116 'r50' FICH 'mapp17.pun' RENA 'r50_17'
RCOU 117 'r60' FICH 'mapp17.pun' RENA 'r60_17'
RCOU 118 'r70' FICH 'mapp17.pun' RENA 'r70_17'
RCOU 119 'r80' FICH 'mapp17.pun' RENA 'r80_17'
TRAC                16 17 18 19 AXES 1.0 'DENS [KG/M3]'
LIST                16 17 18 19 AXES 1.0 'DENS [KG/M3]'
TRAC 16 17 18 19 116 117 118 119 AXES 1.0 'DENS [KG/M3]'
COLO NOIR NOIR NOIR NOIR ROUG ROUG ROUG ROUG
FIN
```

mapp20.dgibi

```
opti echo 1;
opti dime 3 elem cub8;
opti trac psc ftra 'mapp20_mesh.ps';
opti sauv form 'mapp20.msh';
*
lhp3d = 12.0;
lhp1d = 4.0;
llp1d = 6.0;
llp3d = 10.0;
nhp3d = 1200;
nhp1d = 400;
nlp1d = 600;
nlp3d = 1000;
h = lhp3d / nhp3d;
tol = h / 10;
*
p0 = 0 0 0;
p1 = 0 h 0;
p2 = 0 h h;
p3 = 0 0 h;
bashp3d = manu qua4 p0 p1 p2 p3;
hp3d = bashp3d volu tran nhp3d (lhp3d 0 0);
baslp3d = bashp3d plus ((lhp3d+lhp1d+llp1d) 0 0);
lp3d = baslp3d volu tran nlp3d (llp3d 0 0);
p1d1 = p0 plus (lhp3d 0 0);
p1d2 = p1d1 plus (lhp1d 0 0);
p1d3 = p1d2 plus (llp1d 0 0);
hp1d = p1d1 d nhp1d p1d2;
lp1d = p1d2 d nlp1d p1d3;
hp = hp3d et hp1d;
```

```
lp = lp3d et lp1d;
flui = hp et lp;
*
* raccords 3d-1d
*
facehp = bashp3d plus (lhp3d 0 0);
pfacehp = chan poi1 facehp;
elim tol (pfacehp et hp3d);
facelp = baslp3d;
pfacelp = chan poi1 facelp;
rachp = manu supe (p1d1 et facehp);
raclp = manu supe (p1d3 et facelp);
*
mesh = flui et facehp et facelp et rachp et raclp;
*
tass mesh noop;
sauv form mesh;
trac cach qual mesh;
*
fin;
```

mapp20.epx

```
MAPP20
ECHO
!CONV win
CAST mesh
TRID EULE
DIME JONC 10 TERM ! Total n. of nodes in a TUBM juncton
GEOM CUVF hp3d lp3d TUVF hp1d lp1d CL3D facehp facelp
     TUBM rachp raclp TERM
COMP DIAM DROI 0.011283792 LECT hp1d lp1d TERM
     RACC TUBM LECT rachp  TERM
          NTUB LECT p1d1   TERM DTUB 0.011283792
          FACE LECT facehp TERM COEF 1.0
     RACC TUBM LECT raclp  TERM
          NTUB LECT p1d3   TERM DTUB 0.011283792
          FACE LECT facelp TERM COEF 1.0
! Attention: the TUBM elements (rachp and raclp) are NOT included
! in the "mesh" object (although they ARE indeed passed in from Cast3m).
! For this reason we must add them explicitly in the GROU directive below
! if we want to have them in the extracted element groups.
     GROU 2 'nrachp' LECT mesh rachp raclp TERM
                     COND XB GT 11.99 COND XB LT 12.01
            'nraclp' LECT mesh rachp raclp TERM
                     COND XB GT 21.99 COND XB LT 22.01
     COUL ROUG LECT hp TERM
  TURQ LECT lp TERM
          VERT LECT rachp raclp TERM
MATE GAZP RO 14.4 GAMM 1.4 CV 720 PINI 12.E5 PREF 1.E5
          LECT hp TERM
     GAZP RO 1.20 GAMM 1.4 CV 720 PINI 1.0E5 PREF 1.E5
          LECT lp TERM
! In order to obtain a printout at least of the 3D VFCCs I am obliged
! to use a different material for rachp and raclp, but with the
! same characteristics as the materials used for hp and lp, respectively
     GAZP RO 14.4 GAMM 1.4 CV 720 PINI 12.E5 PREF 1.E5
          LECT rachp TERM
     GAZP RO 1.20 GAMM 1.4 CV 720 PINI 1.0E5 PREF 1.E5
          LECT raclp TERM
ECRI ECRO VFCC TFRE 1.E-3
!    NOPO NOEL
     FICH ALIC TFRE 1.E-3
OPTI NOTE CSTA 0.75
     STEP IO LOG 1
     VFCC FCON 6 ! hllc solver
          ORDR 2 ! order in space
          OTPS 2 ! order in time
!         RECO 1 ! Not accepted by CAL_VFCC_1D
CALC TINI 0 TEND 20.E-3
FIN
```

mapp20p.epx

```
Post-treatment (space curves from alice file)
ECHO
OPTI PRIN
RESU ALIC 'mapp20.ali' GARD PSCR
COMP NGRO 1 'xaxo' LECT flui TERM
                   COND LINE X1 0 Y1 0 Z1 0 X2 32 Y2 0 Z2 0 TOL 0.0001
SORT GRAP
PERF 'mapp20.pun'
AXTE 1.0 'Time [s]'
SCOU 61 'p_21'  NSTO 21 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                     ECRO COMP 1
SCOU 62 'ro_21' NSTO 21 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                     ECRO COMP 2
SCOU 65 'vx_21' NSTO 21 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                     VCVI COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.4 ROM 14.4 ROP 1.2 EINT 2.08333E5
                     LENM 16 LENP 16
                     TIME 20.E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.4 ROM 14.4 ROP 1.2 EINT 2.08333E5
                     LENM 16 LENP 16
                     TIME 20.E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.4 ROM 14.4 ROP 1.2 EINT 2.08333E5
                     LENM 16 LENP 16
                     TIME 20.E-3 NRAR 30 VARI 5
TRAC 61 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR ROUG
LIST 61 AXES 1.0 'PRESS. [PA]'
TRAC 62 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR ROUG
LIST 62 AXES 1.0 'DENS. [KG/M3]'
TRAC 65 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR ROUG
LIST 65 AXES 1.0 'VELOC. [M/S]'
FIN
```

mapp21.dgibi

```
opti echo 1;
opti dime 3 elem cub8;
opti trac psc ftra 'mapp21_mesh.ps';
opti sauv form 'mapp21.msh';
*
lhp3d = 12.0;
lhp1d = 4.0;
llp1d = 6.0;
llp3d = 10.0;
nhp3d = 1200;
nhp1d = 400;
nlp1d = 600;
nlp3d = 1000;
h = lhp3d / nhp3d;
tol = h / 10;
*
p0 = 0 0 0;
p1 = 0 h 0;
p2 = 0 h h;
p3 = 0 0 h;
bashp3d = manu qua4 p0 p1 p2 p3;
hp3d = bashp3d volu tran nhp3d (lhp3d 0 0);
baslp3d = bashp3d plus ((lhp3d+lhp1d+llp1d) 0 0);
lp3d = baslp3d volu tran nlp3d (llp3d 0 0);
p1d1 = p0 plus (lhp3d 0 0);
p1d2 = p1d1 plus (lhp1d 0 0);
p1d3 = p1d2 plus (llp1d 0 0);
hp1d = p1d1 d nhp1d p1d2;
lp1d = p1d2 d nlp1d p1d3;
hp = hp3d et hp1d;
lp = lp3d et lp1d;
flui = hp et lp;
*
* raccords 3d-1d
*
facehp = bashp3d plus (lhp3d 0 0);
pfacehp = chan poi1 facehp;
elim tol (pfacehp et hp3d);
facelp = baslp3d;
pfacelp = chan poi1 facelp;
rachp = manu supe (p1d1 et facehp);
raclp = manu supe (p1d3 et facelp);
*
mesh = flui et facehp et facelp et rachp et raclp;
*
tass mesh noop;
sauv form mesh;
trac cach qual mesh;
*
fin;
```

mapp21.epx

```
MAPP21
ECHO
!CONV win
CAST mesh
TRID EULE
DIME JONC 10 TERM ! Total n. of nodes in a TUBM juncton
GEOM CUVF hp3d lp3d TUVF hp1d lp1d CL3D facehp facelp
     TUBM rachp raclp TERM
COMP DIAM DROI 0.011283792 LECT hp1d lp1d TERM
     RACC TUBM LECT rachp  TERM
          NTUB LECT p1d1   TERM DTUB 0.011283792
          FACE LECT facehp TERM COEF 1.0
     RACC TUBM LECT raclp  TERM
          NTUB LECT p1d3   TERM DTUB 0.011283792
          FACE LECT facelp TERM COEF 1.0
! Attention: the TUBM elements (rachp and raclp) are NOT included
! in the "mesh" object (although they ARE indeed passed in from Cast3m).
! For this reason we must add them explicitly in the GROU directive below
! if we want to have them in the extracted element groups.
     GROU 2 'nrachp' LECT mesh rachp raclp TERM
                     COND XB GT 11.99 COND XB LT 12.01
            'nraclp' LECT mesh rachp raclp TERM
                     COND XB GT 21.99 COND XB LT 22.01
     COUL ROUG LECT hp TERM
  TURQ LECT lp TERM
          VERT LECT rachp raclp TERM
MATE GAZP RO 14.4 GAMM 1.4 CV 720 PINI 12.E5 PREF 1.E5
          LECT hp TERM
     GAZP RO 1.20 GAMM 1.4 CV 720 PINI 1.0E5 PREF 1.E5
          LECT lp TERM
! In order to obtain a printout at least of the 3D VFCCs I am obliged
! to use a different material for rachp and raclp, but with the
! same characteristics as the materials used for hp and lp, respectively
     GAZP RO 14.4 GAMM 1.4 CV 720 PINI 12.E5 PREF 1.E5
          LECT rachp TERM
     GAZP RO 1.20 GAMM 1.4 CV 720 PINI 1.0E5 PREF 1.E5
          LECT raclp TERM
```

```
ECRI ECRO VFCC TFRE 1.E-3
!    NOPO NOEL
     FICH ALIC TFRE 1.E-3
     FICH FORM MAPP OBJE LECT hp3d lp3d hp1d lp1d TERM
          TIME PROG 10.E-3 TERM
OPTI NOTE CSTA 0.75
     STEP IO LOG 1
     VFCC FCON 6 ! hllc solver
          ORDR 2 ! order in space
          OTPS 2 ! order in time
!         RECO 1 ! Not accepted by CAL_VFCC_1D
CALC TINI 0 TEND 20.E-3
FIN
```

mapp21p.epx

```
Post-treatment (space curves from alice file)
ECHO
OPTI PRIN
RESU ALIC 'mapp21.ali' GARD PSCR
COMP NGRO 1 'xaxo' LECT flui TERM
                   COND LINE X1 0 Y1 0 Z1 0 X2 32 Y2 0 Z2 0 TOL 0.0001
SORT GRAP
PERF 'mapp21.pun'
AXTE 1.0 'Time [s]'
SCOU 61 'p_21'  NSTO 21 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 1
SCOU 62 'ro_21' NSTO 21 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 2
SCOU 65 'vx_21' NSTO 21 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        VCVI COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.4 ROM 14.4 ROP 1.2 EINT 2.08333E5
                     LENM 16 LENP 16
                     TIME 20.E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.4 ROM 14.4 ROP 1.2 EINT 2.08333E5
                     LENM 16 LENP 16
                     TIME 20.E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.4 ROM 14.4 ROP 1.2 EINT 2.08333E5
                     LENM 16 LENP 16
                     TIME 20.E-3 NRAR 30 VARI 5
TRAC 61 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR ROUG
LIST 61 AXES 1.0 'PRESS. [PA]'
TRAC 62 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR ROUG
LIST 62 AXES 1.0 'DENS. [KG/M3]'
TRAC 65 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR ROUG
LIST 65 AXES 1.0 'VELOC. [M/S]'
FIN
```

mapp22.dgibi

```
opti echo 1;
opti dime 3 elem cub8;
opti trac psc ftra 'mapp22_mesh.ps';
opti sauv form 'mapp22.msh';
*
lhp3d = 12.0;
lhp1d = 4.0;
llp1d = 6.0;
llp3d = 10.0;
nhp3d = 1200;
nhp1d = 400;
nlp1d = 600;
nlp3d = 1000;
h = lhp3d / nhp3d;
tol = h / 10;
*
p0 = 0 0 0;
p1 = 0 h 0;
p2 = 0 h h;
p3 = 0 0 h;
bashp3d = manu qua4 p0 p1 p2 p3;
hp3d = bashp3d volu tran nhp3d (lhp3d 0 0);
baslp3d = bashp3d plus ((lhp3d+lhp1d+llp1d) 0 0);
lp3d = baslp3d volu tran nlp3d (llp3d 0 0);
p1d1 = p0 plus (lhp3d 0 0);
p1d2 = p1d1 plus (lhp1d 0 0);
p1d3 = p1d2 plus (llp1d 0 0);
hp1d = p1d1 d nhp1d p1d2;
lp1d = p1d2 d nlp1d p1d3;
hp = hp3d et hp1d;
lp = lp3d et lp1d;
flui = hp et lp;
*
* raccords 3d-1d
*
facehp = bashp3d plus (lhp3d 0 0);
pfacehp = chan poi1 facehp;
elim tol (pfacehp et hp3d);
facelp = baslp3d;
pfacelp = chan poi1 facelp;
rachp = manu supe (p1d1 et facehp);
raclp = manu supe (p1d3 et facelp);
*
mesh = flui et facehp et facelp et rachp et raclp;
*
tass mesh noop;
sauv form mesh;
trac cach qual mesh;
*
fin;
```

mapp22.epx

```
MAPP22
ECHO
!CONV win
CAST mesh
TRID EULE
DIME JONC 10 TERM ! Total n. of nodes in a TUBM juncton
GEOM CUVF hp3d lp3d TUVF hp1d lp1d CL3D facehp facelp
     TUBM rachp raclp TERM
COMP DIAM DROI 0.011283792 LECT hp1d lp1d TERM
     RACC TUBM LECT rachp  TERM
          NTUB LECT p1d1   TERM DTUB 0.011283792
          FACE LECT facehp TERM COEF 1.0
     RACC TUBM LECT raclp  TERM
          NTUB LECT p1d3   TERM DTUB 0.011283792
          FACE LECT facelp TERM COEF 1.0
! Attention: the TUBM elements (rachp and raclp) are NOT included
! in the "mesh" object (although they ARE indeed passed in from Cast3m).
! For this reason we must add them explicitly in the GROU directive below
! if we want to have them in the extracted element groups.
     GROU 2 'nrachp' LECT mesh rachp raclp TERM
                     COND XB GT 11.99 COND XB LT 12.01
            'nraclp' LECT mesh rachp raclp TERM
                     COND XB GT 21.99 COND XB LT 22.01
     COUL ROUG LECT hp TERM
  TURQ LECT lp TERM
          VERT LECT rachp raclp TERM
MATE GAZP RO 14.4 GAMM 1.4 CV 720 PINI 12.E5 PREF 1.E5
          LECT hp TERM
     GAZP RO 1.20 GAMM 1.4 CV 720 PINI 1.0E5 PREF 1.E5
          LECT lp TERM
! In order to obtain a printout at least of the 3D VFCCs I am obliged
! to use a different material for rachp and raclp, but with the
! same characteristics as the materials used for hp and lp, respectively
     GAZP RO 14.4 GAMM 1.4 CV 720 PINI 12.E5 PREF 1.E5
          LECT rachp TERM
     GAZP RO 1.20 GAMM 1.4 CV 720 PINI 1.0E5 PREF 1.E5
          LECT raclp TERM
INIT MAPP FORM 'mapp21.map' MATC OBJE LECT hp3d lp3d hp1d lp1d TERM
ECRI ECRO VFCC TFRE 1.E-3
!    NOPO NOEL
     FICH ALIC TFRE 1.E-3
!    FICH FORM MAPP OBJE LECT hp3d lp3d hp1d lp1d TERM
!         TIME PROG 10.E-3 TERM
OPTI NOTE CSTA 0.75
     STEP IO LOG 1
     VFCC FCON 6 ! hllc solver
          ORDR 2 ! order in space
          OTPS 2 ! order in time
!         RECO 1 ! Not accepted by CAL_VFCC_1D
CALC TINI 0 TEND 20.E-3
FIN
```

mapp22p.epx

```
Post-treatment (space curves from alice file)
ECHO
OPTI PRIN
RESU ALIC 'mapp22.ali' GARD PSCR
COMP NGRO 1 'xaxo' LECT flui TERM
                   COND LINE X1 0 Y1 0 Z1 0 X2 32 Y2 0 Z2 0 TOL 0.0001
SORT GRAP
PERF 'mapp22.pun'
AXTE 1.0 'Time [s]'
SCOU 61 'p_21'  NSTO 11 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 1
SCOU 62 'ro_21' NSTO 11 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 2
SCOU 65 'vx_21' NSTO 11 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        VCVI COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.4 ROM 14.4 ROP 1.2 EINT 2.08333E5
                     LENM 16 LENP 16
                     TIME 20.E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.4 ROM 14.4 ROP 1.2 EINT 2.08333E5
                     LENM 16 LENP 16
                     TIME 20.E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.4 ROM 14.4 ROP 1.2 EINT 2.08333E5
                     LENM 16 LENP 16
                     TIME 20.E-3 NRAR 30 VARI 5
TRAC 61 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR ROUG
LIST 61 AXES 1.0 'PRESS. [PA]'
TRAC 62 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR ROUG
LIST 62 AXES 1.0 'DENS. [KG/M3]'
TRAC 65 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR ROUG
LIST 65 AXES 1.0 'VELOC. [M/S]'
RCOU 161  'p_21' FICH 'mapp20.pun' RENA  'p_21_20'
RCOU 162 'ro_21' FICH 'mapp20.pun' RENA 'ro_21_20'
RCOU 165 'vx_21' FICH 'mapp20.pun' RENA 'vx_21_20'
TRAC 61 161 AXES 1.0 'PRESS. [PA]'
COLO NOIR VERT
```

```
TRAC 62 162 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR VERT
TRAC 65 165 AXES 1.0 'VELOC. [M/S]'
COLO NOIR VERT
FIN
```

mapp30.dgibi

```
opti echo 1;
opti dime 3 elem cub8;
opti trac psc ftra 'mapp30_mesh.ps';
opti sauv form 'mapp30.msh';
*
len = 10;
n = 10;
tol = 0.001;
*
p0 = 0 0 0;
px = len 0 0;
py = 0 len 0;
pz = 0 0 1;
pxy = len len 0;
*
cx = p0 d n px;
base = cx tran n py;
vol = base volu tran 1 pz;
elim tol (vol et py et pz et pxy);
bomb = vol elem appu larg p0;
ex = vol elem appu larg px;
ey = vol elem appu larg py;
exy = vol elem appu larg pxy;
air = vol diff bomb;
flui = bomb et air;
mesh = flui;
*
tass mesh noop;
sauv form mesh;
trac cach qual mesh;
trac cach qual bomb;
trac cach qual air;
*
fin;
```

mapp30.epx

```
MAPP30
ECHO
!CONV win
CAST mesh
TRID EULE
GEOM CUVF flui TERM
COMP GROU 2 'mapp' LECT flui TERM COND XB LT 5.0
                                  COND YB LT 5.0
            'noma' LECT flui DIFF mapp TERM
     COUL ROUG LECT bomb TERM
  TURQ LECT air  TERM
MATE GAZP RO 120. GAMM 1.4 CV 720 PINI 120.E5 PREF 1.E5
          LECT bomb TERM
     GAZP RO 1.00 GAMM 1.4 CV 720 PINI 1.0E5 PREF 1.E5
          LECT air TERM
ECRI ECRO VFCC TFRE 3.0E-3
     FICH ALIC FREQ 1
OPTI NOTE CSTA 0.5
     STEP IO LOG 1
     VFCC FCON 6 ! hllc solver
          ORDR 2 ! order in space
          OTPS 2 ! order in time
          RECO 1
CALC TINI 0 TEND 30.E-3
SUIT
Post treatment
RESU ALIC GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
COUR 1 'p_bomb' ECRO COMP 1 ELEM LECT bomb TERM
COUR 2 'p_ex'   ECRO COMP 1 ELEM LECT ex   TERM
COUR 3 'p_ey'   ECRO COMP 1 ELEM LECT ey   TERM
COUR 4 'p_exy'  ECRO COMP 1 ELEM LECT exy  TERM
TRAC 1 2 3 4 AXES 1.0 'PRES. [PA]' YZER
COLO ROUG VERT TURQ BLEU
LIST 1 2 3 4 AXES 1.0 'PRES. [PA]' YZER
TRAC 2 3 4 AXES 1.0 'PRES. [PA]' YZER
COLO VERT TURQ BLEU
FIN
```

mapp31.dgibi

```
opti echo 1;
opti dime 3 elem cub8;
opti trac psc ftra 'mapp31_mesh.ps';
opti sauv form 'mapp31.msh';
*
len = 5;
n = 5;
tol = 0.001;
*
p0 = 0 0 0;
px = len 0 0;
py = 0 len 0;
pz = 0 0 1;
pxy = len len 0;
*
cx = p0 d n px;
base = cx tran n py;
vol = base volu tran 1 pz;
elim tol (vol et py et pz et pxy);
bomb = vol elem appu larg p0;
air = vol diff bomb;
flui = bomb et air;
mesh = flui;
*
tass mesh noop;
sauv form mesh;
trac cach qual mesh;
trac cach qual bomb;
trac cach qual air;
*
fin;
```

mapp31.epx

```
MAPP31
ECHO
!CONV win
CAST mesh
TRID EULE
GEOM CUVF flui TERM
COMP COUL ROUG LECT bomb TERM
  TURQ LECT air  TERM
MATE GAZP RO 120. GAMM 1.4 CV 720 PINI 120.E5 PREF 1.E5
          LECT bomb TERM
     GAZP RO 1.00 GAMM 1.4 CV 720 PINI 1.0E5 PREF 1.E5
          LECT air TERM
ECRI ECRO VFCC TFRE 3.0E-3
     FICH ALIC FREQ 1
     FICH FORM MAPP OBJE LECT tous TERM TIME PROG 3.0E-3 TERM
OPTI NOTE CSTA 0.5
     STEP IO LOG 1
     VFCC FCON 6 ! hllc solver
          ORDR 2 ! order in space
          OTPS 2 ! order in time
          RECO 1
CALC TINI 0 TEND 3.E-3
SUIT
Post treatment
RESU ALIC GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
COUR 1 'p_bomb' ECRO COMP 1 ELEM LECT bomb TERM
TRAC 1 AXES 1.0 'PRES. [PA]' YZER
COLO ROUG
LIST 1 AXES 1.0 'PRES. [PA]' YZER
FIN
```

mapp32.dgibi

```
opti echo 1;
opti dime 3 elem cub8;
opti trac psc ftra 'mapp32_mesh.ps';
opti sauv form 'mapp32.msh';
*
len = 10;
n = 10;
tol = 0.001;
*
p0 = 0 0 0;
px = len 0 0;
py = 0 len 0;
pz = 0 0 1;
pxy = len len 0;
*
cx = p0 d n px;
base = cx tran n py;
vol = base volu tran 1 pz;
elim tol (vol et py et pz et pxy);
bomb = vol elem appu larg p0;
ex = vol elem appu larg px;
ey = vol elem appu larg py;
exy = vol elem appu larg pxy;
air = vol diff bomb;
flui = bomb et air;
mesh = flui;
*
tass mesh noop;
sauv form mesh;
trac cach qual mesh;
trac cach qual bomb;
trac cach qual air;
*
fin;
```

mapp32.epx

```
MAPP32
ECHO
!CONV win
CAST mesh
TRID EULE
GEOM CUVF flui TERM
COMP GROU 2 'mapp' LECT flui TERM COND XB LT 5.0
                                  COND YB LT 5.0
            'noma' LECT flui DIFF mapp TERM
     COUL ROUG LECT bomb TERM
  TURQ LECT air  TERM
MATE GAZP RO 120. GAMM 1.4 CV 720 PINI 120.E5 PREF 1.E5
          LECT bomb TERM
     GAZP RO 1.00 GAMM 1.4 CV 720 PINI 1.0E5 PREF 1.E5
          LECT air TERM
INIT MAPP FORM 'mapp31.map' MATC OBJE LECT mapp TERM
ECRI ECRO VFCC TFRE 3.0E-3
     FICH ALIC FREQ 1
OPTI NOTE CSTA 0.5
     STEP IO LOG 1
     VFCC FCON 6 ! hllc solver
          ORDR 2 ! order in space
          OTPS 2 ! order in time
          RECO 1
CALC TINI 0 TEND 30.E-3
SUIT
Post treatment
RESU ALIC GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
COUR 1 'p_bomb' ECRO COMP 1 ELEM LECT bomb TERM
COUR 2 'p_ex'   ECRO COMP 1 ELEM LECT ex   TERM
COUR 3 'p_ey'   ECRO COMP 1 ELEM LECT ey   TERM
COUR 4 'p_exy'  ECRO COMP 1 ELEM LECT exy  TERM
RCOU 301 'p_bomb' FICH 'mapp30.pun' RENA 'p_bomb_30'
RCOU 302 'p_ex'   FICH 'mapp30.pun' RENA 'p_ex_30'
RCOU 303 'p_ey'   FICH 'mapp30.pun' RENA 'p_ey_30'
RCOU 304 'p_exy'  FICH 'mapp30.pun' RENA 'p_exy_30'
TRAC 1 2 3 4 301 302 303 304 AXES 1.0 'PRES. [PA]' YZER
COLO ROUG VERT TURQ BLEU ROUG VERT TURQ BLEU
DASH 0    0    0    0    3    3    3    3
LIST 1 2 3 4 AXES 1.0 'PRES. [PA]' YZER
TRAC 1 301 AXES 1.0 'PRES. [PA]' YLOG
COLO ROUG ROUG
TRAC 2 3 4 302 303 304 AXES 1.0 'PRES. [PA]' YZER
COLO VERT TURQ BLEU VERT TURQ BLEU
DASH 0    0    0    3    3    3
FIN
```

vega45.dgibi

```
'DEBPROC' pxswell cplat*'MAILLAGE' ch2*'POINT' px*'POINT'
                  vr*'POINT' tol*'FLOTTANT' fac*'FLOTTANT';
nho2 = cplat poin cyli ch2 (ch2 plus px) (ch2 plus vr) tol;
ho2 = cplat elem appu stri nho2;
ho2n = ho2 homo fac ch2;
i = 0;
repe loop2 (nbno ho2);
  i = i + 1;
  ni = ho2 poin i;
  nin = ho2n poin i;
  conf ni nin;
fin loop2;
finproc;
*=====================================================================
'DEBPROC' pxshrink frameb*'MAILLAGE' cen*'POINT'
                    rbo*'FLOTTANT' fac*'FLOTTANT';
pxm = -1 0 0;
pxp = 1 0 0;
vr2 = 0 (0.5*rbo) 0;
nbolt = frameb poin cyli (cen plus pxm) (cen plus pxp)
        (cen plus vr2) (0.5001*rbo);
xc yc zc = coor cen;
i = 0;
repe loop2 (nbno nbolt);
  i = i + 1;
  ni = nbolt poin i;
  xi yi zi = coor ni;
  ceni = xi yc zc;
  nin = ni homo fac ceni;
  conf ni nin;
fin loop2;
finproc;
*=====================================================================
opti echo 1;
opti rest form 'vega33.msh';
rest form;
list;
opti trac psc ftra 'vega45_mesh.ps';
oeil = 100000 0 0;
trac oeil qual plate;
cplat = cont plate;
ch1 = 0 26.E-2 0;
p0 = 0 0 0;
p0p = 1 0 0;
ch2 = ch1 tour 15.0 p0 p0p;
ch3 = ch1 tour 30.0 p0 p0p;
ch4 = ch1 tour 45.0 p0 p0p;
ch5 = ch1 tour 60.0 p0 p0p;
ch6 = ch1 tour 75.0 p0 p0p;
ch7 = 0 0 26.E-2;
px = 1 0 0;
r = 1.25E-2;
vr = 0 r 0;
tol = 1.E-4;
fac = 1.016;
pxswell cplat ch1 px vr tol fac;
pxswell cplat ch2 px vr tol fac;
pxswell cplat ch3 px vr tol fac;
pxswell cplat ch4 px vr tol fac;
pxswell cplat ch5 px vr tol fac;
pxswell cplat ch6 px vr tol fac;
pxswell cplat ch7 px vr tol fac;
trac oeil qual plate;
oeil2 = 100000 0 -30000;
trac oeil2 cach qual lframeb;
facs = 0.936;
pxshrink lframeb ch1 r facs;
pxshrink lframeb ch3 r facs;
pxshrink lframeb ch5 r facs;
pxshrink lframeb ch7 r facs;
trac oeil2 cach qual lframeb;
*
opti sauv form 'vega45.msh';
tass mesh noop;
sauv form mesh;
*
fin;
```

vega45.epx

```
VEGA45
ECHO
!CONV win
CAST mesh
TRID ALE
EROS 1.0
DIME ADAP NPOI 100000
          Q4GS 20000
          CUVF 150000
          NVFI 200000
          CL3D 20000
          !Q4GS 20000
          NPIN 20000
     ENDA
     JONC 475 ! Total n. of nodes in a TUBM juncton
     NALE 1 NBLE 1
     TERM
GEOM CUB8 ecub8
     PR6  epri6
     Q4GS equa4 mems
     T3GS etri3
     PMAT nplate
     CUVF flui3d tubelp3 tank
     TUVF tubelp1
     CL3D pre face3d presur abso stub3d
     TUBM rac3d1d raclp
TERM
COMP EPAI 0.8e-3 LECT plate nplate TERM
          1.50E-3 LECT mems TERM
     DIAM DROI 0.1692568 LECT tubelp1 TERM
     RACC TUBM LECT rac3d1d  TERM
          NTUB LECT p1a   TERM DTUB 0.1692568
          FACE LECT face3d TERM COEF 1.0
     RACC TUBM LECT raclp  TERM
          NTUB LECT p1d3   TERM DTUB 0.1692568
          FACE LECT stub3d TERM COEF 1.0
! Attention: the TUBM element (raclp) is NOT included
! in the "mesh" object (although it IS indeed passed in from Cast3m).
! For this reason we must add it explicitly in the GROU directive below
! if we want to have it in the extracted element groups.
     GROU 20 'endtube' LECT tube TERM COND XB GT -0.6
            'trigger' LECT tube TERM COND NEAR POIN -0.1501 0 0
            'frefine' LECT flui TERM COND XB GT -0.3
                                     COND XB LT  1.0
            'nrac3d1d' LECT mesh1 rac3d1d TERM
                     COND XB GT -15.5952 COND XB LT -15.5948
            'nraclp' LECT devi raclp TERM
                     COND XB GT -0.6002 COND XB LT -0.5998
            'pp1'    LECT plate TERM
                     COND BOX X0 0.0 Y0 0.0  Z0 0.0
                              DX 0.1 DY 0.15 DZ 0.15
            'pp2'    LECT plate TERM
                     COND BOX X0 0.0 Y0 0.09 Z0 0.09
                              DX 0.1 DY 0.06 DZ 0.06
            'fcoup1' LECT flui3d TERM
                     COND XB GT -16.405
                     COND XB LT -16.005
            'fcoup'  LECT flui  TERM COND XB GT -0.05
                                     COND XB LT 0.150
                                     COND YB LT 0.150
                                     COND ZB LT 0.150
            'scoup'  LECT plate TERM COND YB LT 0.150
                                     COND ZB LT 0.150
            'S1' LECT tube TERM COND NEAR POIN -0.345 0.15 0.15
            'S2' LECT tube TERM COND NEAR POIN -0.245 0.15 0.15
            'plaEdg' LECT plate DIFF pp1 TERM
                     COND YB LT 0.16
                     COND ZB LT 0.16
            'nplatmp'    LECT nplate  TERM
                     COND YB LT 0.16
                     COND ZB LT 0.16
```

```
           'nplalim'    LECT nplate DIFF nplatmp TERM
           'lfrb2' LECT lframeb TERM
                   COND XB LT -0.865E-2
           'lfrb1' LECT lframeb DIFF lfrb2 TERM
           'epar1' LECT tubelp1 TERM COND NEAR NODE LECT p1a TERM
           'epar2' LECT tubelp1 TERM COND NEAR NODE LECT p1d3 TERM
           'tubelpp' LECT tubelp1 DIFF epar1 epar2 TERM
     NGRO 12 'nmemi' LECT mems TERM
                   COND CYLI X1 -20 Y1 0 Z1 0 X2 20 Y2 0 Z2 0 R 0.1650
           'nmemo' LECT mems DIFF nmemi TERM
           'nsymy' LECT mems TERM COND Y LT 0.001
           'nsymz' LECT mems TERM COND Z LT 0.001
           'm1c'   LECT mem1 TERM COND NEAR POIN -16.335 0 0
           'm2c'   LECT mem2 TERM COND NEAR POIN -16.265 0 0
           'm3c'   LECT mem3 TERM COND NEAR POIN -16.195 0 0
           'blox'  LECT lframeb TERM COND !X LT -0.0253
                                          X GT 0.0253
           'symy'  LECT spec TERM    COND Y LT 0.0001
           'symz'  LECT spec TERM    COND Z LT 0.0001
           'pt0' LECT tubelp TERM COND NEAR POIN -16.19999 0.0 0.0
           'cen' LECT plate TERM COND NEAR POIN 0.0 0.0 0.0
     COUL TURQ LECT lfrb1 tubelp tank tra DIFF trigger TERM
          BLAN LECT lfrb2 TERM
          BLEU LECT uframe raclp TERM
          VERT LECT plate fir2 TERM
          ROSE LECT presur trigger fir1 TERM
          ROUG LECT nplate driver TERM
          GR50 LECT mems TERM
  JAUN LECT pre abso TERM
       DIAM DROI 0.1692568 LECT tubelp1 TERM
ADAP THRS ECRO 3 TMIN 0.01 TMAX 0.4 MAXL 3
        LECT mems TERM
!ADAP THRS ECRO 11 TMIN 0.02 TMAX 0.05 MAXL 3
!          LECT pp1 pp2 TERM
GRIL LAGR LECT spec mems TERM
FONC 1 TABL 5 0.0       0.0
              1.0E-3    1.0
              2.999E-3  1.0
              3.0E-3    0.0
              100.0E-3  0.0
MATE
    !LOI 1
     VM23 RO 1380 YOUN 2757.9E6 NU 0.495 ELAS 120.E6 ! "Melinex/Mylar/PET"
          FAIL PEPR LIMI 1.0
          TRAC 3 120.E6 0.04351
                 180.E6 1.5
                 230.E6 3.5
          LECT mems _q4gs TERM
    !LOI 2
     GAZP RO 46.517 GAMM 1.4 CV 719.286 PINI 39.147E5 PREF 1.011E5
          LECT none TERM
    !LOI 3
     GAZP RO 31.412 GAMM 1.4 CV 719.286 PINI 26.435E5 PREF 1.011E5
          LECT none TERM
    !LOI 4
     GAZP RO 16.307 GAMM 1.4 CV 719.286 PINI 13.723E5 PREF 1.011E5
          LECT none TERM
    !LOI 5
     GAZP RO 1.202 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT flui3d _cuvf TERM
    !LOI 6
!    IMPE PIMP PRES 12.712E5 PREF 0 FONC 1
     IMPE PIMP PRES 13.723E5 PREF 1.011E5 FONC 1
          LECT pre _cl3d TERM
     GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT epar1 epar2 TERM
     GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT rac3d1d raclp tubelpp TERM
     PARO PSIL 0.02
          LECT tubelpp TERM
     MULT 8 9 LECT tubelpp TERM
! In order to obtain a printout at least of the 3D VFCCs I am obliged
! to use a different material for tubelp3 and other 3D parts, but with the
! same characteristics as the material used for tubelp1
     GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT tubelp3 tank _cuvf TERM
     CLVF ABSO RO 1.189
          LECT abso TERM
     VPJC RO 7850.0 YOUN 2.1E11 NU 0.33 ELAS 3.257E8 mxit 500
          QR1 2.348E8 CR1 56.2 QR2 4.457E8 CR2 4.7
          PDOT 5.E-4 C 1.E-2 TQ 0.9 CP 452.0
          TM 1800.0 M 1.0 DC 1.0 WC 555.0E6
          LECT lframeb uframe plate TERM
    !VPJC RO 2700 YOUN 70.0E9 NU 0.3 ELAS 80.0E6 MXIT 500
    !     QR1 31.2E6 CR1 1090 QR2 12.2E6 CR2 20.4
    !     PDOT 5.E-4 C 1.4E-2 TQ 0.9 CP 910.0
    !     TM 893.0 M 1.0 DC 1.0 WC 59.4E6
    !     LECT plate TERM
     MASS 0.0 YOUN 2.1E11 NU 0.33
          LECT nplate TERM
     IMPE PIMP RO 7850.0 PRES 44.0011e6 PREF 1.011E5
          LECT presur TERM
OPTI PINS ASN
LINK COUP SPLT NONE
     BLOQ 123 LECT nmemo TERM
     CONT SPLA NX 0 NY 1 NZ 0 LECT nsymy TERM
     CONT SPLA NX 0 NY 0 NZ 1 LECT nsymz TERM
     BLOQ 1 LECT blox TERM
     CONT SPLA NX 0 NY 1 NZ 0 LECT symy TERM
     CONT SPLA NX 0 NY 0 NZ 1 LECT symz TERM
    !TBLO ! 126 TRIG LECT c1s DIFF p0s p1s TERM
    !     ! 135 TRIG LECT c4s DIFF p0s p3s TERM
    !     ! 1 TRIG LECT p0s TERM
    !     ! 123456 TRIG LECT plat DIFF c1s c2s c3s c4s TERM
    !     123    TRIG LECT lframeb uframe TERM
    !     123456 TRIG LECT plate TERM
LINK DECO
     PINB PENA SFAC 1.0
          BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DMIN 0.0008 ! #1
               LECT lfrb1 TERM
          BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DMIN 0.0008 ! #2
               LECT lfrb2 TERM
          BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DMIN 0.0008 ! #3
               LECT uframe TERM
          BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DMIN 0.0002 ! #4
               LECT plaEdg TERM
          BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DIAM 0.0004 ! #5
               LECT nplalim TERM
          BODY                               DMIN 0.003  ! #6
               LECT mem1 TERM
          BODY                               DMIN 0.003  ! #7
               LECT mem2 TERM
          BODY                               DMIN 0.003  ! #8
               LECT mem3 TERM
          EXCL PAIR 1 2
          EXCL PAIR 1 3
          EXCL PAIR 4 5
          EXCL PAIR 1 6
          EXCL PAIR 1 7
          EXCL PAIR 1 8
          EXCL PAIR 2 6
          EXCL PAIR 2 7
          EXCL PAIR 2 8
          EXCL PAIR 3 6
          EXCL PAIR 3 7
          EXCL PAIR 3 8
          EXCL PAIR 4 6
          EXCL PAIR 4 7
          EXCL PAIR 4 8
          EXCL PAIR 5 6
          EXCL PAIR 5 7
          EXCL PAIR 5 8
     FLSW STRU LECT scoup mems TERM
          FLUI LECT fcoup1 fcoup TERM
          !R 0.0088    ! 0.87*H_FLUID = 0.87*0.01 = 0.0087
          R 0.014    !
          !HGRI 0.0062 ! Slightly bigger than the fully refined
          !            ! fluid element (for this case)
          !            ! h_f^ref = h_f^base / 2^(lmax-1) =
          !            ! 0.01 / 2^1 = 0.005
          HGRI 0.016
          DGRI
          FACE
          BFLU 2 ! block if at least one node is in influence domain
          FSCP 1 ! couple in all directions
          !ADAP LMAX 2 SCAL 6
          ADAP LMAX 2 SCAL 2
     !TBLO 123    TRIG LECT lframeb uframe TERM
     !     123456 TRIG LECT plate TERM
     TBLO 123    UPTO 30.0E-3 LECT lframeb uframe TERM
          123456 UPTO 30.0E-3 LECT plate TERM
INIT SKIP UPTO 3.E-3 VFCC
     ADAP IMAT TIME 3.E-3
               2 MATE 2 OBJE LECT flui3d TERM
                        INSI SURF LECT mem1 TERM
                !MATE 3 OBJE LECT flui3d TERM
                !       OUTS SURF LECT mem1 TERM
                !       INSI SURF LECT mem2 TERM
                 MATE 4 OBJE LECT flui3d TERM
                        OUTS SURF LECT mem2 TERM
                        INSI SURF LECT mem3 TERM
ECRI DEPL VITE ECRO FAIL TFRE 0.25E-3
          POIN LECT cen TERM
          ELEM LECT S1 TERM
     FICH ALIT FREQ 0 TFRE 0.D0
          TIME PROG 0.D0 PAS 0.5D-3 28.D-3 PAS 0.01D-3 80.D-3
          POIN LECT cen TERM
          ELEM LECT S1 S2 TERM
    !FICH PVTK FREQ 0 TFRE 0.D0
    !     TIME PROG 0.D0 PAS 0.5D-3 28.D-3 PAS 0.1D-3 50.D-3
    !     PAS 2.D-3 80.D-3
    !     GROU AUTO
    !     VARI DEPL VITE FAIL ACCE VCVI CONT ECRO FLIA
     FICH SPLI ALIC FREQ 0 TFRE 0.D0
          TIME PROG 0.D0 PAS 0.5D-3 28.D-3 PAS 0.1D-3 50.D-3
          PAS 2.D-3 80.D-3
OPTI NOTE CSTA 0.4
     LOG 1
     JAUM
     LMST
     FANT 10e-3 LECT mems TERM !_q4gs TERM
     PINS GRID DPIN 1.01
     VFCC FCON 6 ! hllc solver
          ORDR 2 ! order in space
          OTPS 2 ! order in time
          RECO 1 ! Not accepted by CAL_VFCC_1D
          NTIL
     ADAP RCON !TRIG ECRO 1 TVAL 1.02E5 LECT trigger TERM
     !NOCR TRIG LECT plate lframeb uframe TERM
     NOCR UPTO 30.0E-3 LECT plate lframeb uframe TERM
     FLS  CUB8 2 ! For the inverse mapping
     QUAS STAT 1670 0.1 UPTO 5.0E-3
CALC TINI 0 TEND 80.0E-3
FIN
```

vega51.dgibi

```
'DEBPROC' pxswell cplat*'MAILLAGE' ch2*'POINT' px*'POINT'
                  vr*'POINT' tol*'FLOTTANT' fac*'FLOTTANT';
nho2 = cplat poin cyli ch2 (ch2 plus px) (ch2 plus vr) tol;
ho2 = cplat elem appu stri nho2;
ho2n = ho2 homo fac ch2;
i = 0;
repe loop2 (nbno ho2);
  i = i + 1;
  ni = ho2 poin i;
  nin = ho2n poin i;
  conf ni nin;
fin loop2;
finproc;
*=====================================================================
'DEBPROC' pxshrink frameb*'MAILLAGE' cen*'POINT'
                   rbo*'FLOTTANT' fac*'FLOTTANT';
pxm = -1 0 0;
pxp = 1 0 0;
vr2 = 0 (0.5*rbo) 0;
nbolt = frameb poin cyli (cen plus pxm) (cen plus pxp)
        (cen plus vr2) (0.5001*rbo);
xc yc zc = coor cen;
i = 0;
repe loop2 (nbno nbolt);
  i = i + 1;
  ni = nbolt poin i;
  xi yi zi = coor ni;
  ceni = xi yc zc;
  nin = ni homo fac ceni;
  conf ni nin;
fin loop2;
finproc;
*=====================================================================
opti echo 1;
opti rest form 'vega33.msh';
rest form;
list;
opti trac psc ftra 'vega51_mesh.ps';
oeil = 100000 0 0;
trac oeil qual plate;
cplat = cont plate;
ch1 = 0 26.E-2 0;
p0 = 0 0 0;
p0p = 1 0 0;
ch2 = ch1 tour 15.0 p0 p0p;
ch3 = ch1 tour 30.0 p0 p0p;
ch4 = ch1 tour 45.0 p0 p0p;
ch5 = ch1 tour 60.0 p0 p0p;
ch6 = ch1 tour 75.0 p0 p0p;
ch7 = 0 0 26.E-2;
px = 1 0 0;
r = 1.25E-2;
vr = 0 r 0;
tol = 1.E-4;
fac = 1.016;
pxswell cplat ch1 px vr tol fac;
pxswell cplat ch2 px vr tol fac;
pxswell cplat ch3 px vr tol fac;
pxswell cplat ch4 px vr tol fac;
pxswell cplat ch5 px vr tol fac;
pxswell cplat ch6 px vr tol fac;
pxswell cplat ch7 px vr tol fac;
trac oeil qual plate;
oeil2 = 100000 0 -30000;
trac oeil2 cach qual lframeb;
facs = 0.936;
pxshrink lframeb ch1 r facs;
pxshrink lframeb ch3 r facs;
pxshrink lframeb ch5 r facs;
pxshrink lframeb ch7 r facs;
trac oeil2 cach qual lframeb;
*
opti sauv form 'vega51.msh';
tass mesh noop;
sauv form mesh;
*
fin;
```

vega51.epx

```
VEGA51
ECHO
!CONV win
CAST mesh
TRID ALE
EROS 1.0
DIME ADAP NPOI 100000
          Q4GS 20000
          CUVF 150000
          NVFI 200000
          CL3D 20000
          !Q4GS 20000
          NPIN 20000
     ENDA
     JONC 475 ! Total n. of nodes in a TUBM juncton
     NALE 1 NBLE 1
     TERM
GEOM CUB8 ecub8
     PR6  epri6
     Q4GS equa4 mems
     T3GS etri3
     PMAT nplate
     CUVF flui3d tubelp3 tank
     TUVF tubelp1
     CL3D pre face3d presur abso stub3d
     TUBM rac3d1d raclp
TERM
COMP EPAI 0.8e-3 LECT plate nplate TERM
          1.50E-3 LECT mems TERM
     DIAM DROI 0.1692568 LECT tubelp1 TERM
     RACC TUBM LECT rac3d1d  TERM
          NTUB LECT p1a   TERM DTUB 0.1692568
          FACE LECT face3d TERM COEF 1.0
     RACC TUBM LECT raclp  TERM
          NTUB LECT p1d3   TERM DTUB 0.1692568
          FACE LECT stub3d TERM COEF 1.0
! Attention: the TUBM element (raclp) is NOT included
! in the "mesh" object (although it IS indeed passed in from Cast3m).
! For this reason we must add it explicitly in the GROU directive below
! if we want to have it in the extracted element groups.
     GROU 20 'endtube' LECT tube TERM COND XB GT -0.6
            'trigger' LECT tube TERM COND NEAR POIN -0.1501 0 0
            'frefine' LECT flui TERM COND XB GT -0.3
                                     COND XB LT  1.0
            'nrac3d1d' LECT mesh1 rac3d1d TERM
                     COND XB GT -15.5952 COND XB LT -15.5948
            'nraclp' LECT devi raclp TERM
                     COND XB GT -0.6002 COND XB LT -0.5998
            'pp1'    LECT plate TERM
                     COND BOX X0 0.0 Y0 0.0  Z0 0.0
                              DX 0.1 DY 0.15 DZ 0.15
            'pp2'    LECT plate TERM
                     COND BOX X0 0.0 Y0 0.09 Z0 0.09
                              DX 0.1 DY 0.06 DZ 0.06
            'fcoup1' LECT flui3d TERM
                     COND XB GT -16.405
                     COND XB LT -16.005
            'fcoup'  LECT flui  TERM COND XB GT -0.05
                                     COND XB LT 0.150
                                     COND YB LT 0.150
                                     COND ZB LT 0.150
            'scoup'  LECT plate TERM COND YB LT 0.150
                                     COND ZB LT 0.150
            'S1' LECT tube TERM COND NEAR POIN -0.345 0.15 0.15
            'S2' LECT tube TERM COND NEAR POIN -0.245 0.15 0.15
            'plaEdg' LECT plate DIFF pp1 TERM
                     COND YB LT 0.16
                     COND ZB LT 0.16
            'nplatmp'    LECT nplate  TERM
                     COND YB LT 0.16
                     COND ZB LT 0.16
            'nplalim'    LECT nplate DIFF nplatmp TERM
            'lfrb2' LECT lframeb TERM
                    COND XB LT -0.865E-2
            'lfrb1' LECT lframeb DIFF lfrb2 TERM
            'epar1' LECT tubelp1 TERM COND NEAR NODE LECT p1a TERM
            'epar2' LECT tubelp1 TERM COND NEAR NODE LECT p1d3 TERM
            'tubelpp' LECT tubelp1 DIFF epar1 epar2 TERM
     NGRO 12 'nmemi' LECT mems TERM
                    COND CYLI X1 -20 Y1 0 Z1 0 X2 20 Y2 0 Z2 0 R 0.1650
            'nmemo' LECT mems DIFF nmemi TERM
            'nsymy' LECT mems TERM COND Y LT 0.001
            'nsymz' LECT mems TERM COND Z LT 0.001
            'm1c'   LECT mem1 TERM COND NEAR POIN -16.335 0 0
            'm2c'   LECT mem2 TERM COND NEAR POIN -16.265 0 0
            'm3c'   LECT mem3 TERM COND NEAR POIN -16.195 0 0
            'blox'  LECT lframeb TERM COND !X LT -0.0253
                                              X GT 0.0253
            'symy'  LECT spec TERM    COND Y LT 0.0001
            'symz'  LECT spec TERM    COND Z LT 0.0001
            'pt0' LECT tubelp TERM COND NEAR POIN -16.19999 0.0 0.0
            'cen' LECT plate TERM COND NEAR POIN 0.0 0.0 0.0
     COUL TURQ LECT lfrb1 tubelp tank tra DIFF trigger TERM
          BLAN LECT lfrb2 TERM
          BLEU LECT uframe raclp TERM
          VERT LECT plate fir2 TERM
          ROSE LECT presur trigger fir1 TERM
          ROUG LECT nplate driver TERM
          GR50 LECT mems TERM
  JAUN LECT pre abso TERM
       DIAM DROI 0.1692568 LECT tubelp1 TERM
ADAP THRS ECRO 3 TMIN 0.01 TMAX 0.4 MAXL 3
          LECT mems TERM
GRIL LAGR LECT spec mems TERM
FONC 1 TABL 5 0.0       0.0
              1.0E-3    1.0
              2.999E-3  1.0
              3.0E-3    0.0
              100.0E-3  0.0
MATE
    !LOI 1
     VM23 RO 1380 YOUN 2757.9E6 NU 0.495 ELAS 120.E6 ! "Melinex/Mylar/PET"
          FAIL PEPR LIMI 1.0
          TRAC 3 120.E6 0.04351
                 180.E6 1.5
                 230.E6 3.5
          LECT mems _q4gs TERM
    !LOI 2
     GAZP RO 46.517 GAMM 1.4 CV 719.286 PINI 39.147E5 PREF 1.011E5
          LECT none TERM
    !LOI 3
     GAZP RO 31.412 GAMM 1.4 CV 719.286 PINI 26.435E5 PREF 1.011E5
```

```
        LECT none TERM
    !LOI 4
     GAZP RO 16.307 GAMM 1.4 CV 719.286 PINI 13.723E5 PREF 1.011E5
        LECT none TERM
    !LOI 5
     GAZP RO 1.202 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
        LECT flui3d _cuvf TERM
    !LOI 6
!    IMPE PIMP PRES 12.712E5 PREF 0 FONC 1
     IMPE PIMP PRES 13.723E5 PREF 1.011E5 FONC 1
        LECT pre _cl3d TERM
     GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
        LECT epar1 epar2 TERM
     GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
        LECT rac3d1d raclp tubelpp TERM
     PARO PSIL 0.02
        LECT tubelpp TERM
     MULT 8 9 LECT tubelpp TERM
! In order to obtain a printout at least of the 3D VFCCs I am obliged
! to use a different material for tubelp3 and other 3D parts, but with the
! same characteristics as the material used for tubelp1
     GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
        LECT tubelp3 tank _cuvf TERM
     CLVF ABSO RO 1.189
        LECT abso TERM
     VPJC RO 7850.0 YOUN 2.1E11 NU 0.33 ELAS 3.257E8 mxit 500
        QR1 2.348E8 CR1 56.2 QR2 4.457E8 CR2 4.7
        PDOT 5.E-4 C 1.E-2 TQ 0.9 CP 452.0
        TM 1800.0 M 1.0 DC 1.0 WC 555.0E6
        LECT lframeb uframe plate TERM
    !VPJC RO 2700 YOUN 70.0E9 NU 0.3 ELAS 80.0E6 MXIT 500
     !     QR1 31.2E6 CR1 1090 QR2 12.2E6 CR2 20.4
     !     PDOT 5.E-4 C 1.4E-2 TQ 0.9 CP 910.0
     !     TM 893.0 M 1.0 DC 1.0 WC 59.4E6
     !     LECT plate TERM
     MASS 0.0 YOUN 2.1E11 NU 0.33
        LECT nplate TERM
     IMPE PIMP RO 7850.0 PRES 44.0011e6 PREF 1.011E5
        LECT presur TERM
OPTI PINS ASN
LINK COUP SPLT NONE
     BLOQ 123 LECT nmemo TERM
     CONT SPLA NX 0 NY 1 NZ 0 LECT nsymy TERM
     CONT SPLA NX 0 NY 0 NZ 1 LECT nsymz TERM
     BLOQ 1 LECT blox TERM
     CONT SPLA NX 0 NY 1 NZ 0 LECT symy TERM
     CONT SPLA NX 0 NY 0 NZ 1 LECT symz TERM
LINK DECO
     PINB PENA SFAC 1.0
          BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DMIN 0.0008 ! #1
               LECT lfrb1 TERM
          BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DMIN 0.0008 ! #2
               LECT lfrb2 TERM
          BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DMIN 0.0008 ! #3
               LECT uframe TERM
          BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DMIN 0.0002 ! #4
               LECT plaEdg TERM
          BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DIAM 0.0004 ! #5
               LECT nplalim TERM
          BODY                                DMIN 0.003  ! #6
               LECT mem1 TERM
          BODY                                DMIN 0.003  ! #7
               LECT mem2 TERM
          BODY                                DMIN 0.003  ! #8
               LECT mem3 TERM
          EXCL PAIR 1 2
          EXCL PAIR 1 3
          EXCL PAIR 4 5
          EXCL PAIR 1 6
          EXCL PAIR 1 7
          EXCL PAIR 1 8
          EXCL PAIR 2 6
          EXCL PAIR 2 7
          EXCL PAIR 2 8
          EXCL PAIR 3 6
          EXCL PAIR 3 7
          EXCL PAIR 3 8
          EXCL PAIR 4 6
          EXCL PAIR 4 7
          EXCL PAIR 4 8
          EXCL PAIR 5 6
          EXCL PAIR 5 7
          EXCL PAIR 5 8
     FLSW STRU LECT scoup mems TERM
          FLUI LECT fcoup1 fcoup TERM
          R 0.014    !
          HGRI 0.016
          DGRI
          FACE
          BFLU 2 ! block if at least one node is in influence domain
          FSCP 1 ! couple in all directions
          ADAP LMAX 2 SCAL 2
     TBLO 123    UPTO 30.0E-3 LECT lframeb uframe TERM
          123456 UPTO 30.0E-3 LECT plate TERM
INIT SKIP UPTO 3.E-3 VFCC
     ADAP IMAT TIME 3.E-3
               2 MATE 2 OBJE LECT flui3d TERM
                        INSI SURF LECT mem1 TERM
                !MATE 3 OBJE LECT flui3d TERM
                !       OUTS SURF LECT mem1 TERM
                !       INSI SURF LECT mem2 TERM
                 MATE 4 OBJE LECT flui3d TERM
                        OUTS SURF LECT mem2 TERM
                        INSI SURF LECT mem3 TERM
ECRI DEPL VITE ECRO FAIL TFRE 1.0E-3
          POIN LECT cen TERM
          ELEM LECT S1 TERM
     FICH ALIT FREQ 0 TFRE 0.D0
          TIME PROG 0.D0 PAS 0.5D-3 28.D-3 PAS 0.01D-3 40.D-3 TERM
          POIN LECT cen TERM
          ELEM LECT S1 S2 TERM
     FICH SPLI ALIC FREQ 0 TFRE 0.D0
          TIME PROG 0.D0 PAS 1.0D-3 40.D-3 TERM
     FICH FORM MAPP OBJE LECT flui3d tubelp1 TERM
                    TIME PROG 28.0E-3 TERM
OPTI NOTE CSTA 0.4
     STEP IO
     LOG 1
     JAUM
     LMST
     FANT 10e-3 LECT mems TERM !_q4gs TERM
     PINS GRID DPIN 1.01
     VFCC FCON 6 ! hllc solver
          ORDR 2 ! order in space
          OTPS 2 ! order in time
          RECO 1 ! Not accepted by CAL_VFCC_1D
          NTIL
     ADAP RCON !TRIG ECRO 1 TVAL 1.02E5 LECT trigger TERM
     NOCR UPTO 30.0E-3 LECT plate lframeb uframe TERM
     FLS  CUB8 2 ! For the inverse mapping
     QUAS STAT 1670 0.1 UPTO 5.0E-3
CALC TINI 0 TEND 40.0E-3
FIN
```

vega51a.epx

```
Post-treatment
ECHO
 CONV WIN
RESU SPLI ALIC 'vega51.ali' GARD PSCR
COMP COUL ROUG LECT mem1 TERM
          VERT LECT mem2 TERM
          TURQ LECT mem3 TERM
SORT VISU NSTO 1
PLAY
CAME   1 EYE  -1.71083E+01  8.20132E-02  8.82573E-01
!        Q     9.22980E-01 -4.07399E-02 -3.82313E-01  1.68750E-02
        VIEW  7.07109E-01 -6.23012E-02 -7.04354E-01
        RIGH  7.07104E-01  6.23015E-02  7.04359E-01
        UP    1.51008E-07  9.96111E-01 -8.81074E-02
        FOV   2.48819E+01
!NAVIGATION MODE: ROTATING CAMERA
!CENTER : -1.62266E+01  4.33068E-03  4.32377E-03
!RSPHERE:  2.65295E-01
!RADIUS :  1.24689E+00
!ASPECT :  1.00000E+00
!NEAR   :  9.81591E-01
!FAR    :  1.51218E+00
SCEN GEOM NAVI FREE
     GEOM LINE HEOU
          FACE SBAC
     LIMA ON
SLER CAM1 1 NFRA 1
TRAC OFFS FICH BMP OBJE LECT mems TERM NFAI SYXY SYXZ REND
FREQ 1
GOTR LOOP 6 OFFS FICH BMP OBJE LECT mems TERM NFAI SYXY SYXZ REND
ENDPLAY
FIN
```

vega51b.epx

```
VEGA51B
ECHO
RESU SPLI ALIC TEMP 'vega51.alt' GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
COUR 1 'SENS1' ECRO COMP 1 LECT S1 TERM
COUR 2 'SENS2' ECRO COMP 1 LECT S2 TERM
TRAC 1 2 AXES 1.0 'Press [Pa]' YZER
COLO BLEU ROUG
LIST 1 2 AXES 1.0 'Press [Pa]' YZER
COUR 10 'DisCen' DEPL COMP 1 POIN LECT cen TERM
TRAC 10 AXES 1.0 'Displ [m]' YZER
COLO BLEU
LIST 10 AXES 1.0 'Displ [m]' YZER
FIN
```

vega51c.epx

```
VEGA51C
ECHO
RESU SPLI ALIC TEMP 'vega51.alt' GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
COUR 1 'SENS1' ECRO COMP 1 LECT S1 TERM
COUR 2 'SENS2' ECRO COMP 1 LECT S2 TERM
COUR 10 'DisCen' DEPL COMP 1 POIN LECT cen TERM
RCOU 11 'SENS1'  FICH 'vega44b.pun' RENA 'S1_44'
RCOU 12 'SENS2'  FICH 'vega44b.pun' RENA 'S2_44'
RCOU 20 'DisCen' FICH 'vega44b.pun' RENA 'DC_44'
TRAC 1 11 AXES 1.0 'PRES [PA]' YZER
     COLO NOIR VERT
TRAC 2 12 AXES 1.0 'PRES [PA]' YZER
```

```
     COLO NOIR VERT
TRAC 10 20 AXES 1.0 'DISP [M]' YZER
     COLO NOIR VERT
COUR 22 INT  2
COUR 32 INT 12
TRAC 22 32 AXES 1.0 'PDT [PA*S]' YZER
     COLO NOIR VERT
TRAC 1 11 AXES 1.0 'PRES [PA]' XMIN 29.E-3 XMAX 40.E-3 NX 11 YZER
     COLO NOIR VERT
TRAC 2 12 AXES 1.0 'PRES [PA]' XMIN 29.E-3 XMAX 40.E-3 NX 11 YZER
     COLO NOIR VERT
FIN
```

vega51k.epx

```
VEGA51K
ECHO
*CONV WIN
LAGR AXIS
GEOM LIBR POIN 18 Q92 1 Q93 1        ED01 2 TERM
  1 0.0 1.5 0.0 2 0.0 2.5 0.0 3 0.0
  1 0.5 1.5 0.5 2 0.5 2.5 0.5 3 0.5
  1 1.0 1.5 1.0 2 1.0 2.5 1.0 3 1.0
  0 0 1 1 1 2
  1 2 3 8 13 12 11 6 7
  3 4 5 10 15 14 13 8 9
  16 17
  17 18
EPAI 1. LECT 1 PAS 1 4 TERM
MATE VM23 RO 8000. YOUN 1.D11 NU 0.3 ELAS 2.D8
          TRAC 3 2.D8 2.D-3 3.D8 1. 3.1D8 2.
          LECT 1 2 TERM
     VM23 RO 4000. YOUN 2.D11 NU 0.2 ELAS 4.D8
          TRAC 2 4.D8 2.D-3 6.D8 1.
          LECT 3 4 TERM
LINK COUP
     BLOQ 12 LECT 5 PAS 5 15 TERM
     BLOQ 123 LECT 16 TERM
INIT VITE 2 300 LECT 6 PAS 1 9 TERM
     VITE 1 -200 LECT 6 PAS 1 8 TERM
     VITE 2 -100 LECT 17 TERM
     VITE 1 200 LECT 18 TERM
ECRI DEPL VITE ACCE FINT FEXT FLIA FDEC CONT ECRO FREQ 100
     FICH ALIC FREQ 1
OPTI PAS UTIL NOTE LOG 1
CALCUL TINI 0. TEND 0.001D0 PASF 1.D-5
*=================================================================
SUIT
Post-treatment (time curves from alice file)
ECHO
RESU ALIC GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
LCOU 22 'cpu'  FICH 'vega51.log' TCPU
TRAC 22 AXES 1.0 'CPU [S]' YZER XMIN 0.0 XMAX 10.E-3 NX 10
                            YMIN 0.0 YMAX 5.0E+4 NY 10
LIST 22 AXES 1.0 'CPU [S]' YZER XMIN 0.0 XMAX 10.E-3 NX 10
                            YMIN 0.0 YMAX 5.0E+4 NY 10
LCOU 23 'dtcr' FICH 'vega51.log' DTCR
TRAC 23 AXES 1.0 'DTCR [S]' XMIN 0.0 XMAX 10.E-3 NX 10
                            YMIN 0.0 YMAX 2.0E-6 NY 10
LIST 23 AXES 1.0 'DTCR [S]' XMIN 0.0 XMAX 10.E-3 NX 10
                            YMIN 0.0 YMAX 2.0E-6 NY 10
*=================================================================
FIN
```

vega51l.epx

```
VEGA51L
ECHO
*CONV WIN
LAGR AXIS
GEOM LIBR POIN 18 Q92 1 Q93 1        ED01 2 TERM
  1 0.0 1.5 0.0 2 0.0 2.5 0.0 3 0.0
  1 0.5 1.5 0.5 2 0.5 2.5 0.5 3 0.5
  1 1.0 1.5 1.0 2 1.0 2.5 1.0 3 1.0
  0 0 1 1 1 2
  1 2 3 8 13 12 11 6 7
  3 4 5 10 15 14 13 8 9
  16 17
  17 18
EPAI 1. LECT 1 PAS 1 4 TERM
MATE VM23 RO 8000. YOUN 1.D11 NU 0.3 ELAS 2.D8
          TRAC 3 2.D8 2.D-3 3.D8 1. 3.1D8 2.
          LECT 1 2 TERM
     VM23 RO 4000. YOUN 2.D11 NU 0.2 ELAS 4.D8
          TRAC 2 4.D8 2.D-3 6.D8 1.
          LECT 3 4 TERM
LINK COUP
     BLOQ 12 LECT 5 PAS 5 15 TERM
     BLOQ 123 LECT 16 TERM
INIT VITE 2 300 LECT 6 PAS 1 9 TERM
     VITE 1 -200 LECT 6 PAS 1 8 TERM
     VITE 2 -100 LECT 17 TERM
     VITE 1 200 LECT 18 TERM
ECRI DEPL VITE ACCE FINT FEXT FLIA FDEC CONT ECRO FREQ 100
     FICH ALIC FREQ 1
OPTI PAS UTIL NOTE LOG 1
CALCUL TINI 0. TEND 0.001D0 PASF 1.D-5
*=================================================================
SUIT
Post-treatment (time curves from alice file)
ECHO
RESU ALIC GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
LCOU 21 'step' FICH 'vega51.log' STEP
LCOU 22 'cpu'  FICH 'vega51.log' TCPU
LCOU 23 'dtcr' FICH 'vega51.log' DTCR
LCOU 24 'elcr' FICH 'vega51.log' ELCR
LCOU 25 'dee'  FICH 'vega51.log' DEE
LCOU 26 'dmmn' FICH 'vega51.log' DMMN
LCOU 27 'dmme' FICH 'vega51.log' DMME
LCOU 28 'dtmx' FICH 'vega51.log' DTMX
LCOU 29 'elmx' FICH 'vega51.log' ELMX
LCOU 30 'vmax' FICH 'vega51.log' VMAX
LCOU 31 'nvmx' FICH 'vega51.log' NVMX
LCOU 32 'elst' FICH 'vega51.log' ELST
LCOU 33 'memo' FICH 'vega51.log' MEMO
LCOU 34 'memp' FICH 'vega51.log' MEMP
*
TRAC 21 AXES 1.0 'STEP [-]' YZER
TRAC 22 AXES 1.0 'CPU [S]' YZER
TRAC 23 AXES 1.0 'DTCR [S]' YZER
TRAC 23 AXES 1.0 'DTCR [S]' YLOG
*
TRAC 24 AXES 1.0 'ELCR [-]' YZER
TRAC 25 AXES 1.0 'DEE [-]' YZER
TRAC 26 AXES 1.0 'DMMN [-]' YZER
TRAC 27 AXES 1.0 'DMME [-]' YZER
TRAC 28 AXES 1.0 'DTMX [S]' YZER
TRAC 29 AXES 1.0 'ELMX [-]' YZER
TRAC 30 AXES 1.0 'VMAX [M/S]' YZER
TRAC 31 AXES 1.0 'NVMX [-]' YZER
TRAC 32 AXES 1.0 'ELST [-]' YZER
TRAC 33 AXES 1.0 'MEMO [-]' YZER
TRAC 34 AXES 1.0 'MEMP [-]' YZER
*
LIST 21 AXES 1.0 'STEP [-]' YZER
LIST 22 AXES 1.0 'CPU [S]' YZER
LIST 23 AXES 1.0 'DTCR [S]' YZER
*
LIST 24 AXES 1.0 'ELCR [-]' YZER
LIST 25 AXES 1.0 'DEE [-]' YZER
LIST 26 AXES 1.0 'DMMN [-]' YZER
LIST 27 AXES 1.0 'DMME [-]' YZER
LIST 28 AXES 1.0 'DTMX [S]' YZER
LIST 29 AXES 1.0 'ELMX [-]' YZER
LIST 30 AXES 1.0 'VMAX [M/S]' YZER
LIST 31 AXES 1.0 'NVMX [-]' YZER
LIST 32 AXES 1.0 'ELST [-]' YZER
LIST 33 AXES 1.0 'MEMO [-]' YZER
LIST 34 AXES 1.0 'MEMP [-]' YZER
*=================================================================
FIN
```

vega51m.epx

```
Post-treatment
ECHO
 CONV WIN
RESU SPLI ALIC 'vega51.ali' GARD PSCR
COMP COUL ROUG LECT mem1 TERM
          VERT LECT mem2 TERM
          TURQ LECT mem3 TERM
SORT VISU NSTO 1
PLAY
CAME   1 EYE  -1.72478E+01  0.00000E+00 -1.87219E-10
!        Q     7.07107E-01  0.00000E+00 -7.07107E-01  0.00000E+00
         VIEW  1.00000E+00  0.00000E+00  2.05103E-10
         RIGH -2.05103E-10  0.00000E+00  1.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   2.48819E+01
!NAVIGATION MODE: ROTATING CAMERA
!CENTER : -1.63350E+01  0.00000E+00  0.00000E+00
!RSPHERE:  2.34052E-01
!RADIUS :  9.12804E-01
!ASPECT :  1.00000E+00
!NEAR   :  6.78752E-01
!FAR    :  1.38091E+00
SCEN GEOM NAVI FREE
        !LINE HEOU
         FACE SBAC
     LIMA ON
SLER CAM1 1 NFRA 1
TRAC OFFS FICH BMP OBJE LECT mem1 TERM NFAI SYXY SYXZ
     AMPD 0 REND
FREQ 1
GOTR LOOP 6 OFFS FICH BMP OBJE LECT mem1 TERM NFAI SYXY SYXZ
     AMPD 0 REND
ENDPLAY
FIN
```

vega51n.epx

```
Post-treatment
ECHO
 CONV WIN
RESU SPLI ALIC 'vega51.ali' GARD PSCR
COMP COUL ROUG LECT mem1 TERM
          VERT LECT mem2 TERM
```

```
         TURQ LECT mem3 TERM
SORT VISU NSTO 1
PLAY
CAME   1 EYE  -1.72478E+01  0.00000E+00 -1.87219E-10
!        Q     7.07107E-01  0.00000E+00 -7.07107E-01  0.00000E+00
         VIEW  1.00000E+00  0.00000E+00  2.05103E-10
         RIGH -2.05103E-10  0.00000E+00  1.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   2.48819E+01
!NAVIGATION MODE: ROTATING CAMERA
!CENTER : -1.63350E+01  0.00000E+00  0.00000E+00
!RSPHERE:  2.34052E-01
!RADIUS :  9.12804E-01
!ASPECT :  1.00000E+00
!NEAR   :  6.78752E-01
!FAR    :  1.38091E+00
SCEN GEOM NAVI FREE
        !LINE HEOU
         FACE SBAC
     LIMA ON
SLER CAM1 1 NFRA 1
TRAC OFFS FICH BMP OBJE LECT mem2 TERM NFAI SYXY SYXZ
     AMPD 0 REND
FREQ 1
GOTR LOOP 6 OFFS FICH BMP OBJE LECT mem2 TERM NFAI SYXY SYXZ
     AMPD 0 REND
ENDPLAY
FIN
```

vega51o.epx

```
Post-treatment
ECHO
 CONV WIN
RESU SPLI ALIC 'vega51.ali' GARD PSCR
COMP COUL ROUG LECT mem1 TERM
          VERT LECT mem2 TERM
          TURQ LECT mem3 TERM
SORT VISU NSTO 1
PLAY
CAME   1 EYE  -1.72478E+01  0.00000E+00 -1.87219E-10
!        Q     7.07107E-01  0.00000E+00 -7.07107E-01  0.00000E+00
         VIEW  1.00000E+00  0.00000E+00  2.05103E-10
         RIGH -2.05103E-10  0.00000E+00  1.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   2.48819E+01
!NAVIGATION MODE: ROTATING CAMERA
!CENTER : -1.63350E+01  0.00000E+00  0.00000E+00
!RSPHERE:  2.34052E-01
!RADIUS :  9.12804E-01
!ASPECT :  1.00000E+00
!NEAR   :  6.78752E-01
!FAR    :  1.38091E+00
SCEN GEOM NAVI FREE
        !LINE HEOU
         FACE SBAC
     LIMA ON
SLER CAM1 1 NFRA 1
TRAC OFFS FICH BMP OBJE LECT mem3 TERM NFAI SYXY SYXZ
     AMPD 0 REND
FREQ 1
GOTR LOOP 6 OFFS FICH BMP OBJE LECT mem3 TERM NFAI SYXY SYXZ
     AMPD 0 REND
ENDPLAY
FIN
```

vega52.dgibi

```
'DEBPROC' pxswell cplat*'MAILLAGE' ch2*'POINT' px*'POINT'
                  vr*'POINT' tol*'FLOTTANT' fac*'FLOTTANT';
nho2 = cplat poin cyli ch2 (ch2 plus px) (ch2 plus vr) tol;
ho2 = cplat elem appu stri nho2;
ho2n = ho2 homo fac ch2;
i = 0;
repe loop2 (nbno ho2);
  i = i + 1;
  ni = ho2 poin i;
  nin = ho2n poin i;
  conf ni nin;
fin loop2;
finproc;
*======================================================================
'DEBPROC' pxshrink frameb*'MAILLAGE' cen*'POINT'
                   rbo*'FLOTTANT' fac*'FLOTTANT';
pxm = -1 0 0;
pxp = 1 0 0;
vr2 = 0 (0.5*rbo) 0;
nbolt = frameb poin cyli (cen plus pxm) (cen plus pxp)
        (cen plus vr2) (0.5001*rbo);
xc yc zc = coor cen;
i = 0;
repe loop2 (nbno nbolt);
  i = i + 1;
  ni = nbolt poin i;
  xi yi zi = coor ni;
  ceni = xi yc zc;
  nin = ni homo fac ceni;
  conf ni nin;
fin loop2;
finproc;
*======================================================================
opti echo 1;
opti rest form 'vega33.msh';
rest form;
list;
*
oubl mesh;
oubl pre;
oubl pre3;
oubl pre2;
oubl pre1;
oubl mems;
oubl mem3;
oubl mem2;
oubl mem1;
oubl mesh1;
*
list;
mesh = spec et devi et stub3d et rac3d1d et pface3d et face3d et
       flui3d et bout et fond;
tass mesh noop;
*
opti trac psc ftra 'vega52_mesh.ps';
oeil = 100000 0 0;
trac oeil qual plate;
cplat = cont plate;
ch1 = 0 26.E-2 0;
p0 = 0 0 0;
p0p = 1 0 0;
ch2 = ch1 tour 15.0 p0 p0p;
ch3 = ch1 tour 30.0 p0 p0p;
ch4 = ch1 tour 45.0 p0 p0p;
ch5 = ch1 tour 60.0 p0 p0p;
ch6 = ch1 tour 75.0 p0 p0p;
ch7 = 0 0 26.E-2;
px = 1 0 0;
r = 1.25E-2;
vr = 0 r 0;
tol = 1.E-4;
fac = 1.016;
pxswell cplat ch1 px vr tol fac;
pxswell cplat ch2 px vr tol fac;
pxswell cplat ch3 px vr tol fac;
pxswell cplat ch4 px vr tol fac;
pxswell cplat ch5 px vr tol fac;
pxswell cplat ch6 px vr tol fac;
pxswell cplat ch7 px vr tol fac;
trac oeil qual plate;
oeil2 = 100000 0 -30000;
trac oeil2 cach qual lframeb;
facs = 0.936;
pxshrink lframeb ch1 r facs;
pxshrink lframeb ch3 r facs;
pxshrink lframeb ch5 r facs;
pxshrink lframeb ch7 r facs;
trac oeil2 cach qual lframeb;
*
opti sauv form 'vega52.msh';
sauv form mesh;
*
fin;
```

vega52.epx

```
VEGA52
ECHO
!CONV win
CAST mesh
TRID ALE
EROS 1.0
DIME ADAP NPOI 100000
          CUVF 150000
          NVFI 200000
          CL3D 20000
     ENDA
     JONC 475 ! Total n. of nodes in a TUBM juncton
     NALE 1 NBLE 1
     TERM
GEOM CUB8 ecub8
     PR6  epri6
     Q4GS equa4
     T3GS etri3
     PMAT nplate
     CUVF flui3d tubelp3 tank
     TUVF tubelp1
     CL3D face3d presur abso stub3d
     TUBM rac3d1d raclp
TERM
COMP EPAI 0.8e-3 LECT plate nplate TERM
     DIAM DROI 0.1692568 LECT tubelp1 TERM
     RACC TUBM LECT rac3d1d  TERM
          NTUB LECT p1a   TERM DTUB 0.1692568
          FACE LECT face3d TERM COEF 1.0
     RACC TUBM LECT raclp  TERM
          NTUB LECT p1d3   TERM DTUB 0.1692568
          FACE LECT stub3d TERM COEF 1.0
     GROU 15 'endtube' LECT tube TERM COND XB GT -0.6
            'frefine' LECT flui TERM COND XB GT -0.3
                                     COND XB LT  1.0
            'pp1'    LECT plate TERM
```

```
                COND BOX X0 0.0 Y0 0.0  Z0 0.0
                         DX 0.1 DY 0.15 DZ 0.15
         'fcoup'  LECT flui  TERM COND XB GT -0.05
                                  COND XB LT 0.150
                                  COND YB LT 0.150
                                  COND ZB LT 0.150
         'scoup'  LECT plate TERM COND YB LT 0.150
                                  COND ZB LT 0.150
         'S1' LECT tube TERM COND NEAR POIN -0.345 0.15 0.15
         'S2' LECT tube TERM COND NEAR POIN -0.245 0.15 0.15
         'plaEdg' LECT plate DIFF pp1 TERM
                COND YB LT 0.16
                COND ZB LT 0.16
         'nplatmp'    LECT nplate  TERM
                COND YB LT 0.16
                COND ZB LT 0.16
         'nplalim'    LECT nplate DIFF nplatmp TERM
         'lfrb2' LECT lframeb TERM
                COND XB LT -0.865E-2
         'lfrb1' LECT lframeb DIFF lfrb2 TERM
         'epar1' LECT tubelp1 TERM COND NEAR NODE LECT p1a TERM
         'epar2' LECT tubelp1 TERM COND NEAR NODE LECT p1d3 TERM
         'tubelpp' LECT tubelp1 DIFF epar1 epar2 TERM
     NGRO 4 'blox'  LECT lframeb TERM COND !X LT -0.0253
                                         X GT 0.0253
         'symy'  LECT spec TERM    COND Y LT 0.0001
         'symz'  LECT spec TERM    COND Z LT 0.0001
         'cen' LECT plate TERM COND NEAR POIN 0.0 0.0 0.0
     COUL TURQ LECT lfrb1 tubelp tank tra TERM
          BLAN LECT lfrb2 TERM
          BLEU LECT uframe raclp TERM
          VERT LECT plate fir2 TERM
          ROSE LECT presur fir1 TERM
          ROUG LECT nplate driver TERM
   JAUN LECT abso TERM
        DIAM DROI 0.1692568 LECT tubelp1 TERM
GRIL LAGR LECT spec TERM
MATE
    !LOI 2
     GAZP RO 46.517 GAMM 1.4 CV 719.286 PINI 39.147E5 PREF 1.011E5
          LECT none TERM
    !LOI 3
     GAZP RO 31.412 GAMM 1.4 CV 719.286 PINI 26.435E5 PREF 1.011E5
          LECT none TERM
    !LOI 4
     GAZP RO 16.307 GAMM 1.4 CV 719.286 PINI 13.723E5 PREF 1.011E5
          LECT none TERM
    !LOI 5
     GAZP RO 1.202 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT flui3d TERM
     GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT epar1 epar2 TERM
     GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT rac3d1d raclp tubelpp TERM
     PARO PSIL 0.02
          LECT tubelpp TERM
     MULT 6 7 LECT tubelpp TERM
     GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT tubelp3 tank _cuvf TERM
     CLVF ABSO RO 1.189
          LECT abso TERM
     VPJC RO 7850.0 YOUN 2.1E11 NU 0.33 ELAS 3.257E8 mxit 500
          QR1 2.348E8 CR1 56.2 QR2 4.457E8 CR2 4.7
          PDOT 5.E-4 C 1.E-2 TQ 0.9 CP 452.0
          TM 1800.0 M 1.0 DC 1.0 WC 555.0E6
          LECT lframeb uframe plate TERM
     MASS 0.0 YOUN 2.1E11 NU 0.33
          LECT nplate TERM
     IMPE PIMP RO 7850.0 PRES 44.0011e6 PREF 1.011E5
          LECT presur _cl3d TERM
OPTI PINS ASN
LINK COUP SPLT NONE
     BLOQ 1 LECT blox TERM
     CONT SPLA NX 0 NY 1 NZ 0 LECT symy TERM
     CONT SPLA NX 0 NY 0 NZ 1 LECT symz TERM
LINK DECO
     PINB PENA SFAC 1.0
          BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DMIN 0.0008 ! #1
               LECT lfrb1 TERM
          BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DMIN 0.0008 ! #2
               LECT lfrb2 TERM
          BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DMIN 0.0008 ! #3
               LECT uframe TERM
          BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DMIN 0.0002 ! #4
               LECT plaEdg TERM
          BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DIAM 0.0004 ! #5
               LECT nplalim TERM
          EXCL PAIR 1 2
          EXCL PAIR 1 3
          EXCL PAIR 4 5
     FLSW STRU LECT scoup TERM
          FLUI LECT fcoup TERM
          R 0.014
          HGRI 0.016
          DGRI
          FACE
          BFLU 2 ! block if at least one node is in influence domain
          FSCP 1 ! couple in all directions
          ADAP LMAX 2 SCAL 2
     TBLO 123    UPTO 30.0E-3 LECT lframeb uframe TERM
          123456 UPTO 30.0E-3 LECT plate TERM
INIT MAPP FORM 'vega51.map' MATC OBJE LECT flui3d tubelp1 TERM
ECRI DEPL VITE ECRO FAIL TFRE 1.0E-3
          POIN LECT cen TERM
          ELEM LECT S1 TERM
     FICH ALIT FREQ 0 TFRE 0.D0
          TIME PROG 0.D0 PAS 0.5D-3 28.D-3 PAS 0.01D-3 40.D-3 TERM
          POIN LECT cen TERM
          ELEM LECT S1 S2 TERM
     FICH SPLI ALIC FREQ 0 TFRE 0.D0
          TIME PROG 0.D0 PAS 1.0D-3 40.D-3 TERM
OPTI NOTE CSTA 0.4
     STEP IO
     LOG 1
     JAUM
     LMST
     PINS GRID DPIN 1.01
     VFCC FCON 6 ! hllc solver
          ORDR 2 ! order in space
          OTPS 2 ! order in time
          RECO 1 ! Not accepted by CAL_VFCC_1D
          NTIL
     ADAP RCON
     NOCR UPTO 30.0E-3 LECT plate lframeb uframe TERM
     FLS  CUB8 2 ! For the inverse mapping
CALC TINI 0 TEND 40.0E-3
FIN
```

vega52a.epx

```
Post-treatment
ECHO
 CONV WIN
RESU SPLI ALIC 'vega52.ali' GARD PSCR
COMP COUL ROUG LECT mem1 TERM
          VERT LECT mem2 TERM
          JAUN LECT mem3 TERM
SORT VISU NSTO 1
FIN
```

vega52b.epx

```
VEGA52B
ECHO
RESU SPLI ALIC TEMP 'vega52.alt' GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
COUR 1 'SENS1' ECRO COMP 1 LECT S1 TERM
COUR 2 'SENS2' ECRO COMP 1 LECT S2 TERM
TRAC 1 2 AXES 1.0 'Press [Pa]' YZER
COLO BLEU ROUG
LIST 1 2 AXES 1.0 'Press [Pa]' YZER
COUR 10 'DisCen' DEPL COMP 1 POIN LECT cen TERM
TRAC 10 AXES 1.0 'Displ [m]' YZER
COLO BLEU
LIST 10 AXES 1.0 'Displ [m]' YZER
RCOU 101 'SENS1'  FICH 'vega51b.pun' RENA 'SENS1_51'
RCOU 102 'SENS2'  FICH 'vega51b.pun' RENA 'SENS2_51'
RCOU 110 'DisCen' FICH 'vega51b.pun' RENA 'DisCen_51'
TRAC 1 2 101 102 AXES 1.0 'Press [Pa]' YZER
COLO BLEU ROUG BLEU ROUG
DASH 0    0    3    3
TRAC 10 110 AXES 1.0 'Displ [m]' YZER
COLO BLEU ROUG
TRAC 1 2 101 102 AXES 1.0 'Press [Pa]' YZER
XMIN 28.E-3 XMAX 33.E-3 DX 1.E-3
COLO BLEU ROUG BLEU ROUG
DASH 0    0    3    3
TRAC 10 110 AXES 1.0 'Displ [m]' YZER
XMIN 28.E-3 XMAX 33.E-3 DX 1.E-3
COLO BLEU ROUG
FIN
```

vega52c.epx

```
VEGA52C
ECHO
RESU SPLI ALIC TEMP 'vega52.alt' GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
COUR 1 'SENS1' ECRO COMP 1 LECT S1 TERM
COUR 2 'SENS2' ECRO COMP 1 LECT S2 TERM
COUR 10 'DisCen' DEPL COMP 1 POIN LECT cen TERM
RCOU 11 'SENS1'  FICH 'vega44b.pun' RENA 'S1_44'
RCOU 12 'SENS2'  FICH 'vega44b.pun' RENA 'S2_44'
RCOU 20 'DisCen' FICH 'vega44b.pun' RENA 'DC_44'
TRAC 1 11 AXES 1.0 'PRES [PA]' YZER
     COLO NOIR VERT
TRAC 2 12 AXES 1.0 'PRES [PA]' YZER
     COLO NOIR VERT
TRAC 10 20 AXES 1.0 'DISP [M]' YZER
     COLO NOIR VERT
COUR 22 INT  2
COUR 32 INT 12
TRAC 22 32 AXES 1.0 'PDT [PA*S]' YZER
     COLO NOIR VERT
TRAC 1 11 AXES 1.0 'PRES [PA]' XMIN 29.E-3 XMAX 40.E-3 NX 11 YZER
     COLO NOIR VERT
TRAC 2 12 AXES 1.0 'PRES [PA]' XMIN 29.E-3 XMAX 40.E-3 NX 11 YZER
     COLO NOIR VERT
FIN
```

vega52l.epx

```
VEGA52L
ECHO
*CONV WIN
LAGR AXIS
GEOM LIBR POIN 18 Q92 1 Q93 1        ED01 2 TERM
  1 0.0 1.5 0.0 2 0.0 2.5 0.0 3 0.0
  1 0.5 1.5 0.5 2 0.5 2.5 0.5 3 0.5
  1 1.0 1.5 1.0 2 1.0 2.5 1.0 3 1.0
  0 0 1 1 1 2
  1 2 3 8 13 12 11 6 7
  3 4 5 10 15 14 13 8 9
  16 17
  17 18
EPAI 1. LECT 1 PAS 1 4 TERM
MATE VM23 RO 8000. YOUN 1.D11 NU 0.3 ELAS 2.D8
          TRAC 3 2.D8 2.D-3 3.D8 1. 3.1D8 2.
          LECT 1 2 TERM
     VM23 RO 4000. YOUN 2.D11 NU 0.2 ELAS 4.D8
          TRAC 2 4.D8 2.D-3 6.D8 1.
          LECT 3 4 TERM
LINK COUP
     BLOQ 12 LECT 5 PAS 5 15 TERM
     BLOQ 123 LECT 16 TERM
INIT VITE 2 300 LECT 6 PAS 1 9 TERM
     VITE 1 -200 LECT 6 PAS 1 8 TERM
     VITE 2 -100 LECT 17 TERM
     VITE 1 200 LECT 18 TERM
ECRI DEPL VITE ACCE FINT FEXT FLIA FDEC CONT ECRO FREQ 100
     FICH ALIC FREQ 1
OPTI PAS UTIL NOTE LOG 1
CALCUL TINI 0. TEND 0.001D0 PASF 1.D-5
*=================================================================
SUIT
Post-treatment (time curves from alice file)
ECHO
RESU ALIC GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
LCOU 21 'step' FICH 'vega52.log' STEP
LCOU 22 'cpu'  FICH 'vega52.log' TCPU
LCOU 23 'dtcr' FICH 'vega52.log' DTCR
LCOU 24 'elcr' FICH 'vega52.log' ELCR
LCOU 25 'dee'  FICH 'vega52.log' DEE
LCOU 26 'dmmn' FICH 'vega52.log' DMMN
LCOU 27 'dmme' FICH 'vega52.log' DMME
LCOU 28 'dtmx' FICH 'vega52.log' DTMX
LCOU 29 'elmx' FICH 'vega52.log' ELMX
LCOU 30 'vmax' FICH 'vega52.log' VMAX
LCOU 31 'nvmx' FICH 'vega52.log' NVMX
LCOU 32 'elst' FICH 'vega52.log' ELST
LCOU 33 'memo' FICH 'vega52.log' MEMO
LCOU 34 'memp' FICH 'vega52.log' MEMP
*
TRAC 21 AXES 1.0 'STEP [-]' YZER
TRAC 22 AXES 1.0 'CPU [S]' YZER
TRAC 23 AXES 1.0 'DTCR [S]' YZER
TRAC 23 AXES 1.0 'DTCR [S]' YLOG
*
TRAC 24 AXES 1.0 'ELCR [-]' YZER
TRAC 25 AXES 1.0 'DEE [-]' YZER
TRAC 26 AXES 1.0 'DMMN [-]' YZER
TRAC 27 AXES 1.0 'DMME [-]' YZER
TRAC 28 AXES 1.0 'DTMX [S]' YZER
TRAC 29 AXES 1.0 'ELMX [-]' YZER
TRAC 30 AXES 1.0 'VMAX [M/S]' YZER
TRAC 31 AXES 1.0 'NVMX [-]' YZER
TRAC 32 AXES 1.0 'ELST [-]' YZER
TRAC 33 AXES 1.0 'MEMO [-]' YZER
TRAC 34 AXES 1.0 'MEMP [-]' YZER
*
LIST 21 AXES 1.0 'STEP [-]' YZER
LIST 22 AXES 1.0 'CPU [S]' YZER
LIST 23 AXES 1.0 'DTCR [S]' YZER
*
LIST 24 AXES 1.0 'ELCR [-]' YZER
LIST 25 AXES 1.0 'DEE [-]' YZER
LIST 26 AXES 1.0 'DMMN [-]' YZER
LIST 27 AXES 1.0 'DMME [-]' YZER
LIST 28 AXES 1.0 'DTMX [S]' YZER
LIST 29 AXES 1.0 'ELMX [-]' YZER
LIST 30 AXES 1.0 'VMAX [M/S]' YZER
LIST 31 AXES 1.0 'NVMX [-]' YZER
LIST 32 AXES 1.0 'ELST [-]' YZER
LIST 33 AXES 1.0 'MEMO [-]' YZER
LIST 34 AXES 1.0 'MEMP [-]' YZER
*=================================================================
FIN
```

vega53.epx

```
VEGA53
ECHO
!CONV win
CAST mesh
TRID ALE
EROS 1.0
DIME ADAP NPOI 100000
          Q4GS 20000
          CUVF 150000
          NVFI 200000
          CL3D 20000
          !Q4GS 20000
          NPIN 20000
     ENDA
     JONC 475 ! Total n. of nodes in a TUBM juncton
     NALE 1 NBLE 1
     TERM
GEOM CUB8 ecub8
     PR6  epri6
     Q4GS equa4 mems
     T3GS etri3
     PMAT nplate
     CUVF flui3d tubelp3 tank
     TUVF tubelp1
     CL3D pre face3d presur abso stub3d
     TUBM rac3d1d raclp
TERM
COMP EPAI 0.8e-3 LECT plate nplate TERM
          1.50E-3 LECT mems TERM
     DIAM DROI 0.1692568 LECT tubelp1 TERM
     RACC TUBM LECT rac3d1d  TERM
          NTUB LECT p1a   TERM DTUB 0.1692568
          FACE LECT face3d TERM COEF 1.0
     RACC TUBM LECT raclp  TERM
          NTUB LECT p1d3   TERM DTUB 0.1692568
          FACE LECT stub3d TERM COEF 1.0
! Attention: the TUBM element (raclp) is NOT included
! in the "mesh" object (although it IS indeed passed in from Cast3m).
! For this reason we must add it explicitly in the GROU directive below
! if we want to have it in the extracted element groups.
     GROU 20 'endtube' LECT tube TERM COND XB GT -0.6
             'trigger' LECT tube TERM COND NEAR POIN -0.1501 0 0
             'frefine' LECT flui TERM COND XB GT -0.3
                                      COND XB LT  1.0
             'nrac3d1d' LECT mesh1 rac3d1d TERM
                      COND XB GT -15.5952 COND XB LT -15.5948
             'nraclp' LECT devi raclp TERM
                      COND XB GT -0.6002 COND XB LT -0.5998
             'pp1'    LECT plate TERM
                      COND BOX X0 0.0 Y0 0.0  Z0 0.0
                               DX 0.1 DY 0.15 DZ 0.15
             'pp2'    LECT plate TERM
                      COND BOX X0 0.0 Y0 0.09 Z0 0.09
                               DX 0.1 DY 0.06 DZ 0.06
             'fcoup1' LECT flui3d TERM
                      COND XB GT -16.405
                      COND XB LT -16.005
             'fcoup'  LECT flui  TERM COND XB GT -0.05
                                      COND XB LT 0.150
                                      COND YB LT 0.150
                                      COND ZB LT 0.150
             'scoup'  LECT plate TERM COND YB LT 0.150
                                      COND ZB LT 0.150
             'S1' LECT tube TERM COND NEAR POIN -0.345 0.15 0.15
             'S2' LECT tube TERM COND NEAR POIN -0.245 0.15 0.15
             'plaEdg' LECT plate DIFF pp1 TERM
                      COND YB LT 0.16
                      COND ZB LT 0.16
             'nplatmp'    LECT nplate  TERM
                      COND YB LT 0.16
                      COND ZB LT 0.16
             'nplalim'    LECT nplate DIFF nplatmp TERM
             'lfrb2' LECT lframeb TERM
                     COND XB LT -0.865E-2
             'lfrb1' LECT lframeb DIFF lfrb2 TERM
             'epar1' LECT tubelp1 TERM COND NEAR NODE LECT p1a TERM
             'epar2' LECT tubelp1 TERM COND NEAR NODE LECT p1d3 TERM
             'tubelpp' LECT tubelp1 DIFF epar1 epar2 TERM
     NGRO 12 'nmemi' LECT mems TERM
                     COND CYLI X1 -20 Y1 0 Z1 0 X2 20 Y2 0 Z2 0 R 0.1650
             'nmemo' LECT mems DIFF nmemi TERM
             'nsymy' LECT mems TERM COND Y LT 0.001
             'nsymz' LECT mems TERM COND Z LT 0.001
             'm1c'   LECT mem1 TERM COND NEAR POIN -16.335 0 0
             'm2c'   LECT mem2 TERM COND NEAR POIN -16.265 0 0
             'm3c'   LECT mem3 TERM COND NEAR POIN -16.195 0 0
             'blox'  LECT lframeb TERM COND !X LT -0.0253
                                            X GT 0.0253
             'symy'  LECT spec TERM    COND Y LT 0.0001
             'symz'  LECT spec TERM    COND Z LT 0.0001
             'pt0' LECT tubelp TERM COND NEAR POIN -16.19999 0.0 0.0
             'cen' LECT plate TERM COND NEAR POIN 0.0 0.0 0.0
     COUL TURQ LECT lfrb1 tubelp tank tra DIFF trigger TERM
          BLAN LECT lfrb2 TERM
          BLEU LECT uframe raclp TERM
          VERT LECT plate fir2 TERM
          ROSE LECT presur trigger fir1 TERM
          ROUG LECT nplate driver TERM
          GR50 LECT mems TERM
  JAUN LECT pre abso TERM
       DIAM DROI 0.1692568 LECT tubelp1 TERM
ADAP THRS ECRO 3 TMIN 0.01 TMAX 0.4 MAXL 3
          LECT mems TERM
GRIL LAGR LECT spec mems TERM
FONC 1 TABL 5 0.0       0.0
              1.0E-3    1.0
              2.999E-3  1.0
              3.0E-3    0.0
              100.0E-3  0.0
MATE
    !LOI 1
     VM23 RO 1380 YOUN 2757.9E6 NU 0.495 ELAS 120.E6 ! "Melinex/Mylar/PET"
```

```
          FAIL PEPR LIMI 1.0
          TRAC 3 120.E6 0.04351
                 180.E6 1.5
                 230.E6 3.5
          LECT mems _q4gs TERM
     !LOI 2
      GAZP RO 46.517 GAMM 1.4 CV 719.286 PINI 39.147E5 PREF 1.011E5
          LECT none TERM
     !LOI 3
      GAZP RO 31.412 GAMM 1.4 CV 719.286 PINI 26.435E5 PREF 1.011E5
          LECT none TERM
     !LOI 4
      GAZP RO 16.307 GAMM 1.4 CV 719.286 PINI 13.723E5 PREF 1.011E5
          LECT none TERM
     !LOI 5
      GAZP RO 1.202 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT flui3d _cuvf TERM
     !LOI 6
!     IMPE PIMP PRES 12.712E5 PREF 0 FONC 1
      IMPE PIMP PRES 13.723E5 PREF 1.011E5 FONC 1
          LECT pre _cl3d TERM
      GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT epar1 epar2 TERM
      GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT rac3d1d raclp tubelpp TERM
      PARO PSIL 0.02
          LECT tubelpp TERM
      MULT 8 9 LECT tubelpp TERM
! In order to obtain a printout at least of the 3D VFCCs I am obliged
! to use a different material for tubelp3 and other 3D parts, but with the
! same characteristics as the material used for tubelp1
      GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT tubelp3 tank _cuvf TERM
      CLVF ABSO RO 1.189
          LECT abso TERM
      VPJC RO 7850.0 YOUN 2.1E11 NU 0.33 ELAS 3.257E8 mxit 500
          QR1 2.348E8 CR1 56.2 QR2 4.457E8 CR2 4.7
          PDOT 5.E-4 C 1.E-2 TQ 0.9 CP 452.0
          TM 1800.0 M 1.0 DC 1.0 WC 555.0E6
          LECT lframeb uframe plate TERM
     !VPJC RO 2700 YOUN 70.0E9 NU 0.3 ELAS 80.0E6 MXIT 500
     !     QR1 31.2E6 CR1 1090 QR2 12.2E6 CR2 20.4
     !     PDOT 5.E-4 C 1.4E-2 TQ 0.9 CP 910.0
     !     TM 893.0 M 1.0 DC 1.0 WC 59.4E6
     !     LECT plate TERM
      MASS 0.0 YOUN 2.1E11 NU 0.33
          LECT nplate TERM
      IMPE PIMP RO 7850.0 PRES 44.0011e6 PREF 1.011E5
          LECT presur TERM
OPTI PINS ASN
LINK COUP SPLT NONE
      BLOQ 123 LECT nmemo TERM
      CONT SPLA NX 0 NY 1 NZ 0 LECT nsymy TERM
      CONT SPLA NX 0 NY 0 NZ 1 LECT nsymz TERM
      BLOQ 1 LECT blox TERM
      CONT SPLA NX 0 NY 1 NZ 0 LECT symy TERM
      CONT SPLA NX 0 NY 0 NZ 1 LECT symz TERM
LINK DECO
      PINB PENA SFAC 1.0
          BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DMIN 0.0008 ! #1
               LECT lfrb1 TERM
          BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DMIN 0.0008 ! #2
               LECT lfrb2 TERM
          BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DMIN 0.0008 ! #3
               LECT uframe TERM
          BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DMIN 0.0002 ! #4
               LECT plaEdg TERM
          BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DIAM 0.0004 ! #5
               LECT nplalim TERM
          BODY                               DMIN 0.003  ! #6
               LECT mem1 TERM
          BODY                               DMIN 0.003  ! #7
               LECT mem2 TERM
          BODY                               DMIN 0.003  ! #8
               LECT mem3 TERM
          EXCL PAIR 1 2
          EXCL PAIR 1 3
          EXCL PAIR 4 5
          EXCL PAIR 1 6
          EXCL PAIR 1 7
          EXCL PAIR 1 8
          EXCL PAIR 2 6
          EXCL PAIR 2 7
          EXCL PAIR 2 8
          EXCL PAIR 3 6
          EXCL PAIR 3 7
          EXCL PAIR 3 8
          EXCL PAIR 4 6
          EXCL PAIR 4 7
          EXCL PAIR 4 8
          EXCL PAIR 5 6
          EXCL PAIR 5 7
          EXCL PAIR 5 8
      FLSW STRU LECT scoup mems TERM
          FLUI LECT fcoup1 fcoup TERM
          R 0.014    !
          HGRI 0.016
          DGRI
          FACE
          BFLU 2 ! block if at least one node is in influence domain
          FSCP 1 ! couple in all directions
          ADAP LMAX 2 SCAL 2
      TBLO 123    UPTO 30.0E-3 LECT lframeb uframe TERM
          123456 UPTO 30.0E-3 LECT plate TERM
INIT SKIP UPTO 3.E-3 VFCC
     ADAP IMAT TIME 3.E-3
               2 MATE 2 OBJE LECT flui3d TERM
                        INSI SURF LECT mem1 TERM
                !MATE 3 OBJE LECT flui3d TERM
                !       OUTS SURF LECT mem1 TERM
                !       INSI SURF LECT mem2 TERM
                 MATE 4 OBJE LECT flui3d TERM
                        OUTS SURF LECT mem2 TERM
                        INSI SURF LECT mem3 TERM
ECRI DEPL VITE ECRO FAIL TFRE 1.0E-3
          POIN LECT cen TERM
          ELEM LECT S1 TERM
     FICH ALIT FREQ 0 TFRE 0.D0
          TIME PROG 0.D0 PAS 0.5D-3 28.D-3 PAS 0.01D-3 40.D-3 TERM
          POIN LECT cen TERM
          ELEM LECT S1 S2 TERM
     FICH SPLI ALIC FREQ 0 TFRE 0.D0
          TIME PROG 0.D0 PAS 1.0D-3 40.D-3 TERM
OPTI NOTE CSTA 0.4
     LOG 1
     JAUM
     LMST
     FANT 10e-3 LECT mems TERM !_q4gs TERM
     PINS GRID DPIN 1.01
     VFCC FCON 6 ! hllc solver
          ORDR 2 ! order in space
          OTPS 2 ! order in time
          RECO 1 ! Not accepted by CAL_VFCC_1D
          NTIL
     ADAP RCON !TRIG ECRO 1 TVAL 1.02E5 LECT trigger TERM
     NOCR UPTO 30.0E-3 LECT plate lframeb uframe TERM
     FLS  CUB8 2 ! For the inverse mapping
     QUAS STAT 1670 0.1 UPTO 5.0E-3
CALC TINI 0 TEND 10.0E-3
FIN
```

vega53a.epx

```
Post-treatment
ECHO
 CONV WIN
RESU SPLI ALIC 'vega53.ali' GARD PSCR
COMP COUL ROUG LECT mem1 TERM
          VERT LECT mem2 TERM
          TURQ LECT mem3 TERM
SORT VISU NSTO 1
PLAY
CAME   1 EYE  -1.71083E+01  8.20132E-02  8.82573E-01
!        Q     9.22980E-01 -4.07399E-02 -3.82313E-01  1.68750E-02
         VIEW  7.07109E-01 -6.23012E-02 -7.04354E-01
         RIGH  7.07104E-01  6.23015E-02  7.04359E-01
         UP    1.51008E-07  9.96111E-01 -8.81074E-02
         FOV   2.48819E+01
!NAVIGATION MODE: ROTATING CAMERA
!CENTER : -1.62266E+01  4.33068E-03  4.32377E-03
!RSPHERE:  2.65295E-01
!RADIUS :  1.24689E+00
!ASPECT :  1.00000E+00
!NEAR   :  9.81591E-01
!FAR    :  1.51218E+00
SCEN GEOM NAVI FREE
     GEOM LINE HEOU
          FACE SBAC
     LIMA ON
SLER CAM1 1 NFRA 1
TRAC OFFS FICH BMP OBJE LECT mems TERM NFAI SYXY SYXZ REND
FREQ 1
GOTR LOOP 6 OFFS FICH BMP OBJE LECT mems TERM NFAI SYXY SYXZ REND
ENDPLAY
FIN
```

vega53b.epx

```
VEGA53B
ECHO
RESU SPLI ALIC TEMP 'vega53.alt' GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
COUR 1 'SENS1' ECRO COMP 1 LECT S1 TERM
COUR 2 'SENS2' ECRO COMP 1 LECT S2 TERM
TRAC 1 2 AXES 1.0 'Press [Pa]' YZER
COLO BLEU ROUG
LIST 1 2 AXES 1.0 'Press [Pa]' YZER
COUR 10 'DisCen' DEPL COMP 1 POIN LECT cen TERM
TRAC 10 AXES 1.0 'Displ [m]' YZER
COLO BLEU
LIST 10 AXES 1.0 'Displ [m]' YZER
FIN
```

vega53c.epx

```
VEGA53C
ECHO
RESU SPLI ALIC TEMP 'vega53.alt' GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
COUR 1 'SENS1' ECRO COMP 1 LECT S1 TERM
COUR 2 'SENS2' ECRO COMP 1 LECT S2 TERM
```

```
COUR 10 'DisCen' DEPL COMP 1 POIN LECT cen TERM
RCOU 11 'SENS1'  FICH 'vega44b.pun' RENA 'S1_44'
RCOU 12 'SENS2'  FICH 'vega44b.pun' RENA 'S2_44'
RCOU 20 'DisCen' FICH 'vega44b.pun' RENA 'DC_44'
TRAC 1 11 AXES 1.0 'PRES [PA]' YZER
     COLO NOIR VERT
TRAC 2 12 AXES 1.0 'PRES [PA]' YZER
     COLO NOIR VERT
TRAC 10 20 AXES 1.0 'DISP [M]' YZER
     COLO NOIR VERT
COUR 22 INT  2
COUR 32 INT 12
TRAC 22 32 AXES 1.0 'PDT [PA*S]' YZER
     COLO NOIR VERT
TRAC 1 11 AXES 1.0 'PRES [PA]' XMIN 29.E-3 XMAX 40.E-3 NX 11 YZER
     COLO NOIR VERT
TRAC 2 12 AXES 1.0 'PRES [PA]' XMIN 29.E-3 XMAX 40.E-3 NX 11 YZER
     COLO NOIR VERT
FIN
```

vega53k.epx

```
VEGA53K
ECHO
*CONV WIN
LAGR AXIS
GEOM LIBR POIN 18 Q92 1 Q93 1        ED01 2 TERM
  1 0.0 1.5 0.0 2 0.0 2.5 0.0 3 0.0
  1 0.5 1.5 0.5 2 0.5 2.5 0.5 3 0.5
  1 1.0 1.5 1.0 2 1.0 2.5 1.0 3 1.0
  0 0 1 1 1 2
  1 2 3 8 13 12 11 6 7
  3 4 5 10 15 14 13 8 9
  16 17
  17 18
EPAI 1. LECT 1 PAS 1 4 TERM
MATE VM23 RO 8000. YOUN 1.D11 NU 0.3 ELAS 2.D8
          TRAC 3 2.D8 2.D-3 3.D8 1. 3.1D8 2.
          LECT 1 2 TERM
     VM23 RO 4000. YOUN 2.D11 NU 0.2 ELAS 4.D8
          TRAC 2 4.D8 2.D-3 6.D8 1.
          LECT 3 4 TERM
LINK COUP
     BLOQ 12 LECT 5 PAS 5 15 TERM
     BLOQ 123 LECT 16 TERM
INIT VITE 2 300 LECT 6 PAS 1 9 TERM
     VITE 1 -200 LECT 6 PAS 1 8 TERM
     VITE 2 -100 LECT 17 TERM
     VITE 1 200 LECT 18 TERM
ECRI DEPL VITE ACCE FINT FEXT FLIA FDEC CONT ECRO FREQ 100
     FICH ALIC FREQ 1
OPTI PAS UTIL NOTE LOG 1
CALCUL TINI 0. TEND 0.001D0 PASF 1.D-5
*=================================================================
SUIT
Post-treatment (time curves from alice file)
ECHO
RESU ALIC GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
LCOU 22 'cpu'  FICH 'vega53.log' TCPU
TRAC 22 AXES 1.0 'CPU [S]' YZER XMIN 0.0 XMAX 10.E-3 NX 10
                           YMIN 0.0 YMAX 5.0E+4 NY 10
LIST 22 AXES 1.0 'CPU [S]' YZER XMIN 0.0 XMAX 10.E-3 NX 10
                           YMIN 0.0 YMAX 5.0E+4 NY 10
LCOU 23 'dtcr' FICH 'vega53.log' DTCR
TRAC 23 AXES 1.0 'DTCR [S]' XMIN 0.0 XMAX 10.E-3 NX 10
                            YMIN 0.0 YMAX 2.0E-6 NY 10
LIST 23 AXES 1.0 'DTCR [S]' XMIN 0.0 XMAX 10.E-3 NX 10
                            YMIN 0.0 YMAX 2.0E-6 NY 10
RCOU 122 'cpu'  FICH 'vega51k.pun' RENA 'cpu_51'
TRAC 22 122 AXES 1.0 'CPU [S]' YZER XMIN 0.0 XMAX 10.E-3 NX 10
                           YMIN 0.0 YMAX 5.0E+4 NY 10
COLO ROUG NOIR
RCOU 123 'dtcr' FICH 'vega51k.pun' RENA 'dtcr_51'
TRAC 23 123 AXES 1.0 'DTCR [S]' XMIN 0.0 XMAX 10.E-3 NX 10
                            YMIN 0.0 YMAX 2.0E-6 NY 10
COLO ROUG NOIR
*=================================================================
FIN
```

vega53l.epx

```
VEGA53L
ECHO
*CONV WIN
LAGR AXIS
GEOM LIBR POIN 18 Q92 1 Q93 1        ED01 2 TERM
  1 0.0 1.5 0.0 2 0.0 2.5 0.0 3 0.0
  1 0.5 1.5 0.5 2 0.5 2.5 0.5 3 0.5
  1 1.0 1.5 1.0 2 1.0 2.5 1.0 3 1.0
  0 0 1 1 1 2
  1 2 3 8 13 12 11 6 7
  3 4 5 10 15 14 13 8 9
  16 17
  17 18
EPAI 1. LECT 1 PAS 1 4 TERM
MATE VM23 RO 8000. YOUN 1.D11 NU 0.3 ELAS 2.D8
          TRAC 3 2.D8 2.D-3 3.D8 1. 3.1D8 2.
          LECT 1 2 TERM
     VM23 RO 4000. YOUN 2.D11 NU 0.2 ELAS 4.D8
          TRAC 2 4.D8 2.D-3 6.D8 1.
          LECT 3 4 TERM
LINK COUP
     BLOQ 12 LECT 5 PAS 5 15 TERM
     BLOQ 123 LECT 16 TERM
INIT VITE 2 300 LECT 6 PAS 1 9 TERM
     VITE 1 -200 LECT 6 PAS 1 8 TERM
     VITE 2 -100 LECT 17 TERM
     VITE 1 200 LECT 18 TERM
ECRI DEPL VITE ACCE FINT FEXT FLIA FDEC CONT ECRO FREQ 100
     FICH ALIC FREQ 1
OPTI PAS UTIL NOTE LOG 1
CALCUL TINI 0. TEND 0.001D0 PASF 1.D-5
*=================================================================
SUIT
Post-treatment (time curves from alice file)
ECHO
RESU ALIC GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
LCOU 21 'step' FICH 'vega53.log' STEP
LCOU 22 'cpu'  FICH 'vega53.log' TCPU
LCOU 23 'dtcr' FICH 'vega53.log' DTCR
LCOU 24 'elcr' FICH 'vega53.log' ELCR
LCOU 25 'dee'  FICH 'vega53.log' DEE
LCOU 26 'dmmn' FICH 'vega53.log' DMMN
LCOU 27 'dmme' FICH 'vega53.log' DMME
LCOU 28 'dtmx' FICH 'vega53.log' DTMX
LCOU 29 'elmx' FICH 'vega53.log' ELMX
LCOU 30 'vmax' FICH 'vega53.log' VMAX
LCOU 31 'nvmx' FICH 'vega53.log' NVMX
LCOU 32 'elst' FICH 'vega53.log' ELST
LCOU 33 'memo' FICH 'vega53.log' MEMO
LCOU 34 'memp' FICH 'vega53.log' MEMP
*
TRAC 21 AXES 1.0 'STEP [-]' YZER
TRAC 22 AXES 1.0 'CPU [S]' YZER
TRAC 23 AXES 1.0 'DTCR [S]' YZER
TRAC 23 AXES 1.0 'DTCR [S]' YLOG
*
TRAC 24 AXES 1.0 'ELCR [-]' YZER
TRAC 25 AXES 1.0 'DEE [-]' YZER
TRAC 26 AXES 1.0 'DMMN [-]' YZER
TRAC 27 AXES 1.0 'DMME [-]' YZER
TRAC 28 AXES 1.0 'DTMX [S]' YZER
TRAC 29 AXES 1.0 'ELMX [-]' YZER
TRAC 30 AXES 1.0 'VMAX [M/S]' YZER
TRAC 31 AXES 1.0 'NVMX [-]' YZER
TRAC 32 AXES 1.0 'ELST [-]' YZER
TRAC 33 AXES 1.0 'MEMO [-]' YZER
TRAC 34 AXES 1.0 'MEMP [-]' YZER
*
LIST 21 AXES 1.0 'STEP [-]' YZER
LIST 22 AXES 1.0 'CPU [S]' YZER
LIST 23 AXES 1.0 'DTCR [S]' YZER
*
LIST 24 AXES 1.0 'ELCR [-]' YZER
LIST 25 AXES 1.0 'DEE [-]' YZER
LIST 26 AXES 1.0 'DMMN [-]' YZER
LIST 27 AXES 1.0 'DMME [-]' YZER
LIST 28 AXES 1.0 'DTMX [S]' YZER
LIST 29 AXES 1.0 'ELMX [-]' YZER
LIST 30 AXES 1.0 'VMAX [M/S]' YZER
LIST 31 AXES 1.0 'NVMX [-]' YZER
LIST 32 AXES 1.0 'ELST [-]' YZER
LIST 33 AXES 1.0 'MEMO [-]' YZER
LIST 34 AXES 1.0 'MEMP [-]' YZER
*=================================================================
FIN
```

vega53m.epx

```
Post-treatment
ECHO
 CONV WIN
RESU SPLI ALIC 'vega53.ali' GARD PSCR
COMP COUL ROUG LECT mem1 TERM
          VERT LECT mem2 TERM
          TURQ LECT mem3 TERM
SORT VISU NSTO 1
PLAY
CAME   1 EYE  -1.72478E+01  0.00000E+00 -1.87219E-10
!        Q      7.07107E-01  0.00000E+00 -7.07107E-01  0.00000E+00
         VIEW  1.00000E+00  0.00000E+00  2.05103E-10
         RIGH -2.05103E-10  0.00000E+00  1.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   2.48819E+01
!NAVIGATION MODE: ROTATING CAMERA
!CENTER : -1.63350E+01  0.00000E+00  0.00000E+00
!RSPHERE:  2.34052E-01
!RADIUS :  9.12804E-01
!ASPECT :  1.00000E+00
!NEAR   :  6.78752E-01
!FAR    :  1.38091E+00
SCEN GEOM NAVI FREE
         !LINE HEOU
          FACE SBAC
     LIMA ON
SLER CAM1 1 NFRA 1
```

```
TRAC OFFS FICH BMP OBJE LECT mem1 TERM NFAI SYXY SYXZ
     AMPD 0 REND
FREQ 1
GOTR LOOP 6 OFFS FICH BMP OBJE LECT mem1 TERM NFAI SYXY SYXZ
     AMPD 0 REND
ENDPLAY
FIN
```

vega53n.epx

```
Post-treatment
ECHO
 CONV WIN
RESU SPLI ALIC 'vega53.ali' GARD PSCR
COMP COUL ROUG LECT mem1 TERM
          VERT LECT mem2 TERM
          TURQ LECT mem3 TERM
SORT VISU NSTO 1
PLAY
CAME   1 EYE  -1.72478E+01  0.00000E+00 -1.87219E-10
!        Q     7.07107E-01  0.00000E+00 -7.07107E-01  0.00000E+00
         VIEW  1.00000E+00  0.00000E+00  2.05103E-10
         RIGH -2.05103E-10  0.00000E+00  1.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   2.48819E+01
!NAVIGATION MODE: ROTATING CAMERA
!CENTER : -1.63350E+01  0.00000E+00  0.00000E+00
!RSPHERE:  2.34052E-01
!RADIUS :  9.12804E-01
!ASPECT :  1.00000E+00
!NEAR   :  6.78752E-01
!FAR    :  1.38091E+00
SCEN GEOM NAVI FREE
         !LINE HEOU
          FACE SBAC
     LIMA ON
SLER CAM1 1 NFRA 1
TRAC OFFS FICH BMP OBJE LECT mem2 TERM NFAI SYXY SYXZ
     AMPD 0 REND
FREQ 1
GOTR LOOP 6 OFFS FICH BMP OBJE LECT mem2 TERM NFAI SYXY SYXZ
     AMPD 0 REND
ENDPLAY
FIN
```

vega53o.epx

```
Post-treatment
ECHO
 CONV WIN
RESU SPLI ALIC 'vega53.ali' GARD PSCR
COMP COUL ROUG LECT mem1 TERM
          VERT LECT mem2 TERM
          TURQ LECT mem3 TERM
SORT VISU NSTO 1
PLAY
CAME   1 EYE  -1.72478E+01  0.00000E+00 -1.87219E-10
!        Q     7.07107E-01  0.00000E+00 -7.07107E-01  0.00000E+00
         VIEW  1.00000E+00  0.00000E+00  2.05103E-10
         RIGH -2.05103E-10  0.00000E+00  1.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   2.48819E+01
!NAVIGATION MODE: ROTATING CAMERA
!CENTER : -1.63350E+01  0.00000E+00  0.00000E+00
!RSPHERE:  2.34052E-01
!RADIUS :  9.12804E-01
!ASPECT :  1.00000E+00
!NEAR   :  6.78752E-01
!FAR    :  1.38091E+00
SCEN GEOM NAVI FREE
         !LINE HEOU
          FACE SBAC
     LIMA ON
SLER CAM1 1 NFRA 1
TRAC OFFS FICH BMP OBJE LECT mem3 TERM NFAI SYXY SYXZ
     AMPD 0 REND
FREQ 1
GOTR LOOP 6 OFFS FICH BMP OBJE LECT mem3 TERM NFAI SYXY SYXZ
     AMPD 0 REND
ENDPLAY
FIN
```

vega61.dgibi

```
opti echo 1;
opti rest form 'vega33.msh';
rest form;
list;
oubl mesh;
oubl spec;
oubl etri3;
oubl equa4;
oubl epri6;
oubl ecub8;
oubl nplate;
oubl presur;
oubl lframeb;
oubl preplat;
oubl plate;
oubl uframe;
oubl devi;
oubl flui;
oubl tube;
oubl raclp;
oubl tubelp;
oubl tubelp3;
oubl abso;
oubl tank;
*
oubl stub3d;
oubl mesh1;
oubl pface3d;
oubl bout;
oubl fond;
oubl p13d;
oubl py;
oubl pz;
*
list;
mesh = flui3d et tubelp1 et rac3d1d et face3d et mems et pre;
tass mesh noop;
opti sauv form 'vega61.msh';
sauv form mesh;
*
opti trac psc ftra 'vega61_mesh.ps';
trac cach mesh;
*
fin;
```

vega61.epx

```
VEGA61
ECHO
!CONV win
CAST mesh
TRID ALE
EROS 1.0
DIME ADAP NPOI 100000
          Q4GS 20000
          CUVF 150000
          NVFI 200000
          CL3D 20000
          NPIN 20000
     ENDA
     JONC 475 ! Total n. of nodes in a TUBM juncton
     NALE 1 NBLE 1
     TERM
GEOM Q4GS mems
     CUVF flui3d
     TUVF tubelp1
     CL3D pre face3d
     TUBM rac3d1d
TERM
COMP EPAI 1.50E-3 LECT mems TERM
     DIAM DROI 0.1692568 LECT tubelp1 TERM
     RACC TUBM LECT rac3d1d  TERM
          NTUB LECT p1a   TERM DTUB 0.1692568
          FACE LECT face3d TERM COEF 1.0
     GROU 4 'fcoup1' LECT flui3d TERM
                     COND XB GT -16.405
                     COND XB LT -16.005
           !'S1' LECT tube TERM COND NEAR POIN -0.345 0.15 0.15
           !'S2' LECT tube TERM COND NEAR POIN -0.245 0.15 0.15
            'epar1' LECT tubelp1 TERM COND NEAR NODE LECT p1a TERM
            'epar2' LECT tubelp1 TERM COND NEAR NODE LECT p1d3 TERM
            'tubelpp' LECT tubelp1 DIFF epar1 epar2 TERM
     NGRO 7 'nmemi' LECT mems TERM
                     COND CYLI X1 -20 Y1 0 Z1 0 X2 20 Y2 0 Z2 0 R 0.1650
            'nmemo' LECT mems DIFF nmemi TERM
            'nsymy' LECT mems TERM COND Y LT 0.001
            'nsymz' LECT mems TERM COND Z LT 0.001
            'm1c'   LECT mem1 TERM COND NEAR POIN -16.335 0 0
            'm2c'   LECT mem2 TERM COND NEAR POIN -16.265 0 0
            'm3c'   LECT mem3 TERM COND NEAR POIN -16.195 0 0
     COUL TURQ LECT tubelp1 tra TERM
          VERT LECT fir2 TERM
          ROSE LECT fir1 TERM
          ROUG LECT driver TERM
          GR50 LECT mems TERM
  JAUN LECT pre TERM
ADAP THRS ECRO 3 TMIN 0.01 TMAX 0.4 MAXL 3
          LECT mems TERM
GRIL LAGR LECT mems TERM
FONC 1 TABL 5 0.0       0.0
              1.0E-3    1.0
              2.999E-3  1.0
              3.0E-3    0.0
              100.0E-3  0.0
MATE
    !LOI 1
     VM23 RO 1380 YOUN 2757.9E6 NU 0.495 ELAS 120.E6 ! "Melinex/Mylar/PET"
          FAIL PEPR LIMI 1.0
          TRAC 3 120.E6 0.04351
                 180.E6 1.5
                 230.E6 3.5
          LECT mems _q4gs TERM
    !LOI 2
     GAZP RO 46.517 GAMM 1.4 CV 719.286 PINI 39.147E5 PREF 1.011E5
```

```
          LECT none TERM
    !LOI 3
     GAZP RO 31.412 GAMM 1.4 CV 719.286 PINI 26.435E5 PREF 1.011E5
          LECT none TERM
    !LOI 4
     GAZP RO 16.307 GAMM 1.4 CV 719.286 PINI 13.723E5 PREF 1.011E5
          LECT none TERM
    !LOI 5
     GAZP RO 1.202 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT flui3d _cuvf TERM
    !LOI 6
     IMPE PIMP PRES 13.723E5 PREF 1.011E5 FONC 1
          LECT pre _cl3d TERM
     GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT epar1 epar2 TERM
     GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT rac3d1d tubelpp TERM
     PARO PSIL 0.02
          LECT tubelpp TERM
     MULT 8 9 LECT tubelpp TERM
     GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT _cuvf TERM
OPTI PINS ASN
LINK COUP SPLT NONE
     BLOQ 123 LECT nmemo TERM
     CONT SPLA NX 0 NY 1 NZ 0 LECT nsymy TERM
     CONT SPLA NX 0 NY 0 NZ 1 LECT nsymz TERM
LINK DECO
     PINB PENA SFAC 1.0
          BODY                                   DMIN 0.003
               LECT mem1 TERM
          BODY                                   DMIN 0.003
               LECT mem2 TERM
          BODY                                   DMIN 0.003
               LECT mem3 TERM
     FLSW STRU LECT mems TERM
          FLUI LECT fcoup1 TERM
          R 0.014
          HGRI 0.016
          DGRI
          FACE
          BFLU 2 ! block if at least one node is in influence domain
          FSCP 1 ! couple in all directions
          ADAP LMAX 2 SCAL 2
INIT SKIP UPTO 3.E-3 VFCC
     ADAP IMAT TIME 3.E-3
               2 MATE 2 OBJE LECT flui3d TERM
                        INSI SURF LECT mem1 TERM
                !MATE 3 OBJE LECT flui3d TERM
                !       OUTS SURF LECT mem1 TERM
                !       INSI SURF LECT mem2 TERM
                 MATE 4 OBJE LECT flui3d TERM
                        OUTS SURF LECT mem2 TERM
                        INSI SURF LECT mem3 TERM
ECRI DEPL VITE ECRO FAIL TFRE 1.0E-3
          NOPO
          NOEL
     FICH SPLI ALIC FREQ 0 TFRE 0.D0
          TIME PROG 0.D0 PAS 1.0D-3 28.D-3 TERM
     FICH FORM MAPP OBJE LECT flui3d tubelp1 TERM
                    TIME PROG 28.0E-3 TERM
OPTI NOTE CSTA 0.4
     STEP IO
     LOG 1
     JAUM
     LMST
     FANT 10e-3 LECT mems TERM
     PINS GRID DPIN 1.01
     VFCC FCON 6 ! hllc solver
          ORDR 2 ! order in space
          OTPS 2 ! order in time
          RECO 1 ! Not accepted by CAL_VFCC_1D
          NTIL
     ADAP RCON
     FLS  CUB8 2 ! For the inverse mapping
     QUAS STAT 1670 0.1 UPTO 5.0E-3
CALC TINI 0 TEND 28.0E-3
FIN
```

vega61a.epx

```
Post-treatment
ECHO
 CONV WIN
RESU SPLI ALIC 'vega61.ali' GARD PSCR
COMP COUL ROUG LECT mem1 TERM
          VERT LECT mem2 TERM
          TURQ LECT mem3 TERM
SORT VISU NSTO 1
PLAY
CAME    1 EYE  -1.71083E+01  8.20132E-02  8.82573E-01
!         Q      9.22980E-01 -4.07399E-02 -3.82313E-01  1.68750E-02
          VIEW  7.07109E-01 -6.23012E-02 -7.04354E-01
          RIGH  7.07104E-01  6.23015E-02  7.04359E-01
          UP    1.51008E-07  9.96111E-01 -8.81074E-02
          FOV   2.48819E+01
!NAVIGATION MODE: ROTATING CAMERA
!CENTER : -1.62266E+01  4.33068E-03  4.32377E-03
!RSPHERE:  2.65295E-01
!RADIUS :  1.24689E+00
!ASPECT :  1.00000E+00
!NEAR   :  9.81591E-01
!FAR    :  1.51218E+00
SCEN GEOM NAVI FREE
     GEOM LINE HEOU
          FACE SBAC
     LIMA ON
SLER CAM1 1 NFRA 1
TRAC OFFS FICH BMP OBJE LECT mems TERM NFAI SYXY SYXZ REND
FREQ 1
GOTR LOOP 6 OFFS FICH BMP OBJE LECT mems TERM NFAI SYXY SYXZ REND
ENDPLAY
FIN
```

vega61b.epx

```
VEGA61B
ECHO
RESU SPLI ALIC TEMP 'vega61.alt' GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
COUR 1 'SENS1' ECRO COMP 1 LECT S1 TERM
COUR 2 'SENS2' ECRO COMP 1 LECT S2 TERM
TRAC 1 2 AXES 1.0 'Press [Pa]' YZER
COLO BLEU ROUG
LIST 1 2 AXES 1.0 'Press [Pa]' YZER
COUR 10 'DisCen' DEPL COMP 1 POIN LECT cen TERM
TRAC 10 AXES 1.0 'Displ [m]' YZER
COLO BLEU
LIST 10 AXES 1.0 'Displ [m]' YZER
FIN
```

vega61c.epx

```
VEGA61C
ECHO
RESU SPLI ALIC TEMP 'vega61.alt' GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
COUR 1 'SENS1' ECRO COMP 1 LECT S1 TERM
COUR 2 'SENS2' ECRO COMP 1 LECT S2 TERM
COUR 10 'DisCen' DEPL COMP 1 POIN LECT cen TERM
RCOU 11 'SENS1'  FICH 'vega44b.pun' RENA 'S1_44'
RCOU 12 'SENS2'  FICH 'vega44b.pun' RENA 'S2_44'
RCOU 20 'DisCen' FICH 'vega44b.pun' RENA 'DC_44'
TRAC 1 11 AXES 1.0 'PRES [PA]' YZER
     COLO NOIR VERT
TRAC 2 12 AXES 1.0 'PRES [PA]' YZER
     COLO NOIR VERT
TRAC 10 20 AXES 1.0 'DISP [M]' YZER
     COLO NOIR VERT
COUR 22 INT  2
COUR 32 INT 12
TRAC 22 32 AXES 1.0 'PDT [PA*S]' YZER
     COLO NOIR VERT
TRAC 1 11 AXES 1.0 'PRES [PA]' XMIN 29.E-3 XMAX 40.E-3 NX 11 YZER
     COLO NOIR VERT
TRAC 2 12 AXES 1.0 'PRES [PA]' XMIN 29.E-3 XMAX 40.E-3 NX 11 YZER
     COLO NOIR VERT
FIN
```

vega61k.epx

```
VEGA61K
ECHO
*CONV WIN
LAGR AXIS
GEOM LIBR POIN 18 Q92 1 Q93 1        ED01 2 TERM
  1 0.0 1.5 0.0 2 0.0 2.5 0.0 3 0.0
  1 0.5 1.5 0.5 2 0.5 2.5 0.5 3 0.5
  1 1.0 1.5 1.0 2 1.0 2.5 1.0 3 1.0
  0 0 1 1 1 2
  1 2 3 8 13 12 11 6 7
  3 4 5 10 15 14 13 8 9
  16 17
  17 18
EPAI 1. LECT 1 PAS 1 4 TERM
MATE VM23 RO 8000. YOUN 1.D11 NU 0.3 ELAS 2.D8
          TRAC 3 2.D8 2.D-3 3.D8 1. 3.1D8 2.
          LECT 1 2 TERM
     VM23 RO 4000. YOUN 2.D11 NU 0.2 ELAS 4.D8
          TRAC 2 4.D8 2.D-3 6.D8 1.
          LECT 3 4 TERM
LINK COUP
     BLOQ 12 LECT 5 PAS 5 15 TERM
     BLOQ 123 LECT 16 TERM
INIT VITE 2 300 LECT 6 PAS 1 9 TERM
     VITE 1 -200 LECT 6 PAS 1 8 TERM
     VITE 2 -100 LECT 17 TERM
     VITE 1 200 LECT 18 TERM
ECRI DEPL VITE ACCE FINT FEXT FLIA FDEC CONT ECRO FREQ 100
     FICH ALIC FREQ 1
OPTI PAS UTIL NOTE LOG 1
CALCUL TINI 0. TEND 0.001D0 PASF 1.D-5
*===============================================================
SUIT
Post-treatment (time curves from alice file)
ECHO
RESU ALIC GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
```

```
LCOU 22 'cpu'  FICH 'vega61.log' TCPU
TRAC 22 AXES 1.0 'CPU [S]' YZER XMIN 0.0 XMAX 10.E-3 NX 10
                           YMIN 0.0 YMAX 2.5E+4 NY 10
LIST 22 AXES 1.0 'CPU [S]' YZER XMIN 0.0 XMAX 10.E-3 NX 10
                           YMIN 0.0 YMAX 2.5E+4 NY 10
LCOU 23 'dtcr' FICH 'vega61.log' DTCR
TRAC 23 AXES 1.0 'DTCR [S]' XMIN 0.0 XMAX 10.E-3 NX 10
                            YMIN 0.0 YMAX 2.0E-6 NY 10
LIST 23 AXES 1.0 'DTCR [S]' XMIN 0.0 XMAX 10.E-3 NX 10
                            YMIN 0.0 YMAX 2.0E-6 NY 10
*=================================================================
FIN
```

vega61l.epx

```
VEGA61L
ECHO
*CONV WIN
LAGR AXIS
GEOM LIBR POIN 18 Q92 1 Q93 1        ED01 2 TERM
  1 0.0 1.5 0.0 2 0.0 2.5 0.0 3 0.0
  1 0.5 1.5 0.5 2 0.5 2.5 0.5 3 0.5
  1 1.0 1.5 1.0 2 1.0 2.5 1.0 3 1.0
  0 0 1 1 1 2
  1 2 3 8 13 12 11 6 7
  3 4 5 10 15 14 13 8 9
  16 17
  17 18
EPAI 1. LECT 1 PAS 1 4 TERM
MATE VM23 RO 8000. YOUN 1.D11 NU 0.3 ELAS 2.D8
          TRAC 3 2.D8 2.D-3 3.D8 1. 3.1D8 2.
          LECT 1 2 TERM
     VM23 RO 4000. YOUN 2.D11 NU 0.2 ELAS 4.D8
          TRAC 2 4.D8 2.D-3 6.D8 1.
          LECT 3 4 TERM
LINK COUP
     BLOQ 12 LECT 5 PAS 5 15 TERM
     BLOQ 123 LECT 16 TERM
INIT VITE 2 300 LECT 6 PAS 1 9 TERM
     VITE 1 -200 LECT 6 PAS 1 8 TERM
     VITE 2 -100 LECT 17 TERM
     VITE 1 200 LECT 18 TERM
ECRI DEPL VITE ACCE FINT FEXT FLIA FDEC CONT ECRO FREQ 100
     FICH ALIC FREQ 1
OPTI PAS UTIL NOTE LOG 1
CALCUL TINI 0. TEND 0.001D0 PASF 1.D-5
*=================================================================
SUIT
Post-treatment (time curves from alice file)
ECHO
RESU ALIC GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
LCOU 21 'step' FICH 'vega61.log' STEP
LCOU 22 'cpu'  FICH 'vega61.log' TCPU
LCOU 23 'dtcr' FICH 'vega61.log' DTCR
LCOU 24 'elcr' FICH 'vega61.log' ELCR
LCOU 25 'dee'  FICH 'vega61.log' DEE
LCOU 26 'dmmn' FICH 'vega61.log' DMMN
LCOU 27 'dmme' FICH 'vega61.log' DMME
LCOU 28 'dtmx' FICH 'vega61.log' DTMX
LCOU 29 'elmx' FICH 'vega61.log' ELMX
LCOU 30 'vmax' FICH 'vega61.log' VMAX
LCOU 31 'nvmx' FICH 'vega61.log' NVMX
LCOU 32 'elst' FICH 'vega61.log' ELST
LCOU 33 'memo' FICH 'vega61.log' MEMO
LCOU 34 'memp' FICH 'vega61.log' MEMP
*
TRAC 21 AXES 1.0 'STEP [-]' YZER
TRAC 22 AXES 1.0 'CPU [S]' YZER
TRAC 23 AXES 1.0 'DTCR [S]' YZER
TRAC 23 AXES 1.0 'DTCR [S]' YLOG
*
TRAC 24 AXES 1.0 'ELCR [-]' YZER
TRAC 25 AXES 1.0 'DEE [-]' YZER
TRAC 26 AXES 1.0 'DMMN [-]' YZER
TRAC 27 AXES 1.0 'DMME [-]' YZER
TRAC 28 AXES 1.0 'DTMX [S]' YZER
TRAC 29 AXES 1.0 'ELMX [-]' YZER
TRAC 30 AXES 1.0 'VMAX [M/S]' YZER
TRAC 31 AXES 1.0 'NVMX [-]' YZER
TRAC 32 AXES 1.0 'ELST [-]' YZER
TRAC 33 AXES 1.0 'MEMO [-]' YZER
TRAC 34 AXES 1.0 'MEMP [-]' YZER
*
LIST 21 AXES 1.0 'STEP [-]' YZER
LIST 22 AXES 1.0 'CPU [S]' YZER
LIST 23 AXES 1.0 'DTCR [S]' YZER
*
LIST 24 AXES 1.0 'ELCR [-]' YZER
LIST 25 AXES 1.0 'DEE [-]' YZER
LIST 26 AXES 1.0 'DMMN [-]' YZER
LIST 27 AXES 1.0 'DMME [-]' YZER
LIST 28 AXES 1.0 'DTMX [S]' YZER
LIST 29 AXES 1.0 'ELMX [-]' YZER
LIST 30 AXES 1.0 'VMAX [M/S]' YZER
LIST 31 AXES 1.0 'NVMX [-]' YZER
LIST 32 AXES 1.0 'ELST [-]' YZER
LIST 33 AXES 1.0 'MEMO [-]' YZER
LIST 34 AXES 1.0 'MEMP [-]' YZER
*=================================================================
FIN
```

vega61m.epx

```
Post-treatment
ECHO
 CONV WIN
RESU SPLI ALIC 'vega61.ali' GARD PSCR
COMP COUL ROUG LECT mem1 TERM
          VERT LECT mem2 TERM
          TURQ LECT mem3 TERM
SORT VISU NSTO 1
PLAY
CAME   1 EYE  -1.72478E+01  0.00000E+00 -1.87219E-10
!        Q     7.07107E-01  0.00000E+00 -7.07107E-01  0.00000E+00
         VIEW  1.00000E+00  0.00000E+00  2.05103E-10
         RIGH -2.05103E-10  0.00000E+00  1.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   2.48819E+01
!NAVIGATION MODE: ROTATING CAMERA
!CENTER : -1.63350E+01  0.00000E+00  0.00000E+00
!RSPHERE:  2.34052E-01
!RADIUS :  9.12804E-01
!ASPECT :  1.00000E+00
!NEAR   :  6.78752E-01
!FAR    :  1.38091E+00
SCEN GEOM NAVI FREE
         !LINE HEOU
          FACE SBAC
     LIMA ON
SLER CAM1 1 NFRA 1
TRAC OFFS FICH BMP OBJE LECT mem1 TERM NFAI SYXY SYXZ
     AMPD 0 REND
FREQ 1
GOTR LOOP 6 OFFS FICH BMP OBJE LECT mem1 TERM NFAI SYXY SYXZ
     AMPD 0 REND
ENDPLAY
FIN
```

vega61n.epx

```
Post-treatment
ECHO
 CONV WIN
RESU SPLI ALIC 'vega61.ali' GARD PSCR
COMP COUL ROUG LECT mem1 TERM
          VERT LECT mem2 TERM
          TURQ LECT mem3 TERM
SORT VISU NSTO 1
PLAY
CAME   1 EYE  -1.72478E+01  0.00000E+00 -1.87219E-10
!        Q     7.07107E-01  0.00000E+00 -7.07107E-01  0.00000E+00
         VIEW  1.00000E+00  0.00000E+00  2.05103E-10
         RIGH -2.05103E-10  0.00000E+00  1.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   2.48819E+01
!NAVIGATION MODE: ROTATING CAMERA
!CENTER : -1.63350E+01  0.00000E+00  0.00000E+00
!RSPHERE:  2.34052E-01
!RADIUS :  9.12804E-01
!ASPECT :  1.00000E+00
!NEAR   :  6.78752E-01
!FAR    :  1.38091E+00
SCEN GEOM NAVI FREE
         !LINE HEOU
          FACE SBAC
     LIMA ON
SLER CAM1 1 NFRA 1
TRAC OFFS FICH BMP OBJE LECT mem2 TERM NFAI SYXY SYXZ
     AMPD 0 REND
FREQ 1
GOTR LOOP 6 OFFS FICH BMP OBJE LECT mem2 TERM NFAI SYXY SYXZ
     AMPD 0 REND
ENDPLAY
FIN
```

vega61o.epx

```
Post-treatment
ECHO
 CONV WIN
RESU SPLI ALIC 'vega61.ali' GARD PSCR
COMP COUL ROUG LECT mem1 TERM
          VERT LECT mem2 TERM
          TURQ LECT mem3 TERM
SORT VISU NSTO 1
PLAY
CAME   1 EYE  -1.72478E+01  0.00000E+00 -1.87219E-10
!        Q     7.07107E-01  0.00000E+00 -7.07107E-01  0.00000E+00
         VIEW  1.00000E+00  0.00000E+00  2.05103E-10
         RIGH -2.05103E-10  0.00000E+00  1.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   2.48819E+01
!NAVIGATION MODE: ROTATING CAMERA
!CENTER : -1.63350E+01  0.00000E+00  0.00000E+00
!RSPHERE:  2.34052E-01
!RADIUS :  9.12804E-01
!ASPECT :  1.00000E+00
!NEAR   :  6.78752E-01
!FAR    :  1.38091E+00
```

```
SCEN GEOM NAVI FREE
         !LINE HEOU
          FACE SBAC
     LIMA ON
SLER CAM1 1 NFRA 1
TRAC OFFS FICH BMP OBJE LECT mem3 TERM NFAI SYXY SYXZ
     AMPD 0 REND
FREQ 1
GOTR LOOP 6 OFFS FICH BMP OBJE LECT mem3 TERM NFAI SYXY SYXZ
     AMPD 0 REND
ENDPLAY
FIN
```

vega62.dgibi

```
'DEBPROC' pxswell cplat*'MAILLAGE' ch2*'POINT' px*'POINT'
                 vr*'POINT' tol*'FLOTTANT' fac*'FLOTTANT';
nho2 = cplat poin cyli ch2 (ch2 plus px) (ch2 plus vr) tol;
ho2 = cplat elem appu stri nho2;
ho2n = ho2 homo fac ch2;
i = 0;
repe loop2 (nbno ho2);
  i = i + 1;
  ni = ho2 poin i;
  nin = ho2n poin i;
  conf ni nin;
fin loop2;
finproc;
*=====================================================================
'DEBPROC' pxshrink frameb*'MAILLAGE' cen*'POINT'
                  rbo*'FLOTTANT' fac*'FLOTTANT';
pxm = -1 0 0;
pxp = 1 0 0;
vr2 = 0 (0.5*rbo) 0;
nbolt = frameb poin cyli (cen plus pxm) (cen plus pxp)
        (cen plus vr2) (0.5001*rbo);
xc yc zc = coor cen;
i = 0;
repe loop2 (nbno nbolt);
  i = i + 1;
  ni = nbolt poin i;
  xi yi zi = coor ni;
  ceni = xi yc zc;
  nin = ni homo fac ceni;
  conf ni nin;
fin loop2;
finproc;
*=====================================================================
opti echo 1;
opti rest form 'vega33.msh';
rest form;
list;
*
oubl mesh;
oubl pre;
oubl pre3;
oubl pre2;
oubl pre1;
oubl mems;
oubl mem3;
oubl mem2;
oubl mem1;
oubl mesh1;
*
list;
mesh = spec et devi et stub3d et rac3d1d et pface3d et face3d et
       flui3d et bout et fond;
tass mesh noop;
*
opti trac psc ftra 'vega62_mesh.ps';
oeil = 100000 0 0;
trac oeil qual plate;
cplat = cont plate;
ch1 = 0 26.E-2 0;
p0 = 0 0 0;
p0p = 1 0 0;
ch2 = ch1 tour 15.0 p0 p0p;
ch3 = ch1 tour 30.0 p0 p0p;
ch4 = ch1 tour 45.0 p0 p0p;
ch5 = ch1 tour 60.0 p0 p0p;
ch6 = ch1 tour 75.0 p0 p0p;
ch7 = 0 0 26.E-2;
px = 1 0 0;
r = 1.25E-2;
vr = 0 r 0;
tol = 1.E-4;
fac = 1.016;
pxswell cplat ch1 px vr tol fac;
pxswell cplat ch2 px vr tol fac;
pxswell cplat ch3 px vr tol fac;
pxswell cplat ch4 px vr tol fac;
pxswell cplat ch5 px vr tol fac;
pxswell cplat ch6 px vr tol fac;
pxswell cplat ch7 px vr tol fac;
trac oeil qual plate;
oeil2 = 100000 0 -30000;
trac oeil2 cach qual lframeb;
facs = 0.936;
pxshrink lframeb ch1 r facs;
pxshrink lframeb ch3 r facs;
pxshrink lframeb ch5 r facs;
pxshrink lframeb ch7 r facs;
trac oeil2 cach qual lframeb;
*
opti sauv form 'vega62.msh';
sauv form mesh;
*
fin;
```

vega62.epx

```
VEGA62
ECHO
!CONV win
CAST mesh
TRID ALE
EROS 1.0
DIME ADAP NPOI 100000
          CUVF 150000
          NVFI 200000
          CL3D 20000
     ENDA
     JONC 475 ! Total n. of nodes in a TUBM juncton
     NALE 1 NBLE 1
     TERM
GEOM CUB8 ecub8
     PR6  epri6
     Q4GS equa4
     T3GS etri3
     PMAT nplate
     CUVF flui3d tubelp3 tank
     TUVF tubelp1
     CL3D face3d presur abso stub3d
     TUBM rac3d1d raclp
TERM
COMP EPAI 0.8e-3 LECT plate nplate TERM
     DIAM DROI 0.1692568 LECT tubelp1 TERM
     RACC TUBM LECT rac3d1d  TERM
          NTUB LECT p1a   TERM DTUB 0.1692568
          FACE LECT face3d TERM COEF 1.0
     RACC TUBM LECT raclp  TERM
          NTUB LECT p1d3   TERM DTUB 0.1692568
          FACE LECT stub3d TERM COEF 1.0
     GROU 15 'endtube' LECT tube TERM COND XB GT -0.6
            'frefine' LECT flui TERM COND XB GT -0.3
                                     COND XB LT  1.0
            'pp1'    LECT plate TERM
                     COND BOX X0 0.0 Y0 0.0  Z0 0.0
                              DX 0.1 DY 0.15 DZ 0.15
            'fcoup'  LECT flui  TERM COND XB GT -0.05
                                     COND XB LT 0.150
                                     COND YB LT 0.150
                                     COND ZB LT 0.150
            'scoup'  LECT plate TERM COND YB LT 0.150
                                     COND ZB LT 0.150
            'S1' LECT tube TERM COND NEAR POIN -0.345 0.15 0.15
            'S2' LECT tube TERM COND NEAR POIN -0.245 0.15 0.15
            'plaEdg' LECT plate DIFF pp1 TERM
                     COND YB LT 0.16
                     COND ZB LT 0.16
            'nplatmp'    LECT nplate  TERM
                     COND YB LT 0.16
                     COND ZB LT 0.16
            'nplalim'    LECT nplate DIFF nplatmp TERM
            'lfrb2' LECT lframeb TERM
                    COND XB LT -0.865E-2
            'lfrb1' LECT lframeb DIFF lfrb2 TERM
            'epar1' LECT tubelp1 TERM COND NEAR NODE LECT p1a TERM
            'epar2' LECT tubelp1 TERM COND NEAR NODE LECT p1d3 TERM
            'tubelpp' LECT tubelp1 DIFF epar1 epar2 TERM
     NGRO 4 'blox'  LECT lframeb TERM COND !X LT -0.0253
                                            X GT 0.0253
            'symy'  LECT spec TERM    COND Y LT 0.0001
            'symz'  LECT spec TERM    COND Z LT 0.0001
            'cen' LECT plate TERM COND NEAR POIN 0.0 0.0 0.0
     COUL TURQ LECT lfrb1 tubelp tank tra TERM
          BLAN LECT lfrb2 TERM
          BLEU LECT uframe raclp TERM
          VERT LECT plate fir2 TERM
          ROSE LECT presur fir1 TERM
          ROUG LECT nplate driver TERM
  JAUN LECT abso TERM
       DIAM DROI 0.1692568 LECT tubelp1 TERM
GRIL LAGR LECT spec TERM
MATE
    !LOI 2
     GAZP RO 46.517 GAMM 1.4 CV 719.286 PINI 39.147E5 PREF 1.011E5
          LECT none TERM
    !LOI 3
     GAZP RO 31.412 GAMM 1.4 CV 719.286 PINI 26.435E5 PREF 1.011E5
          LECT none TERM
    !LOI 4
     GAZP RO 16.307 GAMM 1.4 CV 719.286 PINI 13.723E5 PREF 1.011E5
          LECT none TERM
    !LOI 5
     GAZP RO 1.202 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT flui3d TERM
     GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT epar1 epar2 TERM
     GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT rac3d1d raclp tubelpp TERM
     PARO PSIL 0.02
```

```
        LECT tubelpp TERM
     MULT 6 7 LECT tubelpp TERM
     GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
        LECT tubelp3 tank _cuvf TERM
     CLVF ABSO RO 1.189
        LECT abso TERM
     VPJC RO 7850.0 YOUN 2.1E11 NU 0.33 ELAS 3.257E8 mxit 500
        QR1 2.348E8 CR1 56.2 QR2 4.457E8 CR2 4.7
        PDOT 5.E-4 C 1.E-2 TQ 0.9 CP 452.0
        TM 1800.0 M 1.0 DC 1.0 WC 555.0E6
        LECT lframeb uframe plate TERM
     MASS 0.0 YOUN 2.1E11 NU 0.33
        LECT nplate TERM
     IMPE PIMP RO 7850.0 PRES 44.0011e6 PREF 1.011E5
        LECT presur _cl3d TERM
OPTI PINS ASN
LINK COUP SPLT NONE
     BLOQ 1 LECT blox TERM
     CONT SPLA NX 0 NY 1 NZ 0 LECT symy TERM
     CONT SPLA NX 0 NY 0 NZ 1 LECT symz TERM
LINK DECO
     PINB PENA SFAC 1.0
        BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DMIN 0.0008 ! #1
             LECT lfrb1 TERM
        BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DMIN 0.0008 ! #2
             LECT lfrb2 TERM
        BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DMIN 0.0008 ! #3
             LECT uframe TERM
        BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DMIN 0.0002 ! #4
             LECT plaEdg TERM
        BODY FROT MUST 0.5 MUDY 0.5 GAMM 0 DIAM 0.0004 ! #5
             LECT nplalim TERM
        EXCL PAIR 1 2
        EXCL PAIR 1 3
        EXCL PAIR 4 5
     FLSW STRU LECT scoup TERM
        FLUI LECT fcoup TERM
        R 0.014
        HGRI 0.016
        DGRI
        FACE
        BFLU 2 ! block if at least one node is in influence domain
        FSCP 1 ! couple in all directions
        ADAP LMAX 2 SCAL 2
     TBLO 123    UPTO 30.0E-3 LECT lframeb uframe TERM
        123456 UPTO 30.0E-3 LECT plate TERM
INIT MAPP FORM 'vega61.map' MATC OBJE LECT flui3d tubelp1 TERM
ECRI DEPL VITE ECRO FAIL TFRE 1.0E-3
        POIN LECT cen TERM
        ELEM LECT S1 TERM
     FICH ALIT FREQ 0 TFRE 0.D0
        TIME PROG 0.D0 PAS 0.5D-3 28.D-3 PAS 0.01D-3 40.D-3 TERM
        POIN LECT cen TERM
        ELEM LECT S1 S2 TERM
     FICH SPLI ALIC FREQ 0 TFRE 0.D0
        TIME PROG 0.D0 PAS 1.0D-3 40.D-3 TERM
OPTI NOTE CSTA 0.4
     STEP IO
     LOG 1
     JAUM
     LMST
     PINS GRID DPIN 1.01
     VFCC FCON 6 ! hllc solver
        ORDR 2 ! order in space
        OTPS 2 ! order in time
        RECO 1 ! Not accepted by CAL_VFCC_1D
        NTIL
     ADAP RCON
     NOCR UPTO 30.0E-3 LECT plate lframeb uframe TERM
     FLS  CUB8 2 ! For the inverse mapping
CALC TINI 0 TEND 40.0E-3
FIN
```

vega62a.epx

```
Post-treatment
ECHO
 CONV WIN
RESU SPLI ALIC 'vega62.ali' GARD PSCR
COMP COUL ROUG LECT mem1 TERM
          VERT LECT mem2 TERM
          JAUN LECT mem3 TERM
SORT VISU NSTO 1
FIN
```

vega62b.epx

```
VEGA62B
ECHO
RESU SPLI ALIC TEMP 'vega62.alt' GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
COUR 1 'SENS1' ECRO COMP 1 LECT S1 TERM
COUR 2 'SENS2' ECRO COMP 1 LECT S2 TERM
TRAC 1 2 AXES 1.0 'Press [Pa]' YZER
COLO BLEU ROUG
LIST 1 2 AXES 1.0 'Press [Pa]' YZER
COUR 10 'DisCen' DEPL COMP 1 POIN LECT cen TERM
TRAC 10 AXES 1.0 'Displ [m]' YZER
COLO BLEU
LIST 10 AXES 1.0 'Displ [m]' YZER
RCOU 101 'SENS1'  FICH 'vega51b.pun' RENA 'SENS1_51'
RCOU 102 'SENS2'  FICH 'vega51b.pun' RENA 'SENS2_51'
RCOU 110 'DisCen' FICH 'vega51b.pun' RENA 'DisCen_51'
RCOU 201 'SENS1'  FICH 'vega52b.pun' RENA 'SENS1_52'
RCOU 202 'SENS2'  FICH 'vega52b.pun' RENA 'SENS2_52'
RCOU 210 'DisCen' FICH 'vega52b.pun' RENA 'DisCen_52'
TRAC 1 101 201 AXES 1.0 'Press1 [Pa]' YZER
COLO BLEU ROUG VERT
TRAC 2 102 202 AXES 1.0 'Press1 [Pa]' YZER
COLO BLEU ROUG VERT
TRAC 10 110 210 AXES 1.0 'Displ [m]' YZER
COLO BLEU ROUG VERT
TRAC 1 101 201 AXES 1.0 'Press1 [Pa]' YZER
XMIN 28.E-3 XMAX 35.E-3 DX 1.E-3
COLO BLEU ROUG VERT
TRAC 2 102 202 AXES 1.0 'Press1 [Pa]' YZER
XMIN 28.E-3 XMAX 35.E-3 DX 1.E-3
COLO BLEU ROUG VERT
TRAC 10 110 210 AXES 1.0 'Displ [m]' YZER
XMIN 28.E-3 XMAX 35.E-3 DX 1.E-3
COLO BLEU ROUG VERT
FIN
```

vega62c.epx

```
VEGA62C
ECHO
RESU SPLI ALIC TEMP 'vega62.alt' GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
COUR 1 'SENS1' ECRO COMP 1 LECT S1 TERM
COUR 2 'SENS2' ECRO COMP 1 LECT S2 TERM
COUR 10 'DisCen' DEPL COMP 1 POIN LECT cen TERM
RCOU 11 'SENS1'  FICH 'vega44b.pun' RENA 'S1_44'
RCOU 12 'SENS2'  FICH 'vega44b.pun' RENA 'S2_44'
RCOU 20 'DisCen' FICH 'vega44b.pun' RENA 'DC_44'
TRAC 1 11 AXES 1.0 'PRES [PA]' YZER
     COLO NOIR VERT
TRAC 2 12 AXES 1.0 'PRES [PA]' YZER
     COLO NOIR VERT
TRAC 10 20 AXES 1.0 'DISP [M]' YZER
     COLO NOIR VERT
COUR 22 INT  2
COUR 32 INT 12
TRAC 22 32 AXES 1.0 'PDT [PA*S]' YZER
     COLO NOIR VERT
TRAC 1 11 AXES 1.0 'PRES [PA]' XMIN 29.E-3 XMAX 40.E-3 NX 11 YZER
     COLO NOIR VERT
TRAC 2 12 AXES 1.0 'PRES [PA]' XMIN 29.E-3 XMAX 40.E-3 NX 11 YZER
     COLO NOIR VERT
FIN
```

vega62l.epx

```
VEGA62L
ECHO
*CONV WIN
LAGR AXIS
GEOM LIBR POIN 18 Q92 1 Q93 1        ED01 2 TERM
  1 0.0 1.5 0.0 2 0.0 2.5 0.0 3 0.0
  1 0.5 1.5 0.5 2 0.5 2.5 0.5 3 0.5
  1 1.0 1.5 1.0 2 1.0 2.5 1.0 3 1.0
  0 0 1 1 1 2
  1 2 3 8 13 12 11 6 7
  3 4 5 10 15 14 13 8 9
  16 17
  17 18
EPAI 1. LECT 1 PAS 1 4 TERM
MATE VM23 RO 8000. YOUN 1.D11 NU 0.3 ELAS 2.D8
          TRAC 3 2.D8 2.D-3 3.D8 1. 3.1D8 2.
          LECT 1 2 TERM
     VM23 RO 4000. YOUN 2.D11 NU 0.2 ELAS 4.D8
          TRAC 2 4.D8 2.D-3 6.D8 1.
          LECT 3 4 TERM
LINK COUP
     BLOQ 12 LECT 5 PAS 5 15 TERM
     BLOQ 123 LECT 16 TERM
INIT VITE 2 300 LECT 6 PAS 1 9 TERM
     VITE 1 -200 LECT 6 PAS 1 8 TERM
     VITE 2 -100 LECT 17 TERM
     VITE 1 200 LECT 18 TERM
ECRI DEPL VITE ACCE FINT FEXT FLIA FDEC CONT ECRO FREQ 100
     FICH ALIC FREQ 1
OPTI PAS UTIL NOTE LOG 1
CALCUL TINI 0. TEND 0.001D0 PASF 1.D-5
*=============================================================
SUIT
Post-treatment (time curves from alice file)
ECHO
RESU ALIC GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
LCOU 21 'step' FICH 'vega62.log' STEP
LCOU 22 'cpu'  FICH 'vega62.log' TCPU
LCOU 23 'dtcr' FICH 'vega62.log' DTCR
LCOU 24 'elcr' FICH 'vega62.log' ELCR
LCOU 25 'dee'  FICH 'vega62.log' DEE
LCOU 26 'dmmn' FICH 'vega62.log' DMMN
LCOU 27 'dmme' FICH 'vega62.log' DMME
LCOU 28 'dtmx' FICH 'vega62.log' DTMX
```

```
LCOU 29 'elmx' FICH 'vega62.log' ELMX
LCOU 30 'vmax' FICH 'vega62.log' VMAX
LCOU 31 'nvmx' FICH 'vega62.log' NVMX
LCOU 32 'elst' FICH 'vega62.log' ELST
LCOU 33 'memo' FICH 'vega62.log' MEMO
LCOU 34 'memp' FICH 'vega62.log' MEMP
*
TRAC 21 AXES 1.0 'STEP [-]' YZER
TRAC 22 AXES 1.0 'CPU [S]' YZER
TRAC 23 AXES 1.0 'DTCR [S]' YZER
TRAC 23 AXES 1.0 'DTCR [S]' YLOG
*
TRAC 24 AXES 1.0 'ELCR [-]' YZER
TRAC 25 AXES 1.0 'DEE [-]' YZER
TRAC 26 AXES 1.0 'DMMN [-]' YZER
TRAC 27 AXES 1.0 'DMME [-]' YZER
TRAC 28 AXES 1.0 'DTMX [S]' YZER
TRAC 29 AXES 1.0 'ELMX [-]' YZER
TRAC 30 AXES 1.0 'VMAX [M/S]' YZER
TRAC 31 AXES 1.0 'NVMX [-]' YZER
TRAC 32 AXES 1.0 'ELST [-]' YZER
TRAC 33 AXES 1.0 'MEMO [-]' YZER
TRAC 34 AXES 1.0 'MEMP [-]' YZER
*
LIST 21 AXES 1.0 'STEP [-]' YZER
LIST 22 AXES 1.0 'CPU [S]' YZER
LIST 23 AXES 1.0 'DTCR [S]' YZER
*
LIST 24 AXES 1.0 'ELCR [-]' YZER
LIST 25 AXES 1.0 'DEE [-]' YZER
LIST 26 AXES 1.0 'DMMN [-]' YZER
LIST 27 AXES 1.0 'DMME [-]' YZER
LIST 28 AXES 1.0 'DTMX [S]' YZER
LIST 29 AXES 1.0 'ELMX [-]' YZER
LIST 30 AXES 1.0 'VMAX [M/S]' YZER
LIST 31 AXES 1.0 'NVMX [-]' YZER
LIST 32 AXES 1.0 'ELST [-]' YZER
LIST 33 AXES 1.0 'MEMO [-]' YZER
LIST 34 AXES 1.0 'MEMP [-]' YZER
*==================================================================
FIN
```

vega63.epx

```
VEGA63
ECHO
!CONV win
CAST mesh
TRID ALE
EROS 1.0
DIME ADAP NPOI 100000
          Q4GS 20000
          CUVF 150000
          NVFI 200000
          CL3D 20000
          NPIN 20000
     ENDA
     JONC 475 ! Total n. of nodes in a TUBM juncton
     NALE 1 NBLE 1
     TERM
GEOM Q4GS mems
     CUVF flui3d
     TUVF tubelp1
     CL3D pre face3d
     TUBM rac3d1d
TERM
COMP EPAI 1.50E-3 LECT mems TERM
     DIAM DROI 0.1692568 LECT tubelp1 TERM
     RACC TUBM LECT rac3d1d  TERM
          NTUB LECT p1a   TERM DTUB 0.1692568
          FACE LECT face3d TERM COEF 1.0
     GROU 4 'fcoup1' LECT flui3d TERM
                    COND XB GT -16.405
                    COND XB LT -16.005
           !'S1' LECT tube TERM COND NEAR POIN -0.345 0.15 0.15
           !'S2' LECT tube TERM COND NEAR POIN -0.245 0.15 0.15
            'epar1' LECT tubelp1 TERM COND NEAR NODE LECT p1a TERM
            'epar2' LECT tubelp1 TERM COND NEAR NODE LECT p1d3 TERM
            'tubelpp' LECT tubelp1 DIFF epar1 epar2 TERM
     NGRO 7 'nmemi' LECT mems TERM
                    COND CYLI X1 -20 Y1 0 Z1 0 X2 20 Y2 0 Z2 0 R 0.1650
            'nmemo' LECT mems DIFF nmemi TERM
            'nsymy' LECT mems TERM COND Y LT 0.001
            'nsymz' LECT mems TERM COND Z LT 0.001
            'm1c'   LECT mem1 TERM COND NEAR POIN -16.335 0 0
            'm2c'   LECT mem2 TERM COND NEAR POIN -16.265 0 0
            'm3c'   LECT mem3 TERM COND NEAR POIN -16.195 0 0
     COUL TURQ LECT tubelp1 tra TERM
          VERT LECT fir2 TERM
          ROSE LECT fir1 TERM
          ROUG LECT driver TERM
          GR50 LECT mems TERM
  JAUN LECT pre TERM
ADAP THRS ECRO 3 TMIN 0.01 TMAX 0.4 MAXL 3
          LECT mems TERM
GRIL LAGR LECT mems TERM
FONC 1 TABL 5 0.0       0.0
              1.0E-3    1.0
              2.999E-3  1.0
              3.0E-3    0.0
              100.0E-3  0.0
MATE
    !LOI 1
     VM23 RO 1380 YOUN 2757.9E6 NU 0.495 ELAS 120.E6 ! "Melinex/Mylar/PET"
          FAIL PEPR LIMI 1.0
          TRAC 3 120.E6 0.04351
                 180.E6 1.5
                 230.E6 3.5
          LECT mems _q4gs TERM
    !LOI 2
     GAZP RO 46.517 GAMM 1.4 CV 719.286 PINI 39.147E5 PREF 1.011E5
          LECT none TERM
    !LOI 3
     GAZP RO 31.412 GAMM 1.4 CV 719.286 PINI 26.435E5 PREF 1.011E5
          LECT none TERM
    !LOI 4
     GAZP RO 16.307 GAMM 1.4 CV 719.286 PINI 13.723E5 PREF 1.011E5
          LECT none TERM
    !LOI 5
     GAZP RO 1.202 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT flui3d _cuvf TERM
    !LOI 6
     IMPE PIMP PRES 13.723E5 PREF 1.011E5 FONC 1
          LECT pre _cl3d TERM
     GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT epar1 epar2 TERM
     GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT rac3d1d tubelpp TERM
     PARO PSIL 0.02
          LECT tubelpp TERM
     MULT 8 9 LECT tubelpp TERM
     GAZP RO 1.189 GAMM 1.4 CV 719.286 PINI 1.011E5 PREF 1.011E5
          LECT _cuvf TERM
OPTI PINS ASN
LINK COUP SPLT NONE
     BLOQ 123 LECT nmemo TERM
     CONT SPLA NX 0 NY 1 NZ 0 LECT nsymy TERM
     CONT SPLA NX 0 NY 0 NZ 1 LECT nsymz TERM
LINK DECO
     PINB PENA SFAC 1.0
          BODY                                   DMIN 0.003
               LECT mem1 TERM
          BODY                                   DMIN 0.003
               LECT mem2 TERM
          BODY                                   DMIN 0.003
               LECT mem3 TERM
     FLSW STRU LECT mems TERM
          FLUI LECT fcoup1 TERM
          R 0.014
          HGRI 0.016
          DGRI
          FACE
          BFLU 2 ! block if at least one node is in influence domain
          FSCP 1 ! couple in all directions
          ADAP LMAX 2 SCAL 2
INIT SKIP UPTO 3.E-3 VFCC
     ADAP IMAT TIME 3.E-3
               2 MATE 2 OBJE LECT flui3d TERM
                        INSI SURF LECT mem1 TERM
                !MATE 3 OBJE LECT flui3d TERM
                !       OUTS SURF LECT mem1 TERM
                !       INSI SURF LECT mem2 TERM
                 MATE 4 OBJE LECT flui3d TERM
                        OUTS SURF LECT mem2 TERM
                        INSI SURF LECT mem3 TERM
ECRI DEPL VITE ECRO FAIL TFRE 1.0E-3
          NOPO
          NOEL
     FICH SPLI ALIC FREQ 0 TFRE 0.D0
          TIME PROG 0.D0 PAS 1.0D-3 28.D-3 TERM
OPTI NOTE CSTA 0.4
     LOG 1
     JAUM
     LMST
     FANT 10e-3 LECT mems TERM
     PINS GRID DPIN 1.01
     VFCC FCON 6 ! hllc solver
          ORDR 2 ! order in space
          OTPS 2 ! order in time
          RECO 1 ! Not accepted by CAL_VFCC_1D
          NTIL
     ADAP RCON
     FLS  CUB8 2 ! For the inverse mapping
     QUAS STAT 1670 0.1 UPTO 5.0E-3
CALC TINI 0 TEND 10.0E-3
FIN
```

vega63a.epx

```
Post-treatment
ECHO
 CONV WIN
RESU SPLI ALIC 'vega63.ali' GARD PSCR
COMP COUL ROUG LECT mem1 TERM
          VERT LECT mem2 TERM
          TURQ LECT mem3 TERM
SORT VISU NSTO 1
PLAY
CAME   1 EYE  -1.71083E+01  8.20132E-02  8.82573E-01
!        Q     9.22980E-01 -4.07399E-02 -3.82313E-01  1.68750E-02
         VIEW  7.07109E-01 -6.23012E-02 -7.04354E-01
         RIGH  7.07104E-01  6.23015E-02  7.04359E-01
```

```
        UP    1.51008E-07  9.96111E-01 -8.81074E-02
        FOV   2.48819E+01
!NAVIGATION MODE: ROTATING CAMERA
!CENTER : -1.62266E+01  4.33068E-03  4.32377E-03
!RSPHERE:  2.65295E-01
!RADIUS :  1.24689E+00
!ASPECT :  1.00000E+00
!NEAR   :  9.81591E-01
!FAR    :  1.51218E+00
SCEN GEOM NAVI FREE
     GEOM LINE HEOU
          FACE SBAC
     LIMA ON
SLER CAM1 1 NFRA 1
TRAC OFFS FICH BMP OBJE LECT mems TERM NFAI SYXY SYXZ REND
FREQ 1
GOTR LOOP 6 OFFS FICH BMP OBJE LECT mems TERM NFAI SYXY SYXZ REND
ENDPLAY
FIN
```

vega63b.epx

```
VEGA63B
ECHO
RESU SPLI ALIC TEMP 'vega63.alt' GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
COUR 1 'SENS1' ECRO COMP 1 LECT S1 TERM
COUR 2 'SENS2' ECRO COMP 1 LECT S2 TERM
TRAC 1 2 AXES 1.0 'sens pres' YZER
     COLO bleu roug
     THIC 0.8 0.8
LIST 1 AXES 1.0 'SENS1' YZER
LIST 2 AXES 1.0 'SENS2' YZER
COUR 10 'DisCen' DEPL COMP 1 POIN LECT cen TERM
TRAC 10 AXES 1.0 'DisCen' YZER
     COLO bleu
     THIC 0.8
LIST 10 AXES 1.0 'DisCen' YZER
FIN
```

vega63c.epx

```
VEGA63C
ECHO
RESU SPLI ALIC TEMP 'vega63.alt' GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
COUR 1 'SENS1' ECRO COMP 1 LECT S1 TERM
COUR 2 'SENS2' ECRO COMP 1 LECT S2 TERM
COUR 10 'DisCen' DEPL COMP 1 POIN LECT cen TERM
RCOU 11 'SENS1'  FICH 'vega44b.pun' RENA 'S1_44'
RCOU 12 'SENS2'  FICH 'vega44b.pun' RENA 'S2_44'
RCOU 20 'DisCen' FICH 'vega44b.pun' RENA 'DC_44'
TRAC 1 11 AXES 1.0 'PRES [PA]' YZER
     COLO NOIR VERT
TRAC 2 12 AXES 1.0 'PRES [PA]' YZER
     COLO NOIR VERT
TRAC 10 20 AXES 1.0 'DISP [M]' YZER
     COLO NOIR VERT
COUR 22 INT  2
COUR 32 INT 12
TRAC 22 32 AXES 1.0 'PDT [PA*S]' YZER
     COLO NOIR VERT
TRAC 1 11 AXES 1.0 'PRES [PA]' XMIN 29.E-3 XMAX 40.E-3 NX 11 YZER
     COLO NOIR VERT
TRAC 2 12 AXES 1.0 'PRES [PA]' XMIN 29.E-3 XMAX 40.E-3 NX 11 YZER
     COLO NOIR VERT
FIN
```

vega63k.epx

```
VEGA63K
ECHO
*CONV WIN
LAGR AXIS
GEOM LIBR POIN 18 Q92 1 Q93 1        ED01 2 TERM
  1 0.0 1.5 0.0 2 0.0 2.5 0.0 3 0.0
  1 0.5 1.5 0.5 2 0.5 2.5 0.5 3 0.5
  1 1.0 1.5 1.0 2 1.0 2.5 1.0 3 1.0
  0 0 1 1 1 2
  1 2 3 8 13 12 11 6 7
  3 4 5 10 15 14 13 8 9
  16 17
  17 18
EPAI 1. LECT 1 PAS 1 4 TERM
MATE VM23 RO 8000. YOUN 1.D11 NU 0.3 ELAS 2.D8
          TRAC 3 2.D8 2.D-3 3.D8 1. 3.1D8 2.
          LECT 1 2 TERM
     VM23 RO 4000. YOUN 2.D11 NU 0.2 ELAS 4.D8
          TRAC 2 4.D8 2.D-3 6.D8 1.
          LECT 3 4 TERM
LINK COUP
     BLOQ 12 LECT 5 PAS 5 15 TERM
     BLOQ 123 LECT 16 TERM
INIT VITE 2 300 LECT 6 PAS 1 9 TERM
     VITE 1 -200 LECT 6 PAS 1 8 TERM
     VITE 2 -100 LECT 17 TERM
     VITE 1 200 LECT 18 TERM
ECRI DEPL VITE ACCE FINT FEXT FLIA FDEC CONT ECRO FREQ 100
     FICH ALIC FREQ 1
OPTI PAS UTIL NOTE LOG 1
CALCUL TINI 0. TEND 0.001D0 PASF 1.D-5
*===============================================================
SUIT
Post-treatment (time curves from alice file)
ECHO
RESU ALIC GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
LCOU 22 'cpu'  FICH 'vega63.log' TCPU
TRAC 22 AXES 1.0 'CPU [S]' YZER XMIN 0.0 XMAX 10.E-3 NX 10
                            YMIN 0.0 YMAX 2.5E+4 NY 10
LIST 22 AXES 1.0 'CPU [S]' YZER XMIN 0.0 XMAX 10.E-3 NX 10
                            YMIN 0.0 YMAX 2.5E+4 NY 10
LCOU 23 'dtcr' FICH 'vega63.log' DTCR
TRAC 23 AXES 1.0 'DTCR [S]' XMIN 0.0 XMAX 10.E-3 NX 10
                             YMIN 0.0 YMAX 2.0E-6 NY 10
LIST 23 AXES 1.0 'DTCR [S]' XMIN 0.0 XMAX 10.E-3 NX 10
                             YMIN 0.0 YMAX 2.0E-6 NY 10
RCOU 122 'cpu'  FICH 'vega61k.pun' RENA 'cpu_61'
TRAC 22 122 AXES 1.0 'CPU [S]' YZER XMIN 0.0 XMAX 10.E-3 NX 10
                            YMIN 0.0 YMAX 2.5E+4 NY 10
COLO ROUG NOIR
RCOU 123 'dtcr' FICH 'vega61k.pun' RENA 'dtcr_61'
TRAC 23 123 AXES 1.0 'DTCR [S]' XMIN 0.0 XMAX 10.E-3 NX 10
                             YMIN 0.0 YMAX 2.0E-6 NY 10
COLO ROUG NOIR
*===============================================================
FIN
```

vega63l.epx

```
VEGA63L
ECHO
*CONV WIN
LAGR AXIS
GEOM LIBR POIN 18 Q92 1 Q93 1        ED01 2 TERM
  1 0.0 1.5 0.0 2 0.0 2.5 0.0 3 0.0
  1 0.5 1.5 0.5 2 0.5 2.5 0.5 3 0.5
  1 1.0 1.5 1.0 2 1.0 2.5 1.0 3 1.0
  0 0 1 1 1 2
  1 2 3 8 13 12 11 6 7
  3 4 5 10 15 14 13 8 9
  16 17
  17 18
EPAI 1. LECT 1 PAS 1 4 TERM
MATE VM23 RO 8000. YOUN 1.D11 NU 0.3 ELAS 2.D8
          TRAC 3 2.D8 2.D-3 3.D8 1. 3.1D8 2.
          LECT 1 2 TERM
     VM23 RO 4000. YOUN 2.D11 NU 0.2 ELAS 4.D8
          TRAC 2 4.D8 2.D-3 6.D8 1.
          LECT 3 4 TERM
LINK COUP
     BLOQ 12 LECT 5 PAS 5 15 TERM
     BLOQ 123 LECT 16 TERM
INIT VITE 2 300 LECT 6 PAS 1 9 TERM
     VITE 1 -200 LECT 6 PAS 1 8 TERM
     VITE 2 -100 LECT 17 TERM
     VITE 1 200 LECT 18 TERM
ECRI DEPL VITE ACCE FINT FEXT FLIA FDEC CONT ECRO FREQ 100
     FICH ALIC FREQ 1
OPTI PAS UTIL NOTE LOG 1
CALCUL TINI 0. TEND 0.001D0 PASF 1.D-5
*===============================================================
SUIT
Post-treatment (time curves from alice file)
ECHO
RESU ALIC GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
LCOU 21 'step' FICH 'vega63.log' STEP
LCOU 22 'cpu'  FICH 'vega63.log' TCPU
LCOU 23 'dtcr' FICH 'vega63.log' DTCR
LCOU 24 'elcr' FICH 'vega63.log' ELCR
LCOU 25 'dee'  FICH 'vega63.log' DEE
LCOU 26 'dmmn' FICH 'vega63.log' DMMN
LCOU 27 'dmme' FICH 'vega63.log' DMME
LCOU 28 'dtmx' FICH 'vega63.log' DTMX
LCOU 29 'elmx' FICH 'vega63.log' ELMX
LCOU 30 'vmax' FICH 'vega63.log' VMAX
LCOU 31 'nvmx' FICH 'vega63.log' NVMX
LCOU 32 'elst' FICH 'vega63.log' ELST
LCOU 33 'memo' FICH 'vega63.log' MEMO
LCOU 34 'memp' FICH 'vega63.log' MEMP
*
TRAC 21 AXES 1.0 'STEP [-]' YZER
TRAC 22 AXES 1.0 'CPU [S]' YZER
TRAC 23 AXES 1.0 'DTCR [S]' YZER
TRAC 23 AXES 1.0 'DTCR [S]' YLOG
*
TRAC 24 AXES 1.0 'ELCR [-]' YZER
TRAC 25 AXES 1.0 'DEE [-]' YZER
TRAC 26 AXES 1.0 'DMMN [-]' YZER
TRAC 27 AXES 1.0 'DMME [-]' YZER
TRAC 28 AXES 1.0 'DTMX [S]' YZER
TRAC 29 AXES 1.0 'ELMX [-]' YZER
TRAC 30 AXES 1.0 'VMAX [M/S]' YZER
```

```
TRAC 31 AXES 1.0 'NVMX [-]' YZER
TRAC 32 AXES 1.0 'ELST [-]' YZER
TRAC 33 AXES 1.0 'MEMO [-]' YZER
TRAC 34 AXES 1.0 'MEMP [-]' YZER
*
LIST 21 AXES 1.0 'STEP [-]' YZER
LIST 22 AXES 1.0 'CPU [S]' YZER
LIST 23 AXES 1.0 'DTCR [S]' YZER
*
LIST 24 AXES 1.0 'ELCR [-]' YZER
LIST 25 AXES 1.0 'DEE [-]' YZER
LIST 26 AXES 1.0 'DMMN [-]' YZER
LIST 27 AXES 1.0 'DMME [-]' YZER
LIST 28 AXES 1.0 'DTMX [S]' YZER
LIST 29 AXES 1.0 'ELMX [-]' YZER
LIST 30 AXES 1.0 'VMAX [M/S]' YZER
LIST 31 AXES 1.0 'NVMX [-]' YZER
LIST 32 AXES 1.0 'ELST [-]' YZER
LIST 33 AXES 1.0 'MEMO [-]' YZER
LIST 34 AXES 1.0 'MEMP [-]' YZER
*==================================================================
FIN
```

vega63m.epx

```
Post-treatment
ECHO
 CONV WIN
RESU SPLI ALIC 'vega63.ali' GARD PSCR
COMP COUL ROUG LECT mem1 TERM
          VERT LECT mem2 TERM
          TURQ LECT mem3 TERM
SORT VISU NSTO 1
PLAY
CAME   1 EYE  -1.72478E+01  0.00000E+00 -1.87219E-10
!        Q     7.07107E-01  0.00000E+00 -7.07107E-01  0.00000E+00
         VIEW  1.00000E+00  0.00000E+00  2.05103E-10
         RIGH -2.05103E-10  0.00000E+00  1.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   2.48819E+01
!NAVIGATION MODE: ROTATING CAMERA
!CENTER : -1.63350E+01  0.00000E+00  0.00000E+00
!RSPHERE:  2.34052E-01
!RADIUS :  9.12804E-01
!ASPECT :  1.00000E+00
!NEAR   :  6.78752E-01
!FAR    :  1.38091E+00
SCEN GEOM NAVI FREE
         !LINE HEOU
          FACE SBAC
     LIMA ON
SLER CAM1 1 NFRA 1
TRAC OFFS FICH BMP OBJE LECT mem1 TERM NFAI SYXY SYXZ
     AMPD 0 REND
FREQ 1
GOTR LOOP 6 OFFS FICH BMP OBJE LECT mem1 TERM NFAI SYXY SYXZ
     AMPD 0 REND
ENDPLAY
FIN
```

vega63n.epx

```
Post-treatment
ECHO
 CONV WIN
RESU SPLI ALIC 'vega63.ali' GARD PSCR
COMP COUL ROUG LECT mem1 TERM
          VERT LECT mem2 TERM
          TURQ LECT mem3 TERM
SORT VISU NSTO 1
PLAY
CAME   1 EYE  -1.72478E+01  0.00000E+00 -1.87219E-10
!        Q     7.07107E-01  0.00000E+00 -7.07107E-01  0.00000E+00
         VIEW  1.00000E+00  0.00000E+00  2.05103E-10
         RIGH -2.05103E-10  0.00000E+00  1.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   2.48819E+01
!NAVIGATION MODE: ROTATING CAMERA
!CENTER : -1.63350E+01  0.00000E+00  0.00000E+00
!RSPHERE:  2.34052E-01
!RADIUS :  9.12804E-01
!ASPECT :  1.00000E+00
!NEAR   :  6.78752E-01
!FAR    :  1.38091E+00
SCEN GEOM NAVI FREE
         !LINE HEOU
          FACE SBAC
     LIMA ON
SLER CAM1 1 NFRA 1
TRAC OFFS FICH BMP OBJE LECT mem2 TERM NFAI SYXY SYXZ
     AMPD 0 REND
FREQ 1
GOTR LOOP 6 OFFS FICH BMP OBJE LECT mem2 TERM NFAI SYXY SYXZ
     AMPD 0 REND
ENDPLAY
FIN
```

vega63o.epx

```
Post-treatment
ECHO
 CONV WIN
RESU SPLI ALIC 'vega63.ali' GARD PSCR
COMP COUL ROUG LECT mem1 TERM
          VERT LECT mem2 TERM
          TURQ LECT mem3 TERM
SORT VISU NSTO 1
PLAY
CAME   1 EYE  -1.72478E+01  0.00000E+00 -1.87219E-10
!        Q     7.07107E-01  0.00000E+00 -7.07107E-01  0.00000E+00
         VIEW  1.00000E+00  0.00000E+00  2.05103E-10
         RIGH -2.05103E-10  0.00000E+00  1.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   2.48819E+01
!NAVIGATION MODE: ROTATING CAMERA
!CENTER : -1.63350E+01  0.00000E+00  0.00000E+00
!RSPHERE:  2.34052E-01
!RADIUS :  9.12804E-01
!ASPECT :  1.00000E+00
!NEAR   :  6.78752E-01
!FAR    :  1.38091E+00
SCEN GEOM NAVI FREE
         !LINE HEOU
          FACE SBAC
     LIMA ON
SLER CAM1 1 NFRA 1
TRAC OFFS FICH BMP OBJE LECT mem3 TERM NFAI SYXY SYXZ
     AMPD 0 REND
FREQ 1
GOTR LOOP 6 OFFS FICH BMP OBJE LECT mem3 TERM NFAI SYXY SYXZ
     AMPD 0 REND
ENDPLAY
FIN
```

List of input files

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KJ-NA-29259-EN-N

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doi:10.2760/5627
ISBN 978-92-79-86762-0