ASSAS Project: INR/SCC Test

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# Introduction

A training database of about 300 ASTEC v3.1 calculations has been assessed for the French PWR-1300 (simplified model). The core is modelled radially by three core channels and one downcomer channel and 15 meshes axially (Figure 1).

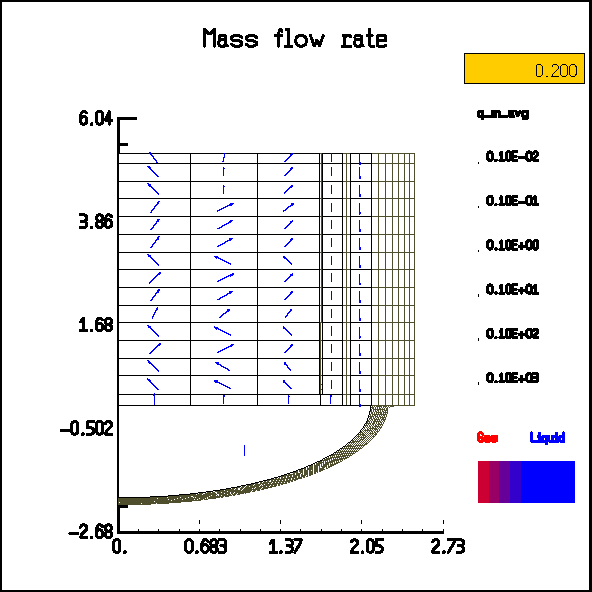


Figure 1. Radial and axial meshing of the simplified model of the French PWR-1300.

The training database is assessed for a severe accident induced by a break on the cold leg.

# Input

The input data have been selected having in mind the goal of the ASSAS project, namely operator actions have been considered.

The progress of the actions after the break in the base input deck is the following:

* Safety injection systems are automatically activated under certain conditions on the pressure in the vessel;
* After 10 minutes the primary pump is stopped (GMPPi) – Operator action;
* After 10 minutes the water level in the steam generator is maintained by activating the feedwater system (ASGi) – operator action.

The following input parameters have been considered:

1. Size of the break (pbreak);
2. Instant of activation of the safety injection system (pdtis);
3. Cooling speed of the steam relief valves (igcta);
4. Delay in time of the operator action for stopping the primary pumps (pdelIS);
5. Activation or not of the primary pumps by the operator (pgmpp);
6. Delay of the activation of the feedwater system in the steam generator (pdelSG);
7. Type of action to control of the water level in the steam generator (pasg).

The input parameters have been sampled by means of KATUSA according to the PDFs in Table 1.

Table 1. Input parameters.

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | PDF | Minimum | Maximum |
| pbreak | uniform | 0.01 m2 | 0.072965 m2 |
| pdtis | uniform | 17 s | 77 s |
| igcta | Discrete | 0,1,2,3 | |
| pdelIS | uniform | 400 s | 1200 s |
| pgmpp | Discrete | 0.0, 1.0 | |
| pdelSG | uniform | 0 s | 600 s |
| pasg | Discrete | 0, 1, 2 | |

The actions corresponding to the values of the parameters igcta, pgmpp, and pasg are shown in Table 2.

Table 2. Values and corresponding actions of the igcta, pgmpp, and pasg parameters.

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Action |
| igcta | 0 | Steam generator valve pressure set point |
|  | 1 | Steam generator i controlled cooling |
|  | 2 | Steam generator i maximum cooling |
|  | 3 | Steam generator fast cooling (-56°C/h) |
| pgmpp | 0.0 | Not activated |
|  | 1.0 | Activated |
| pasg | 0 | null mass flow rate (kg/s) |
|  | 1 | maximum mass flow rate possible |
|  | 2 | level regulation (44 %) |

# Output

The output variables are shown in Table 3. Note that the channels are numbered from 1 to 3 starting from the central channel (left in Figure 1). The downcomer is labelled as ‘Ch0’ in Table 3. Furthermore, the axial meshes are numbered from 1 to 15 starting from the bottom of each channel.

The format of the output variables is the following:

<*variable*>\_<*# of the channel*>\_mesh<*# of the mesh*>

Table 3. Output variables.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Channel 1**  **Output** | **Channel 2**  **Output** | **Channel 3**  **Output** | **Downcomer**  **Output** | **Unit** | **Meaning** |
| Magma\_Ch1\_mesh1 | Magma\_Ch2\_mesh1 | Magma\_Ch3\_mesh1 | Magma\_Ch0\_mesh1 | [m3] | Volume of the magma |
| Magma\_Ch1\_mesh2 | Magma\_Ch2\_mesh2 | Magma\_Ch3\_mesh2 | Magma\_Ch0\_mesh2 | [m3] | Volume of the magma |
| Magma\_Ch1\_mesh3 | Magma\_Ch2\_mesh3 | Magma\_Ch3\_mesh3 | Magma\_Ch0\_mesh3 | [m3] | Volume of the magma |
| Magma\_Ch1\_mesh4 | Magma\_Ch2\_mesh4 | Magma\_Ch3\_mesh4 | Magma\_Ch0\_mesh4 | [m3] | Volume of the magma |
| Magma\_Ch1\_mesh5 | Magma\_Ch2\_mesh5 | Magma\_Ch3\_mesh5 | Magma\_Ch0\_mesh5 | [m3] | Volume of the magma |
| Magma\_Ch1\_mesh6 | Magma\_Ch2\_mesh6 | Magma\_Ch3\_mesh6 | Magma\_Ch0\_mesh6 | [m3] | Volume of the magma |
| Magma\_Ch1\_mesh7 | Magma\_Ch2\_mesh7 | Magma\_Ch3\_mesh7 | Magma\_Ch0\_mesh7 | [m3] | Volume of the magma |
| Magma\_Ch1\_mesh8 | Magma\_Ch2\_mesh8 | Magma\_Ch3\_mesh8 | Magma\_Ch0\_mesh8 | [m3] | Volume of the magma |
| Magma\_Ch1\_mesh9 | Magma\_Ch2\_mesh9 | Magma\_Ch3\_mesh9 | Magma\_Ch0\_mesh9 | [m3] | Volume of the magma |
| Magma\_Ch1\_mesh10 | Magma\_Ch2\_mesh10 | Magma\_Ch3\_mesh10 | Magma\_Ch0\_mesh10 | [m3] | Volume of the magma |
| Magma\_Ch1\_mesh11 | Magma\_Ch2\_mesh11 | Magma\_Ch3\_mesh11 | Magma\_Ch0\_mesh11 | [m3] | Volume of the magma |
| Magma\_Ch1\_mesh12 | Magma\_Ch2\_mesh12 | Magma\_Ch3\_mesh12 | Magma\_Ch0\_mesh12 | [m3] | Volume of the magma |
| Magma\_Ch1\_mesh13 | Magma\_Ch2\_mesh13 | Magma\_Ch3\_mesh13 | Magma\_Ch0\_mesh13 | [m3] | Volume of the magma |
| Magma\_Ch1\_mesh14 | Magma\_Ch2\_mesh14 | Magma\_Ch3\_mesh14 | Magma\_Ch0\_mesh14 | [m3] | Volume of the magma |
| Magma\_Ch1\_mesh15 | Magma\_Ch2\_mesh15 | Magma\_Ch3\_mesh15 | Magma\_Ch0\_mesh15 | [m3] | Volume of the magma |
| Debris\_Ch1\_mesh1 | Debris\_Ch2\_mesh1 | Debris\_Ch3\_mesh1 | Debris\_Ch0\_mesh1 | [m3] | Volume of the debris |
| Debris\_Ch1\_mesh2 | Debris\_Ch2\_mesh2 | Debris\_Ch3\_mesh2 | Debris\_Ch0\_mesh2 | [m3] | Volume of the debris |
| Debris\_Ch1\_mesh3 | Debris\_Ch2\_mesh3 | Debris\_Ch3\_mesh3 | Debris\_Ch0\_mesh3 | [m3] | Volume of the debris |
| Debris\_Ch1\_mesh4 | Debris\_Ch2\_mesh4 | Debris\_Ch3\_mesh4 | Debris\_Ch0\_mesh4 | [m3] | Volume of the debris |
| Debris\_Ch1\_mesh5 | Debris\_Ch2\_mesh5 | Debris\_Ch3\_mesh5 | Debris\_Ch0\_mesh5 | [m3] | Volume of the debris |
| Debris\_Ch1\_mesh6 | Debris\_Ch2\_mesh6 | Debris\_Ch3\_mesh6 | Debris\_Ch0\_mesh6 | [m3] | Volume of the debris |
| Debris\_Ch1\_mesh7 | Debris\_Ch2\_mesh7 | Debris\_Ch3\_mesh7 | Debris\_Ch0\_mesh7 | [m3] | Volume of the debris |
| Debris\_Ch1\_mesh8 | Debris\_Ch2\_mesh8 | Debris\_Ch3\_mesh8 | Debris\_Ch0\_mesh8 | [m3] | Volume of the debris |
| Debris\_Ch1\_mesh9 | Debris\_Ch2\_mesh9 | Debris\_Ch3\_mesh9 | Debris\_Ch0\_mesh9 | [m3] | Volume of the debris |
| Debris\_Ch1\_mesh10 | Debris\_Ch2\_mesh10 | Debris\_Ch3\_mesh10 | Debris\_Ch0\_mesh10 | [m3] | Volume of the debris |
| Debris\_Ch1\_mesh11 | Debris\_Ch2\_mesh11 | Debris\_Ch3\_mesh11 | Debris\_Ch0\_mesh11 | [m3] | Volume of the debris |
| Debris\_Ch1\_mesh12 | Debris\_Ch2\_mesh12 | Debris\_Ch3\_mesh12 | Debris\_Ch0\_mesh12 | [m3] | Volume of the debris |
| Debris\_Ch1\_mesh13 | Debris\_Ch2\_mesh13 | Debris\_Ch3\_mesh13 | Debris\_Ch0\_mesh13 | [m3] | Volume of the debris |
| Debris\_Ch1\_mesh14 | Debris\_Ch2\_mesh14 | Debris\_Ch3\_mesh14 | Debris\_Ch0\_mesh14 | [m3] | Volume of the debris |
| Debris\_Ch1\_mesh15 | Debris\_Ch2\_mesh15 | Debris\_Ch3\_mesh15 | Debris\_Ch0\_mesh15 | [m3] | Volume of the debris |
| P\_Ch1\_mesh1 | P\_Ch2\_mesh1 | P\_Ch3\_mesh1 | P\_Ch0\_mesh1 | [Pa] | Pressure |
| P\_Ch1\_mesh2 | P\_Ch2\_mesh2 | P\_Ch3\_mesh2 | P\_Ch0\_mesh2 | [Pa] | Pressure |
| P\_Ch1\_mesh3 | P\_Ch2\_mesh3 | P\_Ch3\_mesh3 | P\_Ch0\_mesh3 | [Pa] | Pressure |
| P\_Ch1\_mesh4 | P\_Ch2\_mesh4 | P\_Ch3\_mesh4 | P\_Ch0\_mesh4 | [Pa] | Pressure |
| P\_Ch1\_mesh5 | P\_Ch2\_mesh5 | P\_Ch3\_mesh5 | P\_Ch0\_mesh5 | [Pa] | Pressure |
| P\_Ch1\_mesh6 | P\_Ch2\_mesh6 | P\_Ch3\_mesh6 | P\_Ch0\_mesh6 | [Pa] | Pressure |
| P\_Ch1\_mesh7 | P\_Ch2\_mesh7 | P\_Ch3\_mesh7 | P\_Ch0\_mesh7 | [Pa] | Pressure |
| P\_Ch1\_mesh8 | P\_Ch2\_mesh8 | P\_Ch3\_mesh8 | P\_Ch0\_mesh8 | [Pa] | Pressure |
| P\_Ch1\_mesh9 | P\_Ch2\_mesh9 | P\_Ch3\_mesh9 | P\_Ch0\_mesh9 | [Pa] | Pressure |
| P\_Ch1\_mesh10 | P\_Ch2\_mesh10 | P\_Ch3\_mesh10 | P\_Ch0\_mesh10 | [Pa] | Pressure |
| P\_Ch1\_mesh11 | P\_Ch2\_mesh11 | P\_Ch3\_mesh11 | P\_Ch0\_mesh11 | [Pa] | Pressure |
| P\_Ch1\_mesh12 | P\_Ch2\_mesh12 | P\_Ch3\_mesh12 | P\_Ch0\_mesh12 | [Pa] | Pressure |
| P\_Ch1\_mesh13 | P\_Ch2\_mesh13 | P\_Ch3\_mesh13 | P\_Ch0\_mesh13 | [Pa] | Pressure |
| P\_Ch1\_mesh14 | P\_Ch2\_mesh14 | P\_Ch3\_mesh14 | P\_Ch0\_mesh14 | [Pa] | Pressure |
| P\_Ch1\_mesh15 | P\_Ch2\_mesh15 | P\_Ch3\_mesh15 | P\_Ch0\_mesh15 | [Pa] | Pressure |
| q\_liq\_Ch1\_mesh1 | q\_liq\_Ch2\_mesh1 | q\_liq\_Ch3\_mesh1 | q\_liq\_Ch0\_mesh1 | [kg/s] | Liquid flow rate |
| q\_liq\_Ch1\_mesh2 | q\_liq\_Ch2\_mesh2 | q\_liq\_Ch3\_mesh2 | q\_liq\_Ch0\_mesh2 | [kg/s] | Liquid flow rate |
| q\_liq\_Ch1\_mesh3 | q\_liq\_Ch2\_mesh3 | q\_liq\_Ch3\_mesh3 | q\_liq\_Ch0\_mesh3 | [kg/s] | Liquid flow rate |
| q\_liq\_Ch1\_mesh4 | q\_liq\_Ch2\_mesh4 | q\_liq\_Ch3\_mesh4 | q\_liq\_Ch0\_mesh4 | [kg/s] | Liquid flow rate |
| q\_liq\_Ch1\_mesh5 | q\_liq\_Ch2\_mesh5 | q\_liq\_Ch3\_mesh5 | q\_liq\_Ch0\_mesh5 | [kg/s] | Liquid flow rate |
| q\_liq\_Ch1\_mesh6 | q\_liq\_Ch2\_mesh6 | q\_liq\_Ch3\_mesh6 | q\_liq\_Ch0\_mesh6 | [kg/s] | Liquid flow rate |
| q\_liq\_Ch1\_mesh7 | q\_liq\_Ch2\_mesh7 | q\_liq\_Ch3\_mesh7 | q\_liq\_Ch0\_mesh7 | [kg/s] | Liquid flow rate |
| q\_liq\_Ch1\_mesh8 | q\_liq\_Ch2\_mesh8 | q\_liq\_Ch3\_mesh8 | q\_liq\_Ch0\_mesh8 | [kg/s] | Liquid flow rate |
| q\_liq\_Ch1\_mesh9 | q\_liq\_Ch2\_mesh9 | q\_liq\_Ch3\_mesh9 | q\_liq\_Ch0\_mesh9 | [kg/s] | Liquid flow rate |
| q\_liq\_Ch1\_mesh10 | q\_liq\_Ch2\_mesh10 | q\_liq\_Ch3\_mesh10 | q\_liq\_Ch0\_mesh10 | [kg/s] | Liquid flow rate |
| q\_liq\_Ch1\_mesh11 | q\_liq\_Ch2\_mesh11 | q\_liq\_Ch3\_mesh11 | q\_liq\_Ch0\_mesh11 | [kg/s] | Liquid flow rate |
| q\_liq\_Ch1\_mesh12 | q\_liq\_Ch2\_mesh12 | q\_liq\_Ch3\_mesh12 | q\_liq\_Ch0\_mesh12 | [kg/s] | Liquid flow rate |
| q\_liq\_Ch1\_mesh13 | q\_liq\_Ch2\_mesh13 | q\_liq\_Ch3\_mesh13 | q\_liq\_Ch0\_mesh13 | [kg/s] | Liquid flow rate |
| q\_liq\_Ch1\_mesh14 | q\_liq\_Ch2\_mesh14 | q\_liq\_Ch3\_mesh14 | q\_liq\_Ch0\_mesh14 | [kg/s] | Liquid flow rate |
| q\_liq\_Ch1\_mesh15 | q\_liq\_Ch2\_mesh15 | q\_liq\_Ch3\_mesh15 | q\_liq\_Ch0\_mesh15 | [kg/s] | Liquid flow rate |
| T\_sat\_Ch1\_mesh1 | T\_sat\_Ch2\_mesh1 | T\_sat\_Ch3\_mesh1 | T\_sat\_Ch0\_mesh1 | [K] | Saturation temperature |
| T\_sat\_Ch1\_mesh2 | T\_sat\_Ch2\_mesh2 | T\_sat\_Ch3\_mesh2 | T\_sat\_Ch0\_mesh2 | [K] | Saturation temperature |
| T\_sat\_Ch1\_mesh3 | T\_sat\_Ch2\_mesh3 | T\_sat\_Ch3\_mesh3 | T\_sat\_Ch0\_mesh3 | [K] | Saturation temperature |
| T\_sat\_Ch1\_mesh4 | T\_sat\_Ch2\_mesh4 | T\_sat\_Ch3\_mesh4 | T\_sat\_Ch0\_mesh4 | [K] | Saturation temperature |
| T\_sat\_Ch1\_mesh5 | T\_sat\_Ch2\_mesh5 | T\_sat\_Ch3\_mesh5 | T\_sat\_Ch0\_mesh5 | [K] | Saturation temperature |
| T\_sat\_Ch1\_mesh6 | T\_sat\_Ch2\_mesh6 | T\_sat\_Ch3\_mesh6 | T\_sat\_Ch0\_mesh6 | [K] | Saturation temperature |
| T\_sat\_Ch1\_mesh7 | T\_sat\_Ch2\_mesh7 | T\_sat\_Ch3\_mesh7 | T\_sat\_Ch0\_mesh7 | [K] | Saturation temperature |
| T\_sat\_Ch1\_mesh8 | T\_sat\_Ch2\_mesh8 | T\_sat\_Ch3\_mesh8 | T\_sat\_Ch0\_mesh8 | [K] | Saturation temperature |
| T\_sat\_Ch1\_mesh9 | T\_sat\_Ch2\_mesh9 | T\_sat\_Ch3\_mesh9 | T\_sat\_Ch0\_mesh9 | [K] | Saturation temperature |
| T\_sat\_Ch1\_mesh10 | T\_sat\_Ch2\_mesh10 | T\_sat\_Ch3\_mesh10 | T\_sat\_Ch0\_mesh10 | [K] | Saturation temperature |
| T\_sat\_Ch1\_mesh11 | T\_sat\_Ch2\_mesh11 | T\_sat\_Ch3\_mesh11 | T\_sat\_Ch0\_mesh11 | [K] | Saturation temperature |
| T\_sat\_Ch1\_mesh12 | T\_sat\_Ch2\_mesh12 | T\_sat\_Ch3\_mesh12 | T\_sat\_Ch0\_mesh12 | [K] | Saturation temperature |
| T\_sat\_Ch1\_mesh13 | T\_sat\_Ch2\_mesh13 | T\_sat\_Ch3\_mesh13 | T\_sat\_Ch0\_mesh13 | [K] | Saturation temperature |
| T\_sat\_Ch1\_mesh14 | T\_sat\_Ch2\_mesh14 | T\_sat\_Ch3\_mesh14 | T\_sat\_Ch0\_mesh14 | [K] | Saturation temperature |
| T\_sat\_Ch1\_mesh15 | T\_sat\_Ch2\_mesh15 | T\_sat\_Ch3\_mesh15 | T\_sat\_Ch0\_mesh15 | [K] | Saturation temperature |
| T\_liq\_Ch1\_mesh1 | T\_liq\_Ch2\_mesh1 | T\_liq\_Ch3\_mesh1 | T\_liq\_Ch0\_mesh1 | [K] | Liquid temperature |
| T\_liq\_Ch1\_mesh2 | T\_liq\_Ch2\_mesh2 | T\_liq\_Ch3\_mesh2 | T\_liq\_Ch0\_mesh2 | [K] | Liquid temperature |
| T\_liq\_Ch1\_mesh3 | T\_liq\_Ch2\_mesh3 | T\_liq\_Ch3\_mesh3 | T\_liq\_Ch0\_mesh3 | [K] | Liquid temperature |
| T\_liq\_Ch1\_mesh4 | T\_liq\_Ch2\_mesh4 | T\_liq\_Ch3\_mesh4 | T\_liq\_Ch0\_mesh4 | [K] | Liquid temperature |
| T\_liq\_Ch1\_mesh5 | T\_liq\_Ch2\_mesh5 | T\_liq\_Ch3\_mesh5 | T\_liq\_Ch0\_mesh5 | [K] | Liquid temperature |
| T\_liq\_Ch1\_mesh6 | T\_liq\_Ch2\_mesh6 | T\_liq\_Ch3\_mesh6 | T\_liq\_Ch0\_mesh6 | [K] | Liquid temperature |
| T\_liq\_Ch1\_mesh7 | T\_liq\_Ch2\_mesh7 | T\_liq\_Ch3\_mesh7 | T\_liq\_Ch0\_mesh7 | [K] | Liquid temperature |
| T\_liq\_Ch1\_mesh8 | T\_liq\_Ch2\_mesh8 | T\_liq\_Ch3\_mesh8 | T\_liq\_Ch0\_mesh8 | [K] | Liquid temperature |
| T\_liq\_Ch1\_mesh9 | T\_liq\_Ch2\_mesh9 | T\_liq\_Ch3\_mesh9 | T\_liq\_Ch0\_mesh9 | [K] | Liquid temperature |
| T\_liq\_Ch1\_mesh10 | T\_liq\_Ch2\_mesh10 | T\_liq\_Ch3\_mesh10 | T\_liq\_Ch0\_mesh10 | [K] | Liquid temperature |
| T\_liq\_Ch1\_mesh11 | T\_liq\_Ch2\_mesh11 | T\_liq\_Ch3\_mesh11 | T\_liq\_Ch0\_mesh11 | [K] | Liquid temperature |
| T\_liq\_Ch1\_mesh12 | T\_liq\_Ch2\_mesh12 | T\_liq\_Ch3\_mesh12 | T\_liq\_Ch0\_mesh12 | [K] | Liquid temperature |
| T\_liq\_Ch1\_mesh13 | T\_liq\_Ch2\_mesh13 | T\_liq\_Ch3\_mesh13 | T\_liq\_Ch0\_mesh13 | [K] | Liquid temperature |
| T\_liq\_Ch1\_mesh14 | T\_liq\_Ch2\_mesh14 | T\_liq\_Ch3\_mesh14 | T\_liq\_Ch0\_mesh14 | [K] | Liquid temperature |
| T\_liq\_Ch1\_mesh15 | T\_liq\_Ch2\_mesh15 | T\_liq\_Ch3\_mesh15 | T\_liq\_Ch0\_mesh15 | [K] | Liquid temperature |
| void\_Ch1\_mesh1 | void\_Ch2\_mesh1 | void\_Ch3\_mesh1 | void\_Ch0\_mesh1 | [-] | Water void fraction |
| void\_Ch1\_mesh2 | void\_Ch2\_mesh2 | void\_Ch3\_mesh2 | void\_Ch0\_mesh2 | [-] | Water void fraction |
| void\_Ch1\_mesh3 | void\_Ch2\_mesh3 | void\_Ch3\_mesh3 | void\_Ch0\_mesh3 | [-] | Water void fraction |
| void\_Ch1\_mesh4 | void\_Ch2\_mesh4 | void\_Ch3\_mesh4 | void\_Ch0\_mesh4 | [-] | Water void fraction |
| void\_Ch1\_mesh5 | void\_Ch2\_mesh5 | void\_Ch3\_mesh5 | void\_Ch0\_mesh5 | [-] | Water void fraction |
| void\_Ch1\_mesh6 | void\_Ch2\_mesh6 | void\_Ch3\_mesh6 | void\_Ch0\_mesh6 | [-] | Water void fraction |
| void\_Ch1\_mesh7 | void\_Ch2\_mesh7 | void\_Ch3\_mesh7 | void\_Ch0\_mesh7 | [-] | Water void fraction |
| void\_Ch1\_mesh8 | void\_Ch2\_mesh8 | void\_Ch3\_mesh8 | void\_Ch0\_mesh8 | [-] | Water void fraction |
| void\_Ch1\_mesh9 | void\_Ch2\_mesh9 | void\_Ch3\_mesh9 | void\_Ch0\_mesh9 | [-] | Water void fraction |
| void\_Ch1\_mesh10 | void\_Ch2\_mesh10 | void\_Ch3\_mesh10 | void\_Ch0\_mesh10 | [-] | Water void fraction |
| void\_Ch1\_mesh11 | void\_Ch2\_mesh11 | void\_Ch3\_mesh11 | void\_Ch0\_mesh11 | [-] | Water void fraction |
| void\_Ch1\_mesh12 | void\_Ch2\_mesh12 | void\_Ch3\_mesh12 | void\_Ch0\_mesh12 | [-] | Water void fraction |
| void\_Ch1\_mesh13 | void\_Ch2\_mesh13 | void\_Ch3\_mesh13 | void\_Ch0\_mesh13 | [-] | Water void fraction |
| void\_Ch1\_mesh14 | void\_Ch2\_mesh14 | void\_Ch3\_mesh14 | void\_Ch0\_mesh14 | [-] | Water void fraction |
| void\_Ch1\_mesh15 | void\_Ch2\_mesh15 | void\_Ch3\_mesh15 | void\_Ch0\_mesh15 | [-] | Water void fraction |