SAND2011-4240C

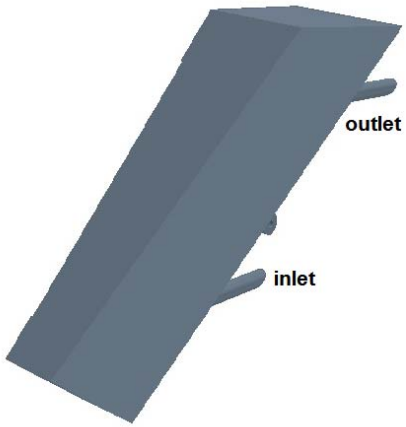
Diagnostic First Wall Conceptual Design Review

ITER Site
Cadarache, France
June 23, 2011

Dennis Youchison
Sandia National Laboratories

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

½ Diagnostic FW – ss analysis with heating

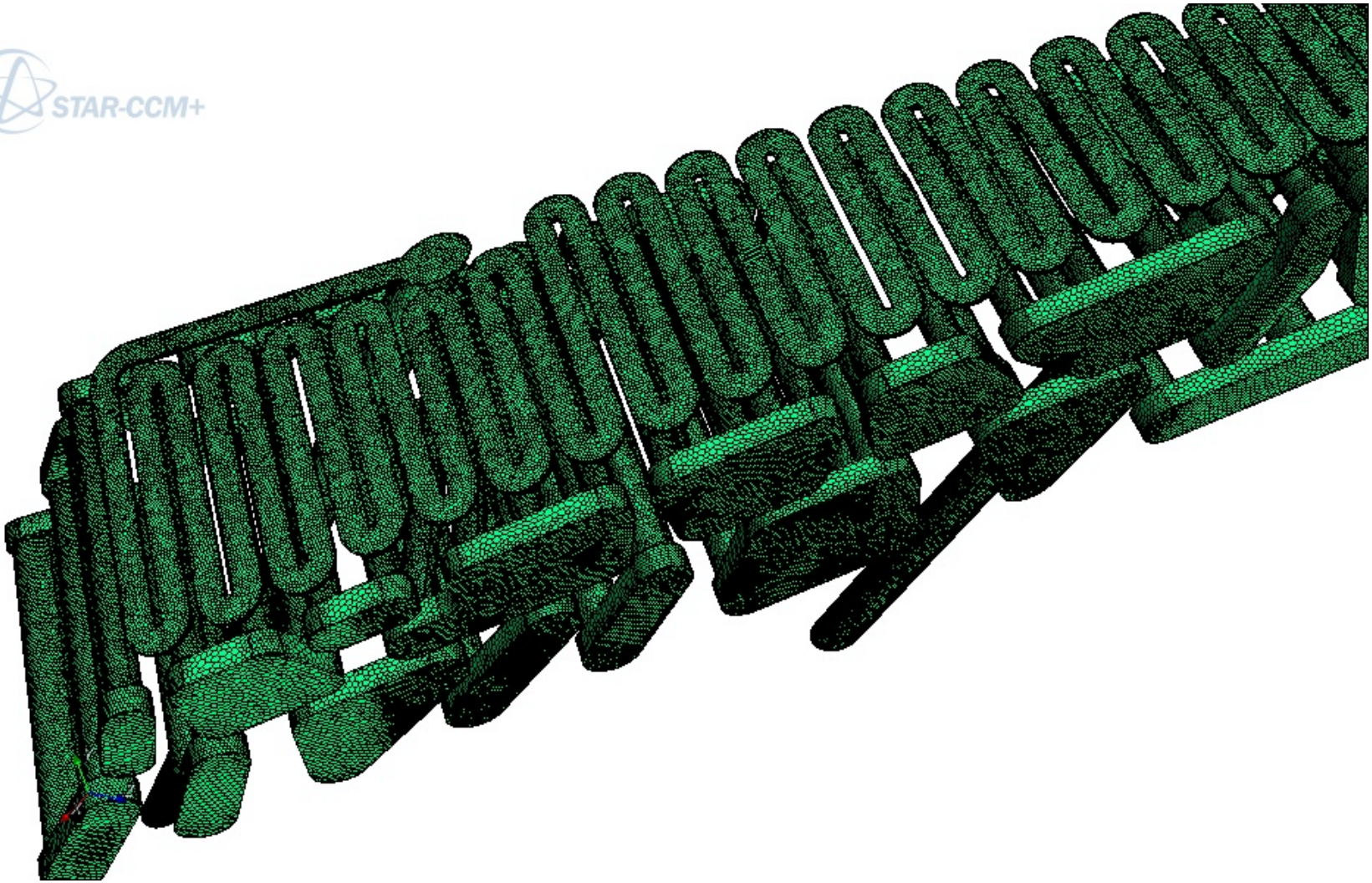


Mesh contains 5.6M cells
With 3 prism layers

Parameters

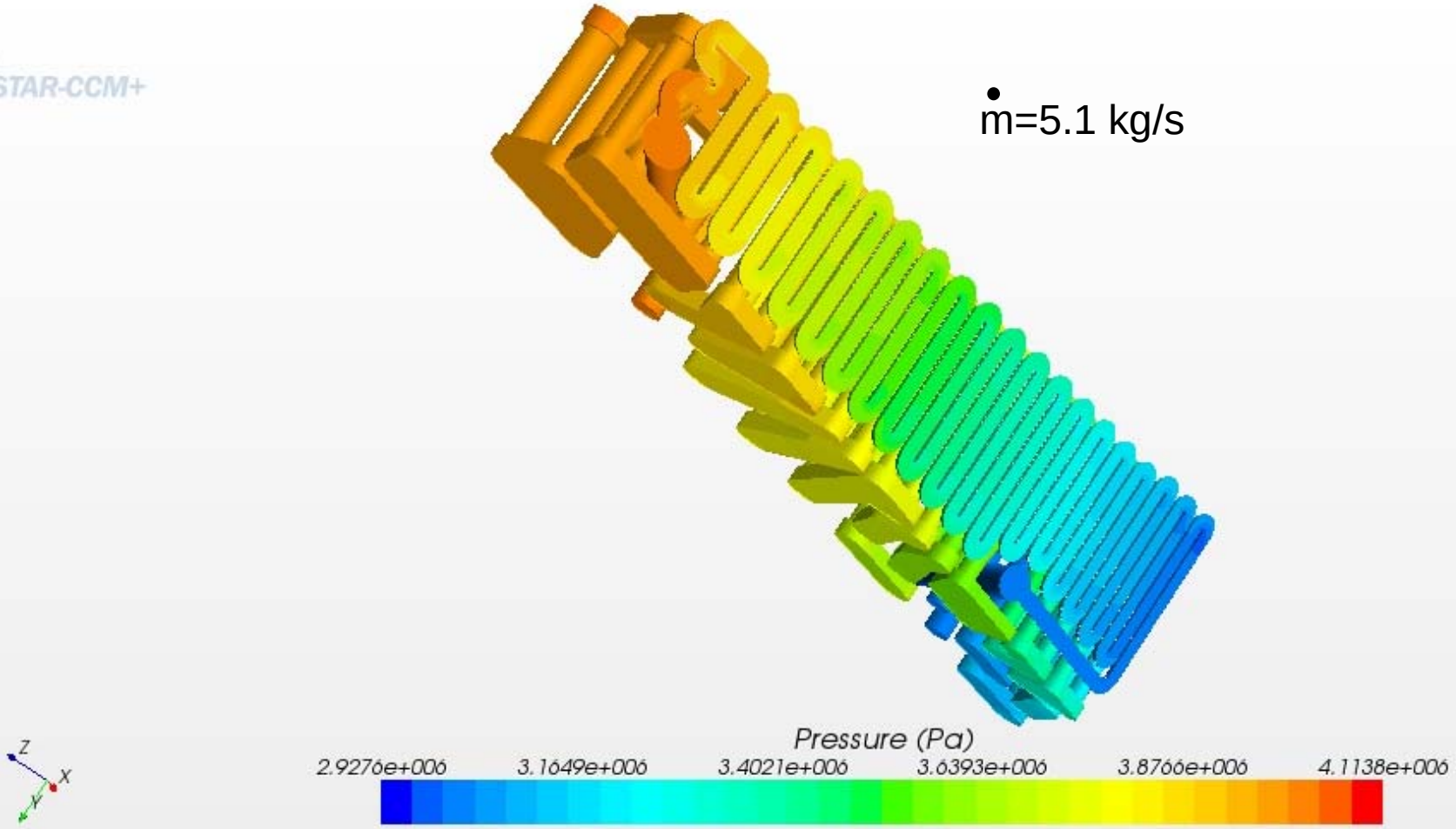
- 3.0 MPa, 70 C water
- 5.1 kg/s mass flow inlet
- Q”=0.35 MW/m^2 on top surface.
- 1) Q_n=e(1.55657-0.0621156x) W/cm^3 16 cm e-folding distance
- 2) Q_n=e(1.55657-0.1111096x) W/cm^3 9 cm e-folding distance

4.1 M cells in fluid volume

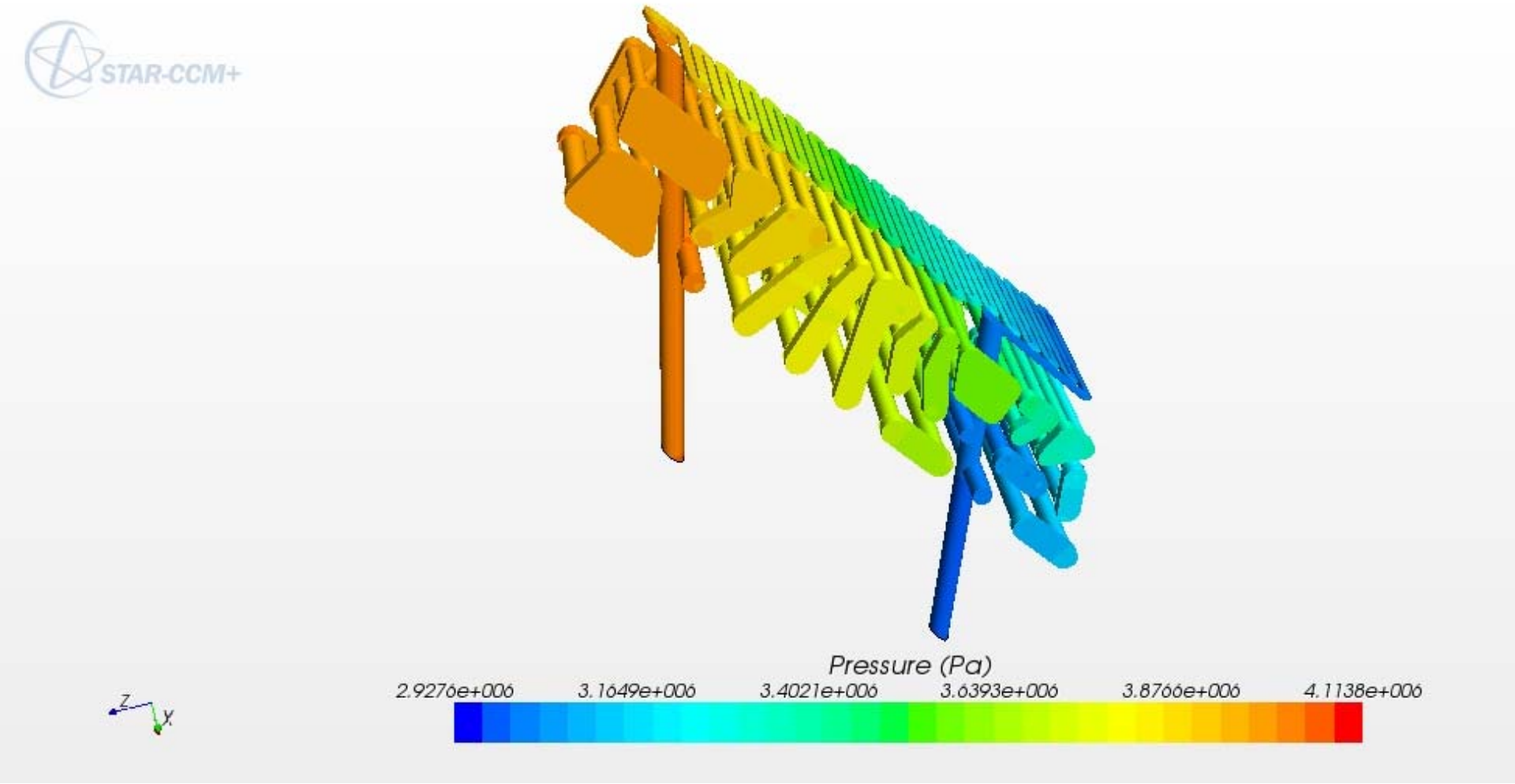


Delta-P about 1.1 MPa

$\dot{m}$=5.1 kg/s

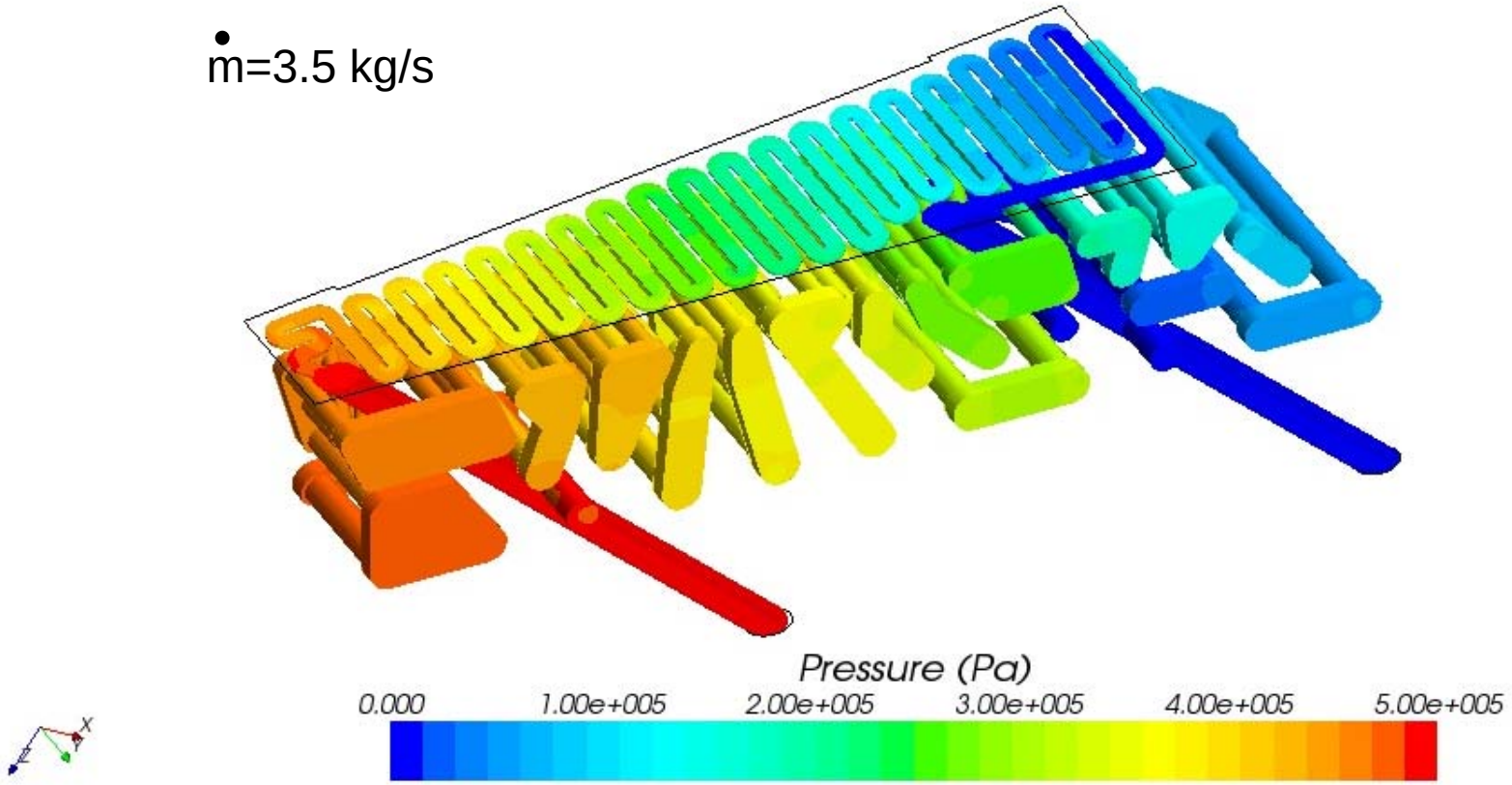


Pressure distribution

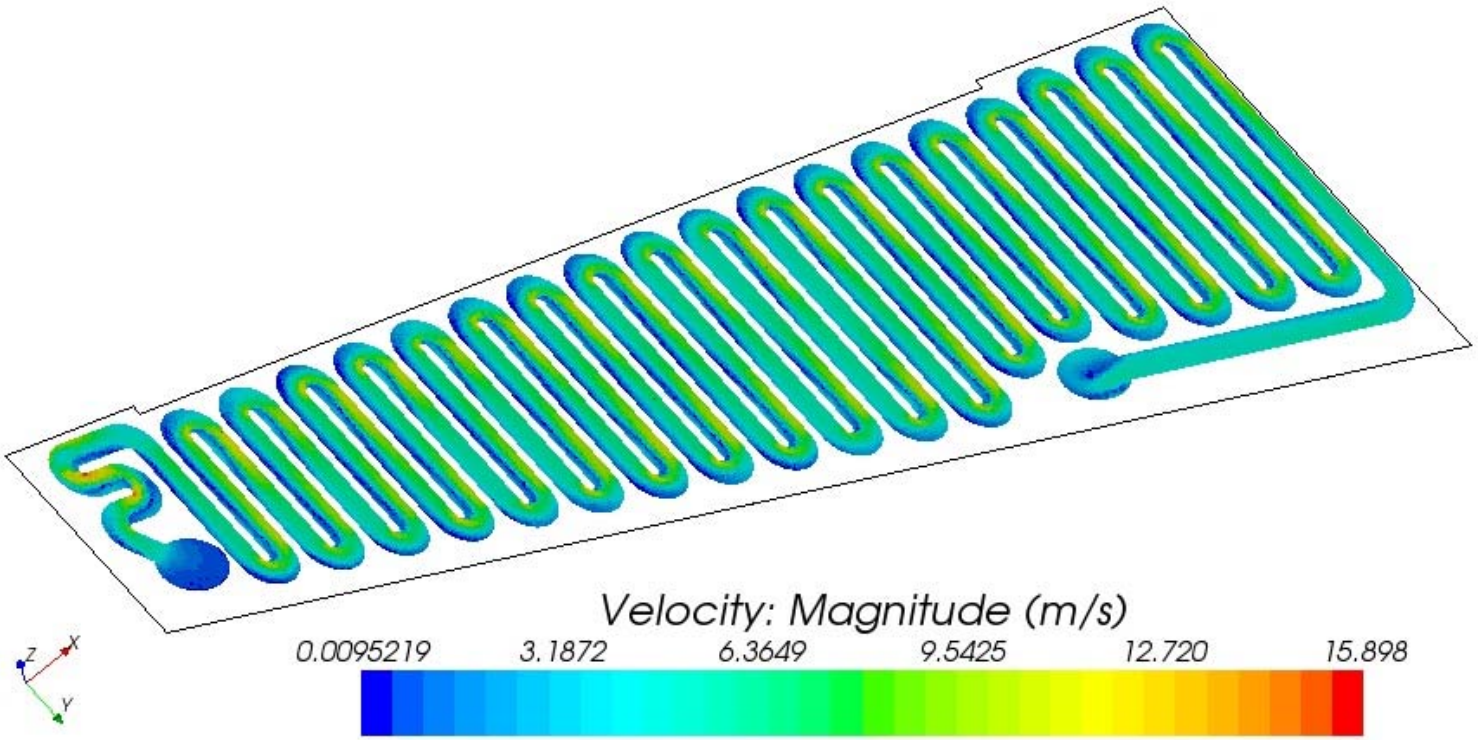


Pressure distribution

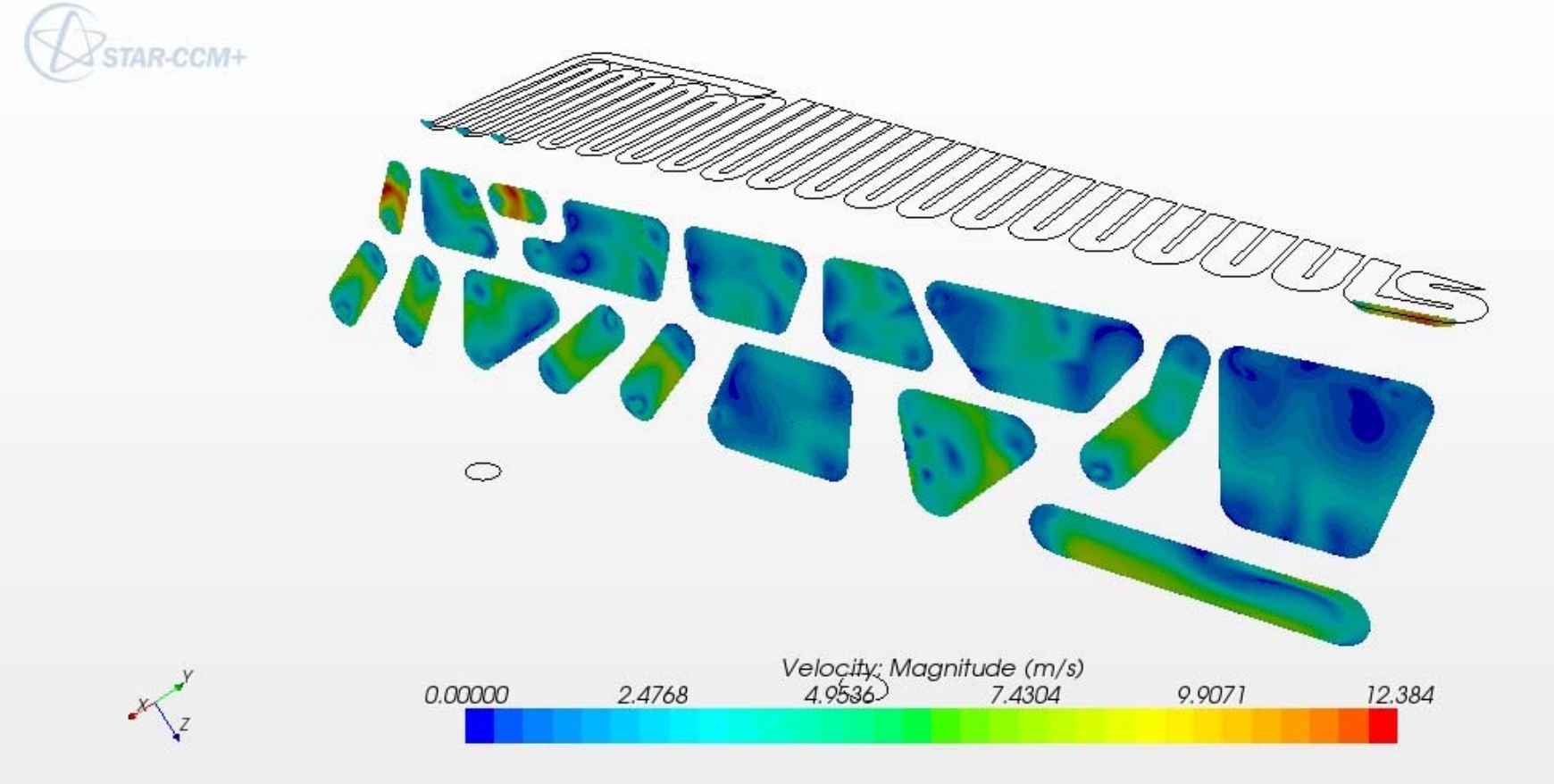
- $\dot{m}$=3.5 kg/s



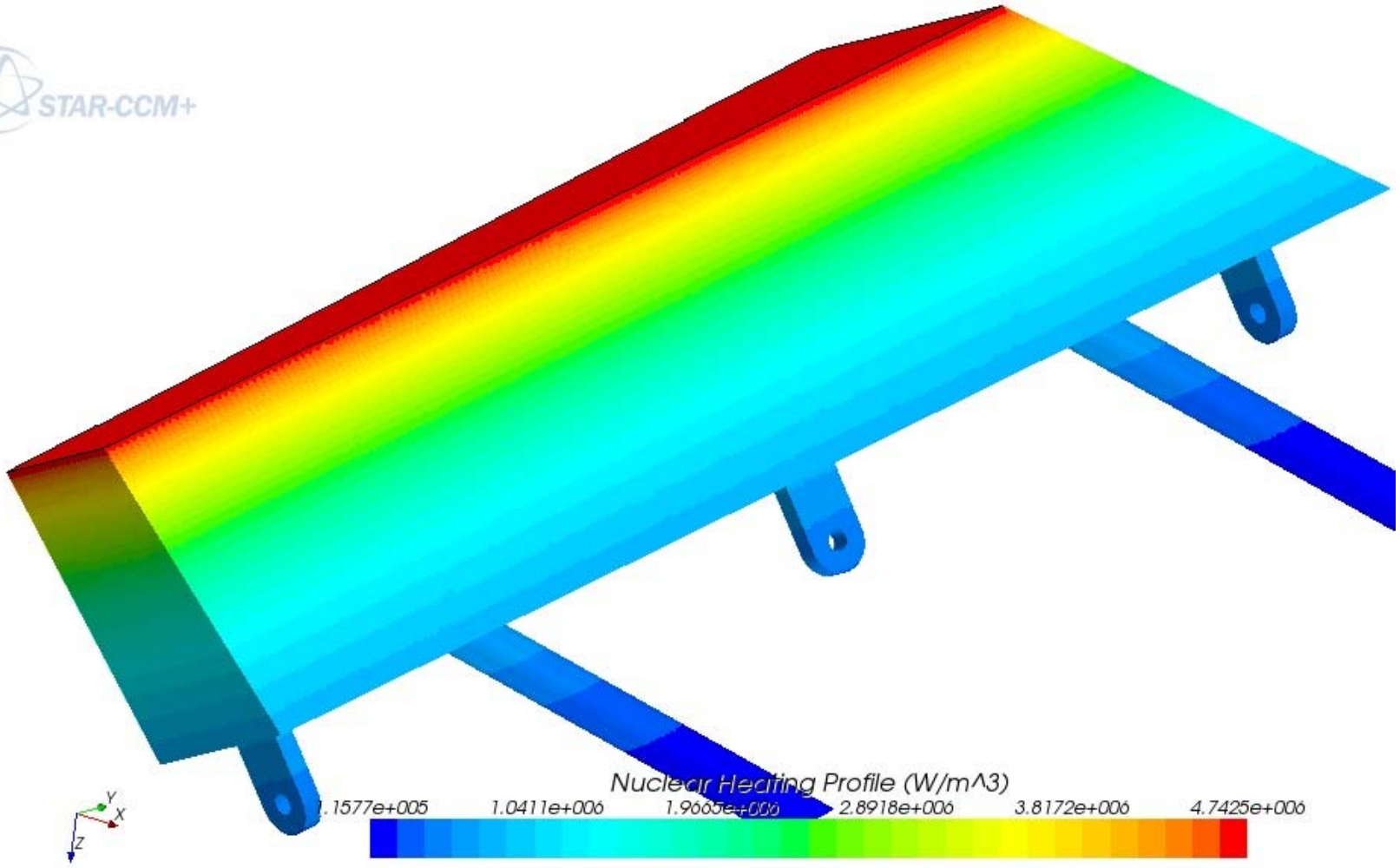
Velocity distribution cutplane



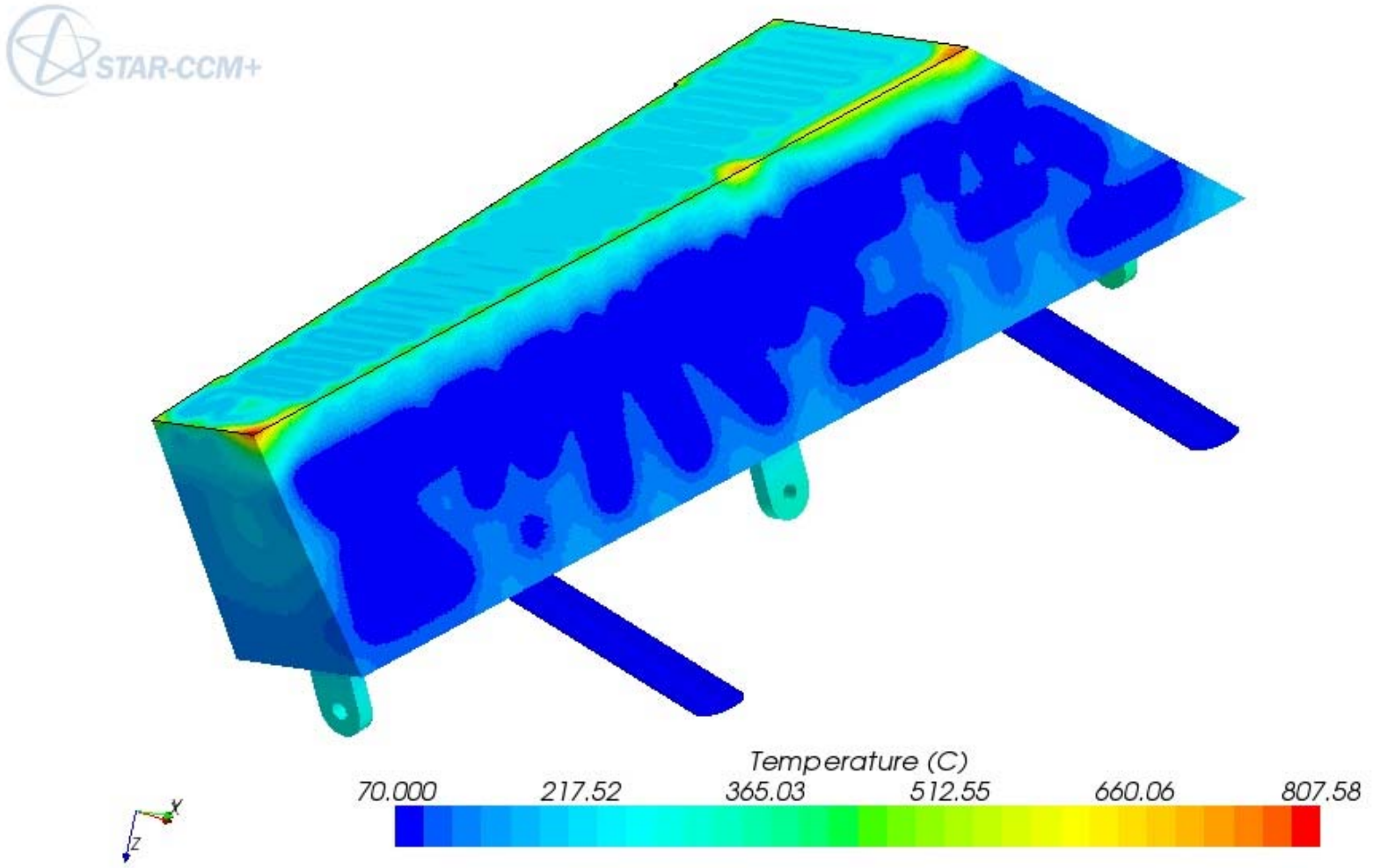
Velocity distribution cutplane



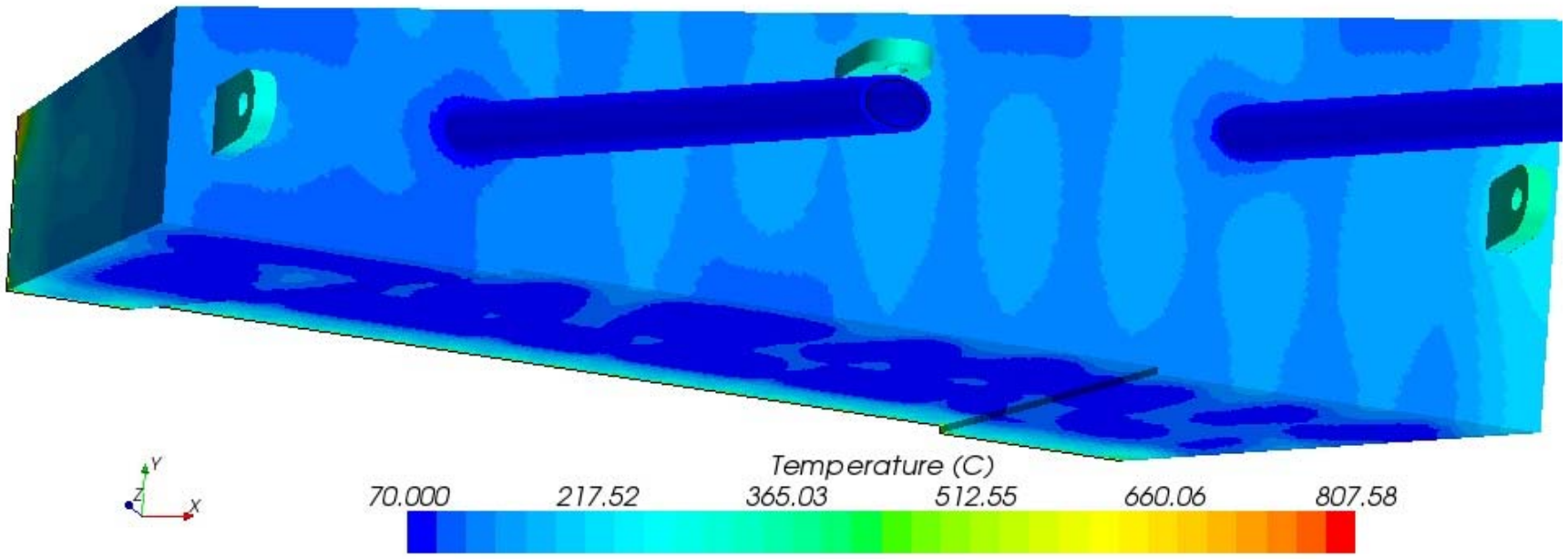
Nuclear heating profile – λ=16 cm



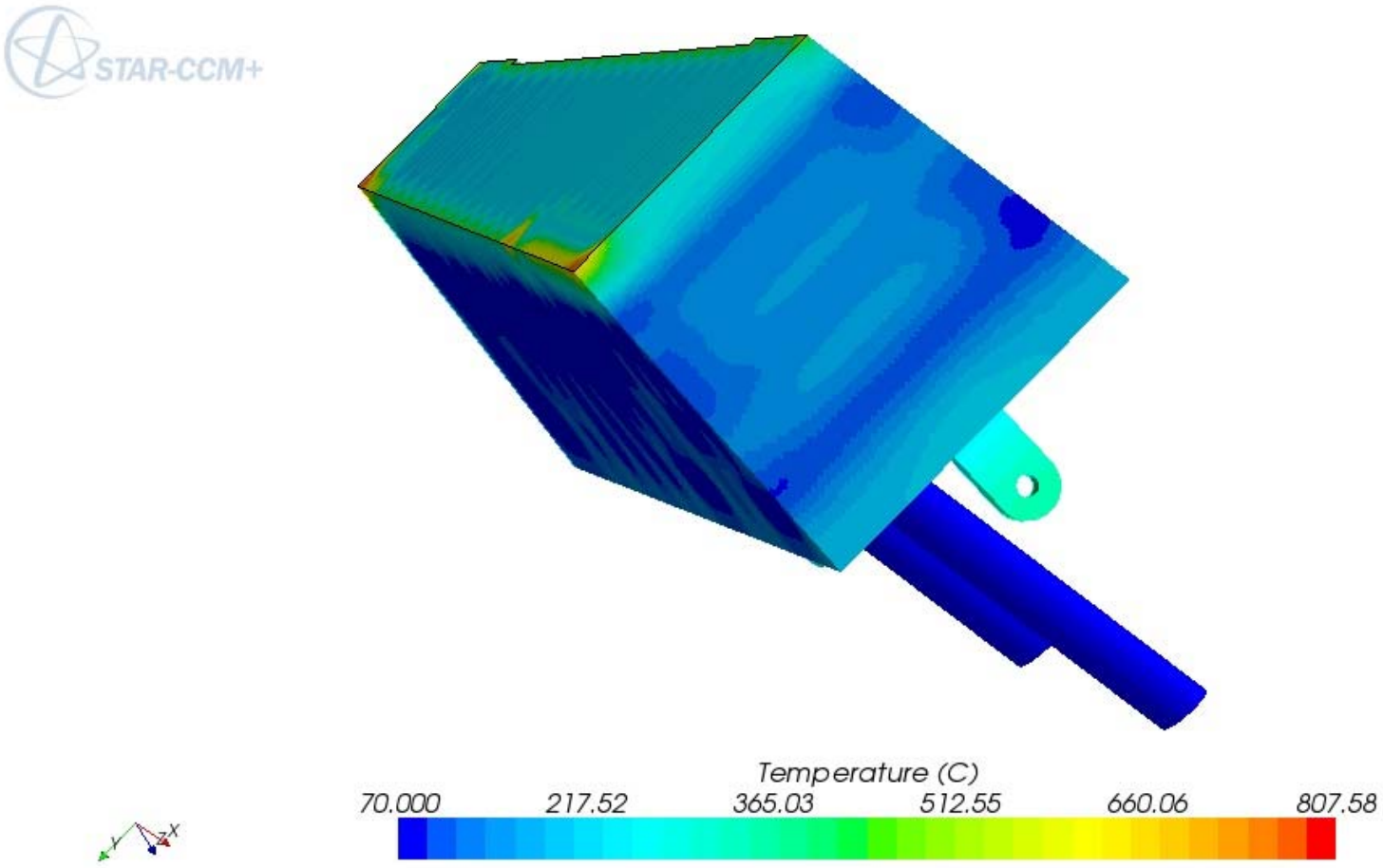
Most surface temperatures are acceptable



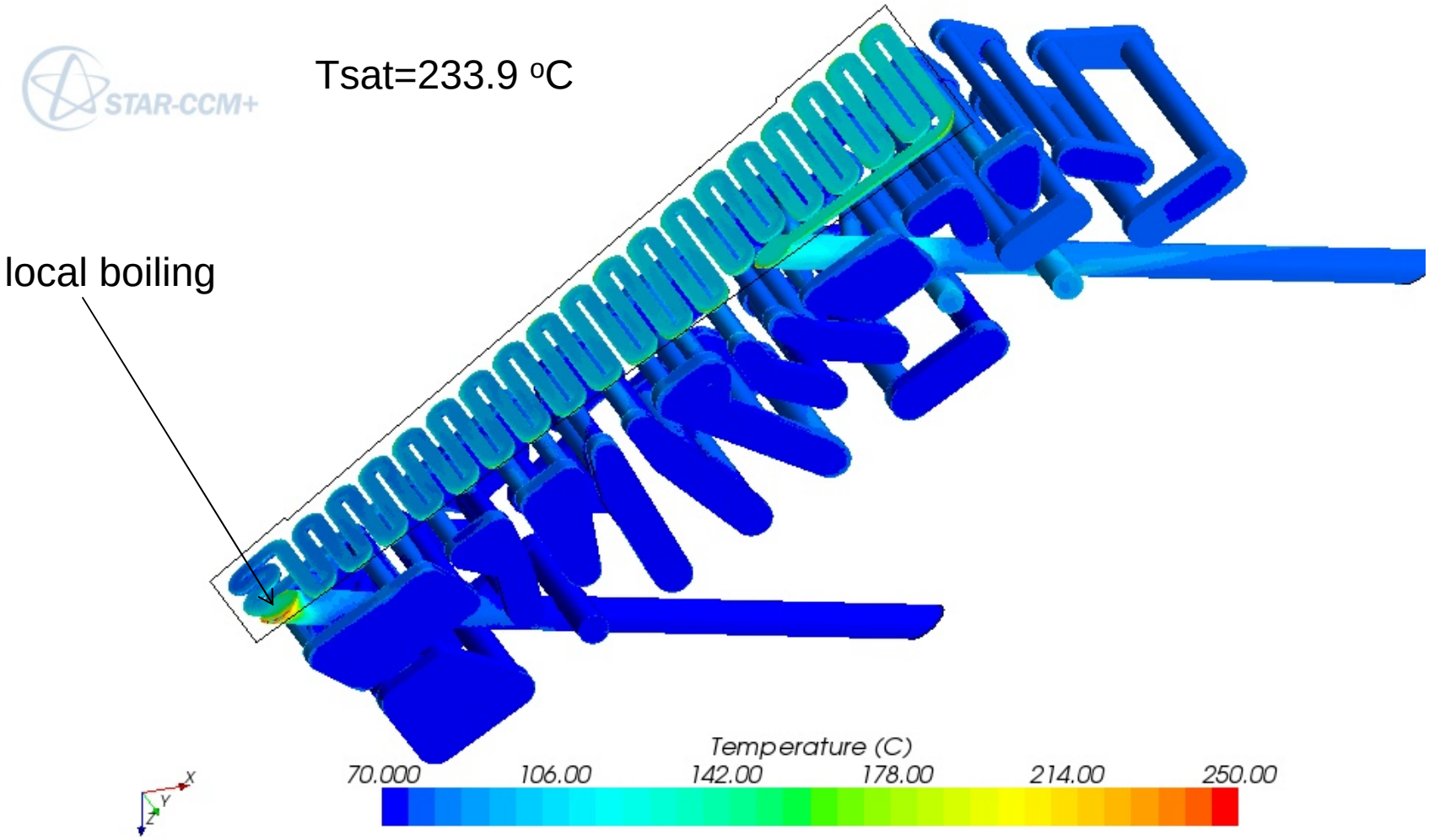
Mounting tabs at 356 °C



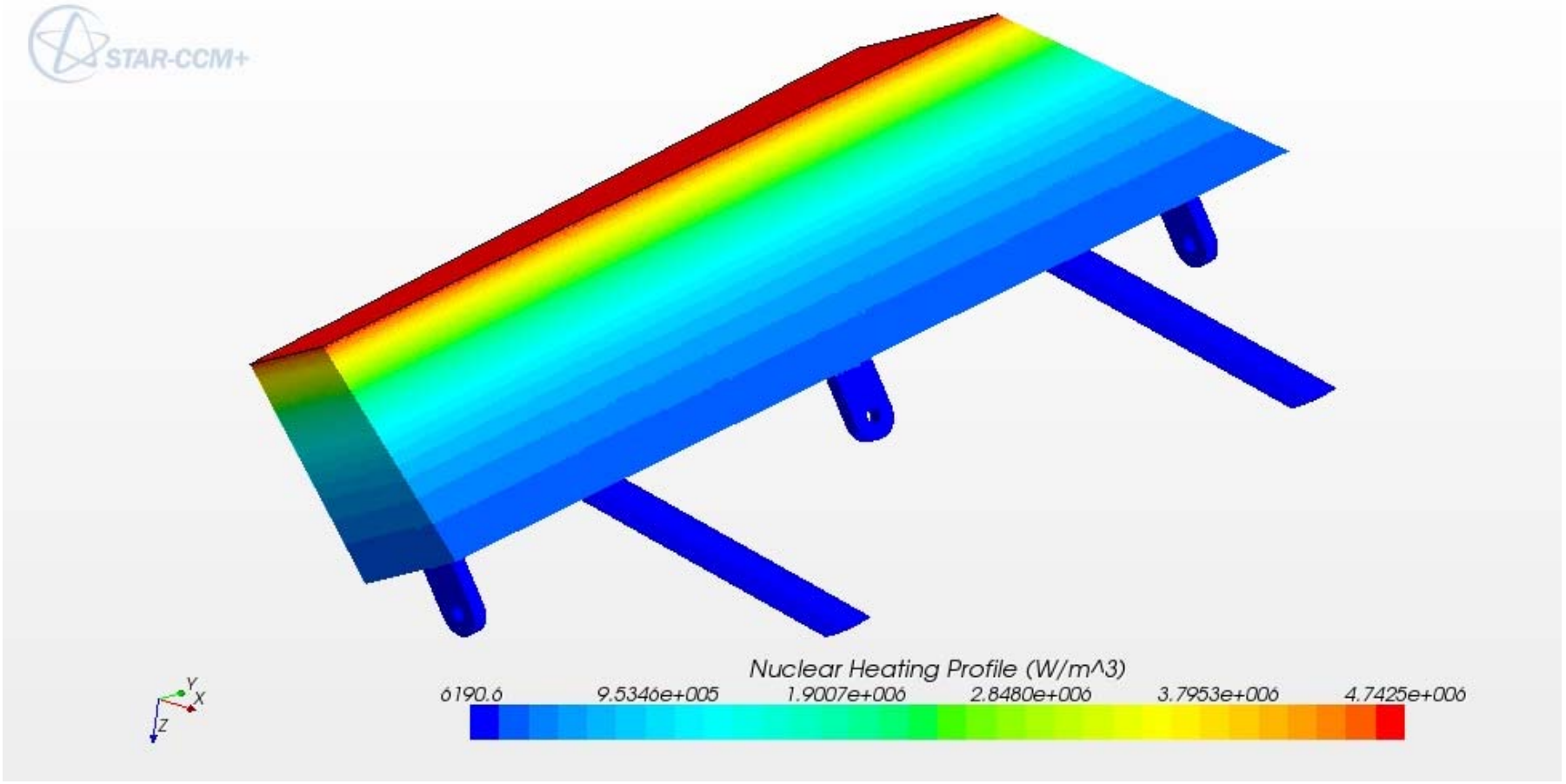
Temperatures along top edges are high.



Coolant temperature distribution

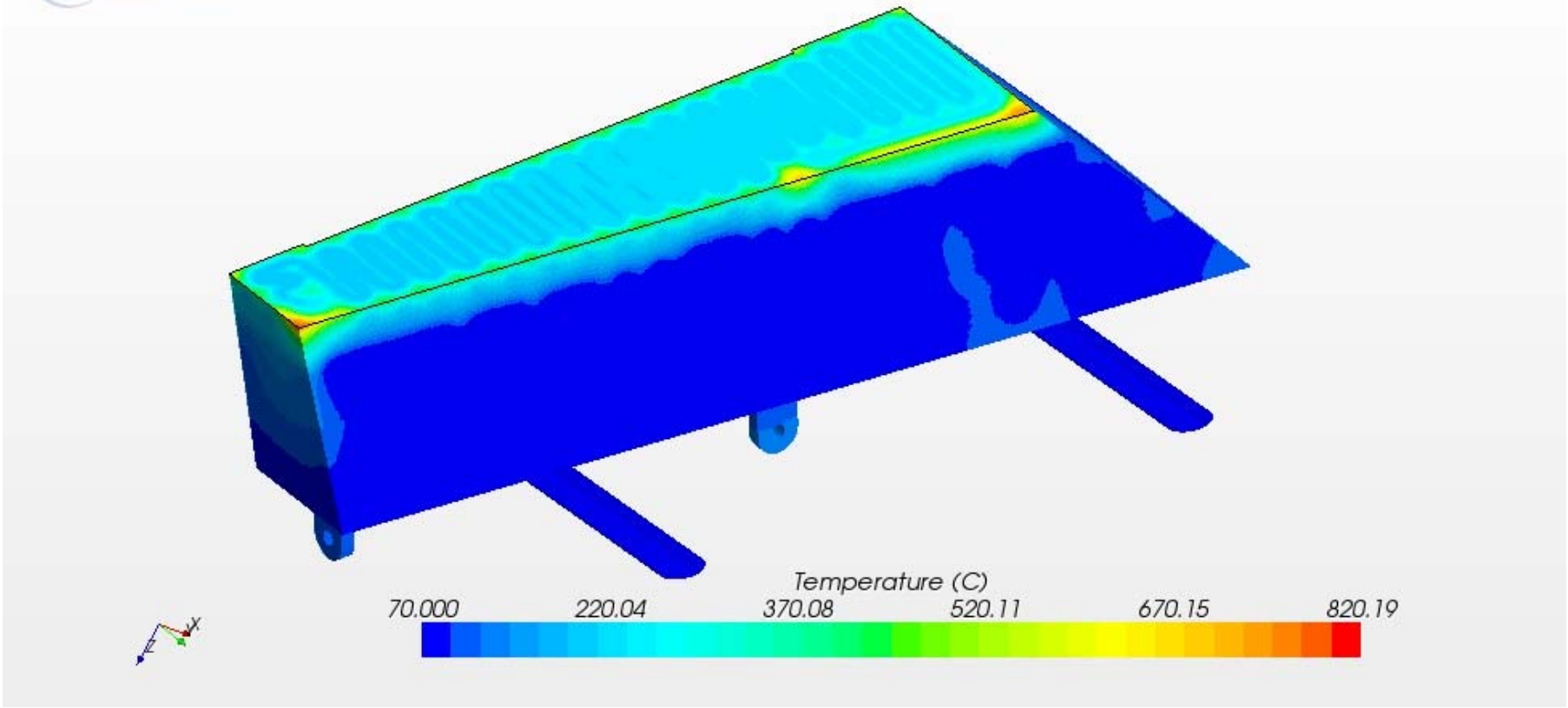


Nuclear heating profile – λ=9 cm



Temperatures are modest.

Although overall temperatures are low, possible thermal stress issues exist near plasma facing side.



summary

- DFW Upper18 pressure drop ~ 0.5 MPa at 3.5 kg/s.
- DFW Upper18 mounting tabs at acceptable temperatures for both λ=16 (356 ^{o}C) and λ=9 cm (128 ^{o}C).
- DFW Upper18 plasma facing edges are hot
- Very localized boiling due to cavitation at inlet bend. Delta-T in coolant=18.9 ^{o}C
- Thermal loads exported to Abaqus for thermal stress analysis