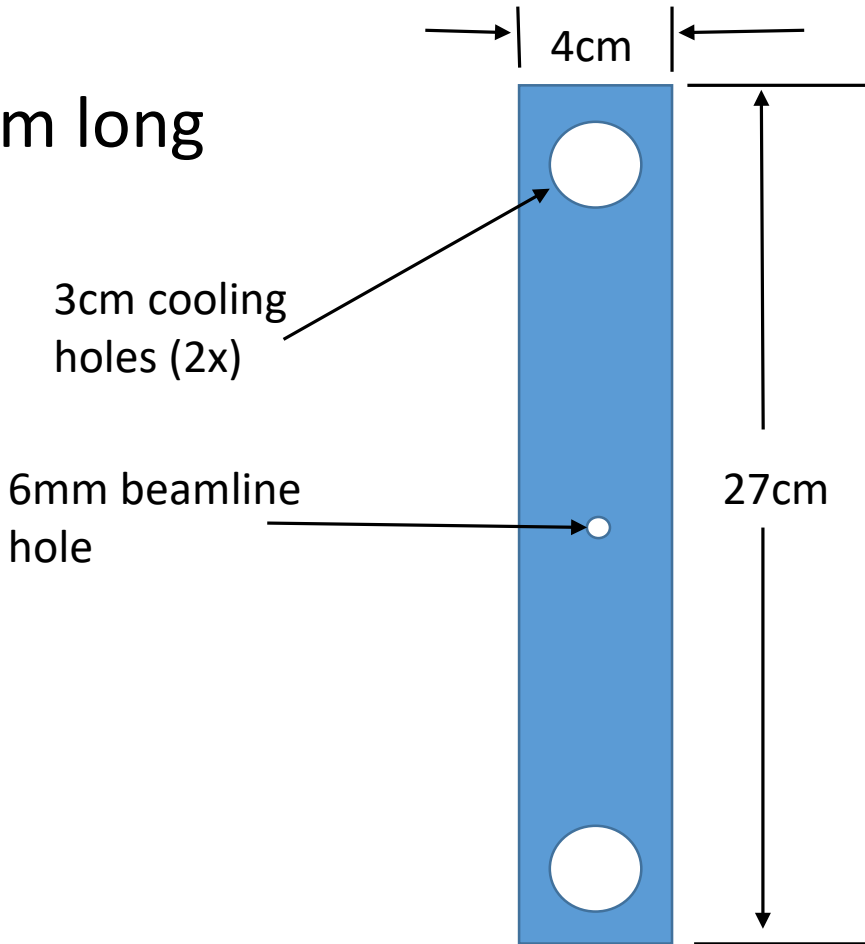
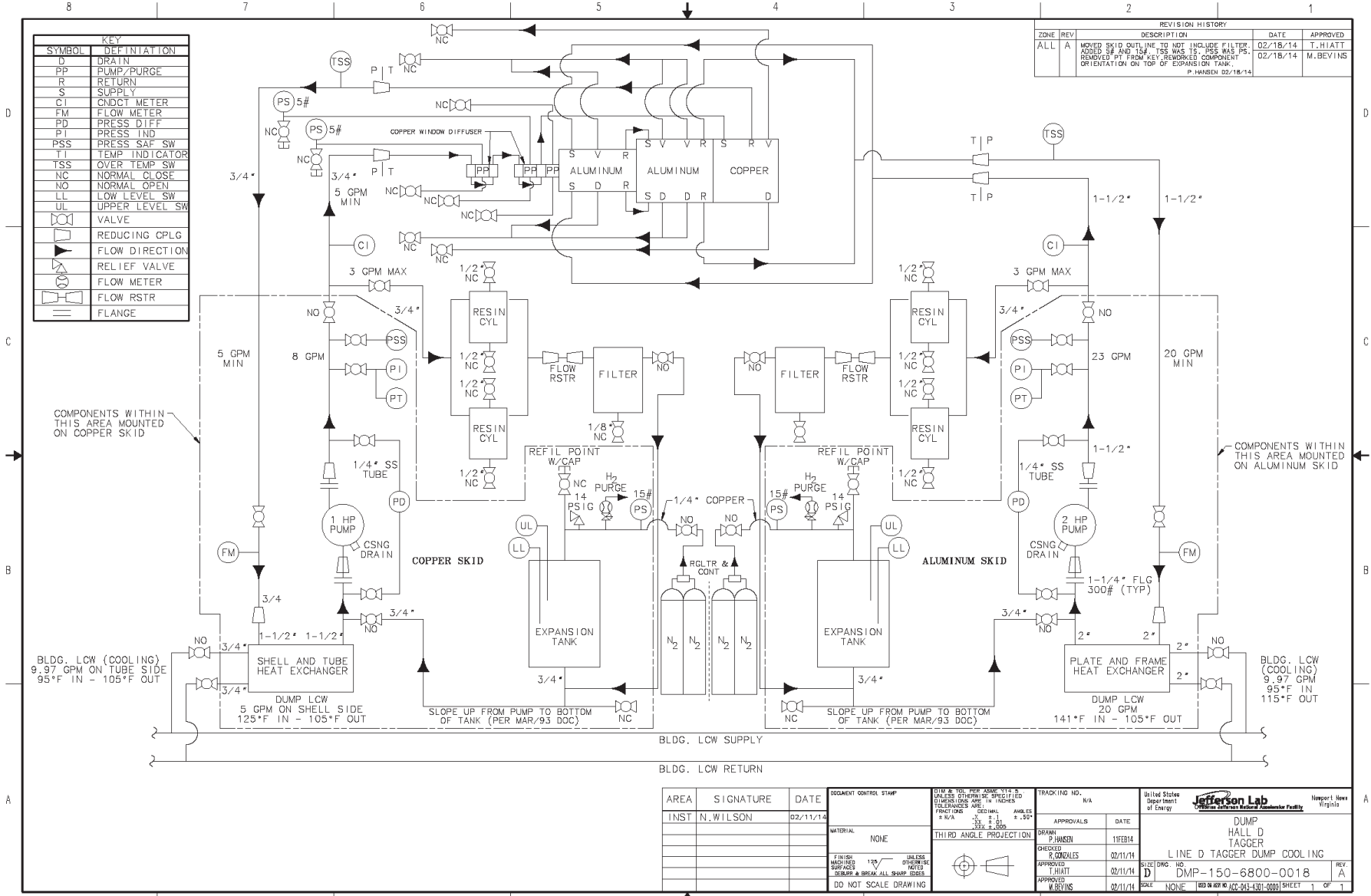


KLF CPS Copper Absorber v1

- 3m long



Existing Tagger Dump P&ID



KEY	
SYMBOL	DEFINITION
D	DRAIN
PP	PUMP/PURGE
R	RETURN
S	SUPPLY
CI	CNDCT METER
FM	FLOW METER
PD	PRESS DIFF
PI	PRESS IND
PSS	PRESS SAF SW
TI	TEMP INDICATOR
TSS	OVER TEMP SW
NC	NORMAL CLOSE
NO	NORMAL OPEN
LL	LOW LEVEL SW
UL	UPPER LEVEL SW
Valve Symbol	VALVE
Reducing Cplg Symbol	REDUCING CPLG
Flow Direction Symbol	FLOW DIRECTION
Relief Valve Symbol	RELIEF VALVE
Flow Meter Symbol	FLOW METER
Flow Rstr Symbol	FLOW RSTR
Flange Symbol	FLANGE

REVISION HISTORY				
ZONE	REV	DESCRIPTION	DATE	APPROVED
ALL	A	MOVED SKID OUTLINE TO NOT INCLUDE FILTER. ADDED SF AND 15# TSS WAS 15". PSS WAS PS. REVISED PT FROM KEY. REWORKED COMPONENT ORIENTATION ON TOP OF EXPANSION TANK.	02/18/14	T. HIATT
			02/18/14	M. BEVINS

COMPONENTS WITHIN THIS AREA MOUNTED ON COPPER SKID

COMPONENTS WITHIN THIS AREA MOUNTED ON ALUMINUM SKID

BLDG. LCW (COOLING)
9.97 GPM ON TUBE SIDE
95°F IN - 105°F OUT

DUMP LCW
5 GPM ON SHELL SIDE
125°F IN - 105°F OUT

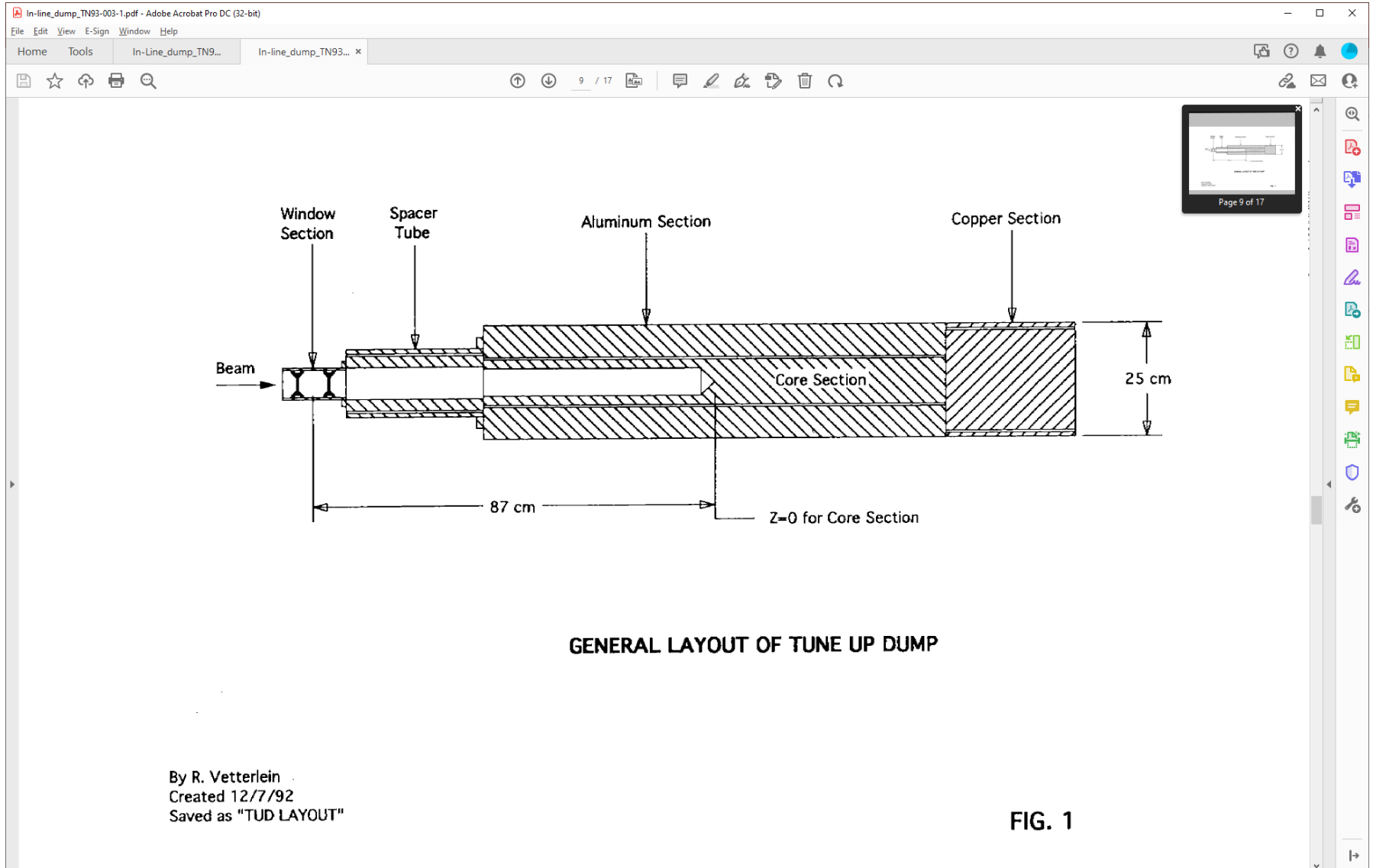
BLDG. LCW (COOLING)
9.97 GPM
95°F IN
115°F OUT

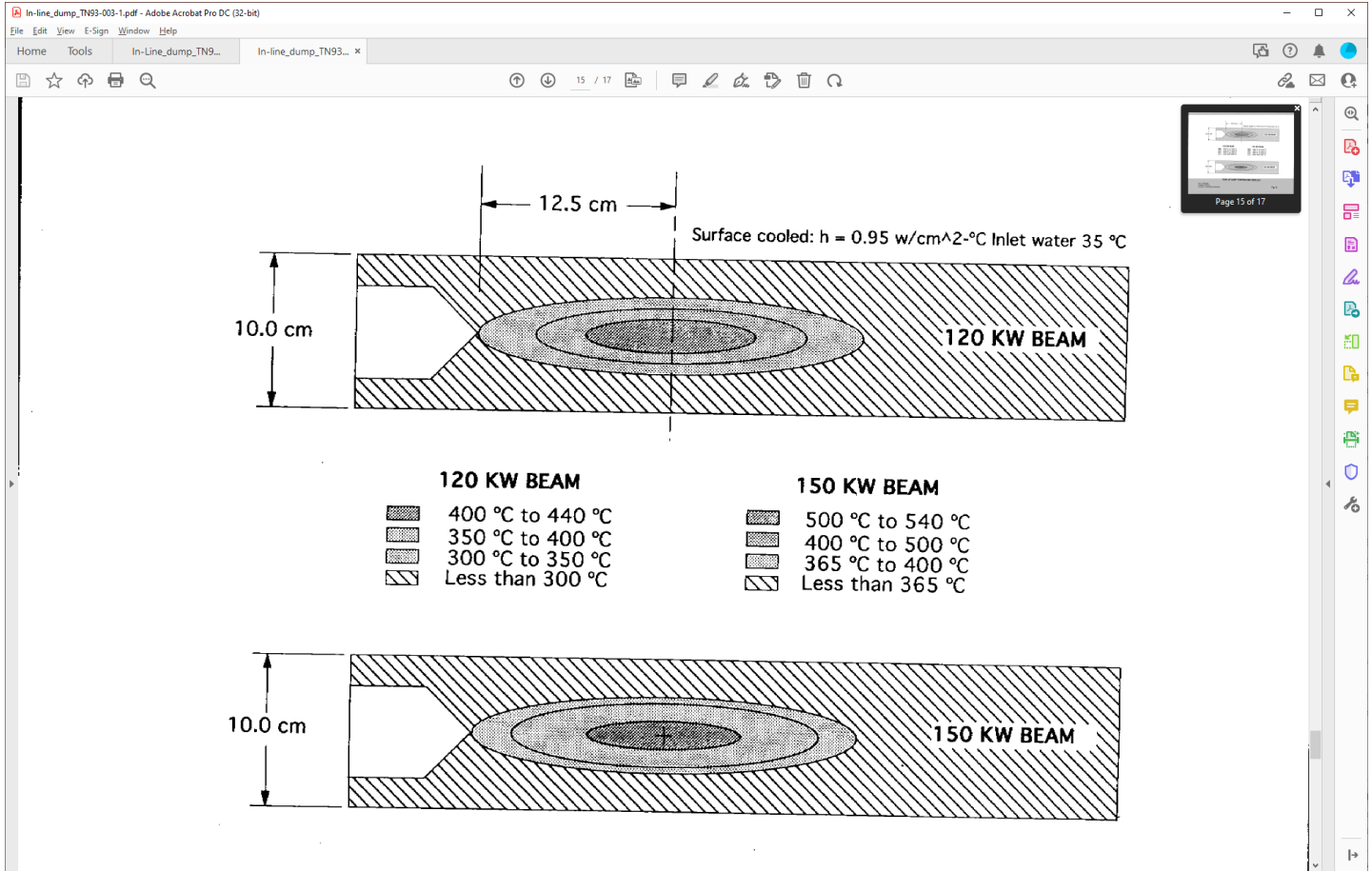
AREA	SIGNATURE	DATE	DOCUMENT CONTROL STAMP
INST	N. WILSON	02/11/14	
MATERIAL	NONE		
<small>F FINISH UNLESS OTHERWISE NOTED</small> <small>W MACHINES 125° UNLESS OTHERWISE NOTED</small> <small>SURFACES & BREAK ALL SHARP EDGES</small> <small>DO NOT SCALE DRAWING</small>			

DRAWING CONTROL		TRACKING NO.	
DATE	BY	NO.	REV.
02/11/14	N. WILSON	111111	1
02/11/14	T. HIATT		
02/11/14	M. BEVINS		

United States Department of Energy	Jefferson Lab <small>Thomas Jefferson National Accelerator Facility</small>	Project Name Higgs
DUMP HALL D TAGGER LINE D TAGGER DUMP COOLING DMP-150-6800-0018 SHEET 1 OF 1		

Existing Tagger Dump





Water cooling

CPS Absorber cooling water_v1 - tanabe [Compatibility Mode] - Excel

File Home Insert Page Layout Formulas Data Review View Acrobat Tell me what you want to do... Timothy Whitlatch Share

A29

KLing CPS 45KW total, 2 circuits LCW

Units Units Units

d 30 mm 0.098425 ft 0.03 M ID of tube

L 3 m 3000 mm

epsilon 0.000005 ft

nu 0.0000929 ft²/sec at 37°C

Power 45 kW 45000 W

Heat Exchange with water at DP row 28

Twater = 40.38222144 C average

Nud = 223 From Oliver &

K = 0.623 W/MK From White

Pr = 4.84 extrapolate from White ap

f = 0.023334503 friction factor

h = Nud K/D W/M² K

h = 4630.966667

q = hA(Tw-Twall) = mCpdeltaT

A = piDL use L for area inside cool

Twall = 91.93341443

$$v = -2 \sqrt{\frac{2g\Delta P d}{0.433 L}} \log_{10} \left(\frac{\epsilon}{3.7d} + \frac{2.51}{\frac{d}{v} \sqrt{\frac{2g\Delta P d}{0.433 L}}} \right)$$

$$\frac{1}{\sqrt{f}} = -2 \log_{10} \left(\frac{\epsilon}{3.7d} + \frac{2.51}{\frac{d}{v} \sqrt{\frac{2g\Delta P d}{0.433 L}}} \right)$$

$$q \left(\frac{\text{gpm}}{\text{circuit}} \right) = v \frac{\pi d^2}{4}$$

$$= v \left(\frac{\text{ft}}{\text{sec}} \right) \frac{\pi d^2 (\text{ft}^2)}{4} \times \frac{\text{gal}}{0.1337 \text{ ft}^3} \times 60 \frac{\text{sec}}{\text{min}}$$

P=mCpdeltaT
3.8 factor= 1kg/s=15.83gpm
Cp = 4.18 KJ/Kg*K
KW=KJ/s=(kg/s)(kj/kg*K)

$$Re = \frac{vd}{\nu}$$

$$\Delta T = \frac{3.8P}{q}$$

DeltaP (psi)	$\sqrt{\frac{2g\Delta P d}{0.433 L}}$ (ft/sec)	$\frac{\epsilon}{3.7d} + \frac{2.51}{\frac{d}{v} \sqrt{\frac{2g\Delta P d}{0.433 L}}}$ (no units)	f (no units)	v (ft/sec)	Re	q (gpm)	DT (deg.C)	V	DP	h
0.14	0.45631317	0.000533	6.546688	0.023332	2.98734	31650.11	10.20016002	16.76444		
20	5.45398555	5.72E-05	8.485699	0.013888	46.28088	490334.2	158.0243164	1.082112		
0.04	0.24390965	0.000985	6.0131	0.027657	1.46653	15538.82	5.00783143	34.14652	1.466653	0.04
20	5.45398555	5.72E-05	8.485699	0.013888	46.28088	490334.2	158.0243164	1.082112	46.28088	20
40	7.71310034	4.44E-05	8.704354	0.013199	67.13756	711305.4	229.2386574	0.745947	67.13756	40
45	8.18097833	4.27E-05	8.739381	0.013093	71.49669	757489.3	244.1227395	0.700467	71.49669	45
50	8.62350834	4.12E-05	8.770157	0.013001	75.62952	801275.7	258.2341515	0.66219	75.62952	50
55	9.04441185	3.99E-05	8.797536	0.01292	79.56854	843008.6	271.6837828	0.629408	79.56854	55
60	9.44658008	3.88E-05	8.822143	0.012848	83.33908	882956.5	284.5581496	0.600932		
65	9.83231229	3.78E-05	8.844448	0.012784	86.96137	921333.7	296.9263142	0.5759		
70	10.2034727	3.69E-05	8.864811	0.012725	90.45186	958314.6	308.8444628	0.553677		
75	10.5615976	3.62E-05	8.88352	0.012672	93.82416	994043.2	320.3590438	0.533776		
80	10.9079711	3.54E-05	8.900799	0.012622	97.08966	1028640	331.5089849	0.515823		
85	11.2436793	3.48E-05	8.916836	0.012577	100.258	1062209	342.3272993	0.499522		
90	11.5696505	3.42E-05	8.931781	0.012535	103.376	1094836	352.8422756	0.484636		

2 para circuits air-n2 Hx

Fig. 7. Heat transfer results for the fully developed smooth tubes

Quick Hand Calc

$T_{wall} = 108^\circ\text{C}$
 Cooling hole T_2
 10 cm
 4 cm
 center T_1
 $q = 45000\text{ W}$

$q = \frac{\Delta T}{R} \quad R = \frac{l}{kA}$

$L = 10\text{ cm}$
 $k = 400\text{ W/m}^\circ\text{C}$
 $A = 4\text{ cm} \times 1\text{ m} = 0.04\text{ m}^2$

$R = \frac{1\text{ m}}{400\text{ W/m}^\circ\text{C} (0.04\text{ m}^2)} = 0.00625\text{ }^\circ\text{C/W}$

$\Delta T = qR = 281^\circ\text{C}$
 $T_1 = 381^\circ\text{C}$

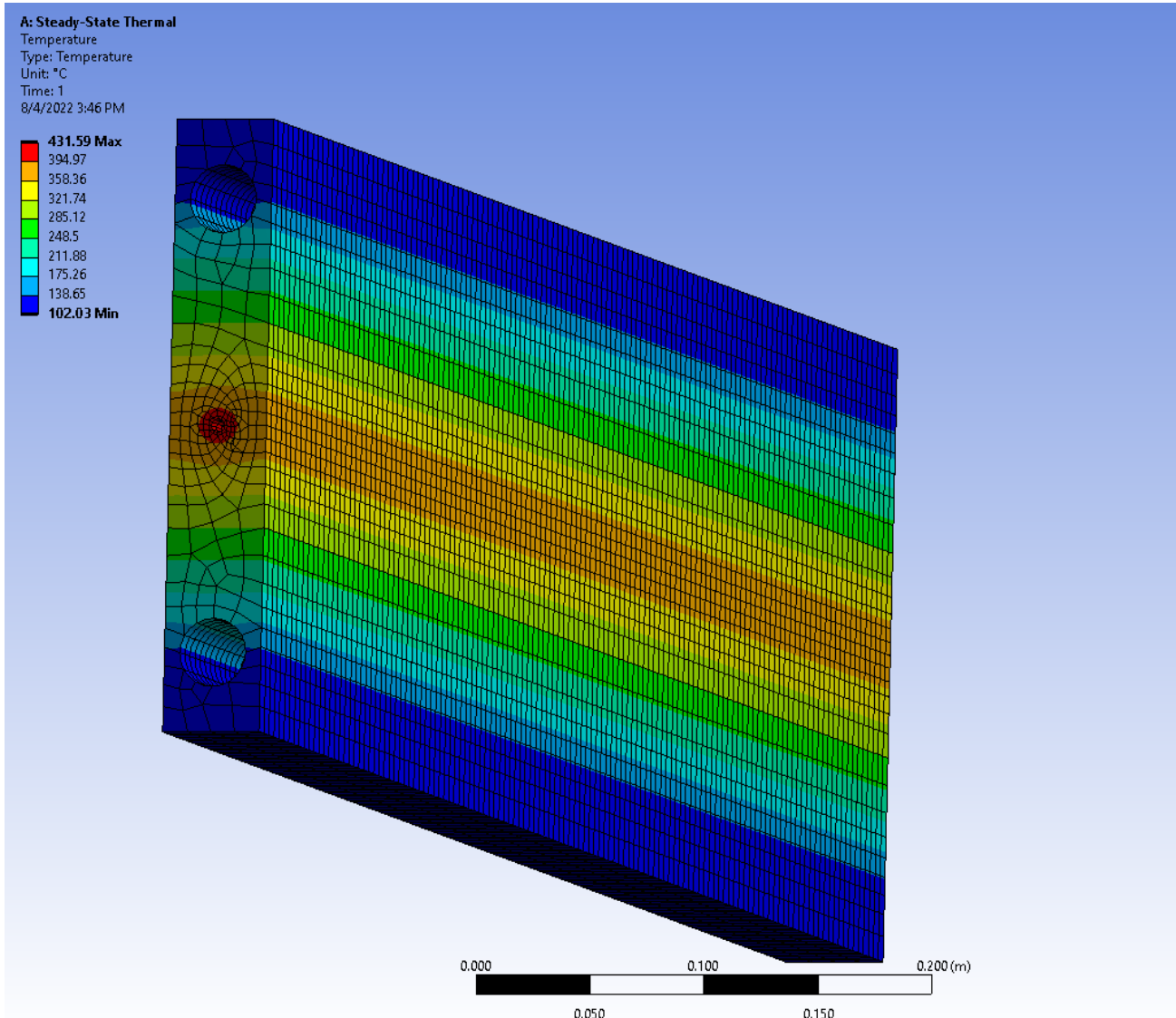
IF 90 kW $\Delta T = 562^\circ \Rightarrow T_1 = 662^\circ\text{C}$

90 kW/m 90 W/mm

0.6 cm hole $\frac{\pi \cdot 6}{2} = 9\text{ mm}$

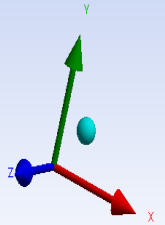
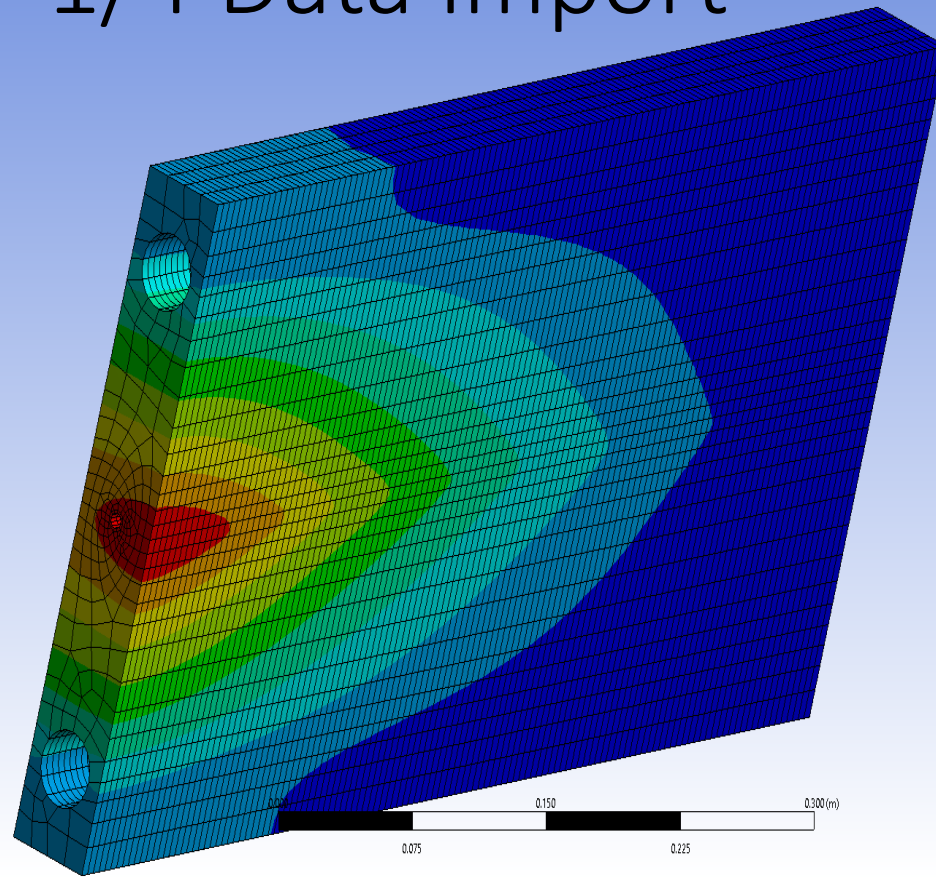
10 W/mm^3

90KW inner hole- 1m long – 5Kw/m² cooling inside 3cm holes



1/4 Data import

B: Steady-State Thermal
Temperature
Type: Temperature
Unit: °C
Time: 1
8/5/2022 1:02 PM



Graph window showing animation controls (20 Frames, 2 Sec (Auto), 3 Cycles) and a plot area with Y-axis labeled [°C] and X-axis labeled [s].

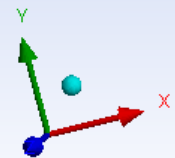
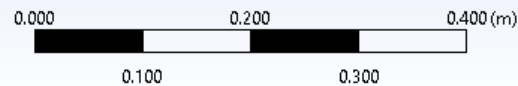
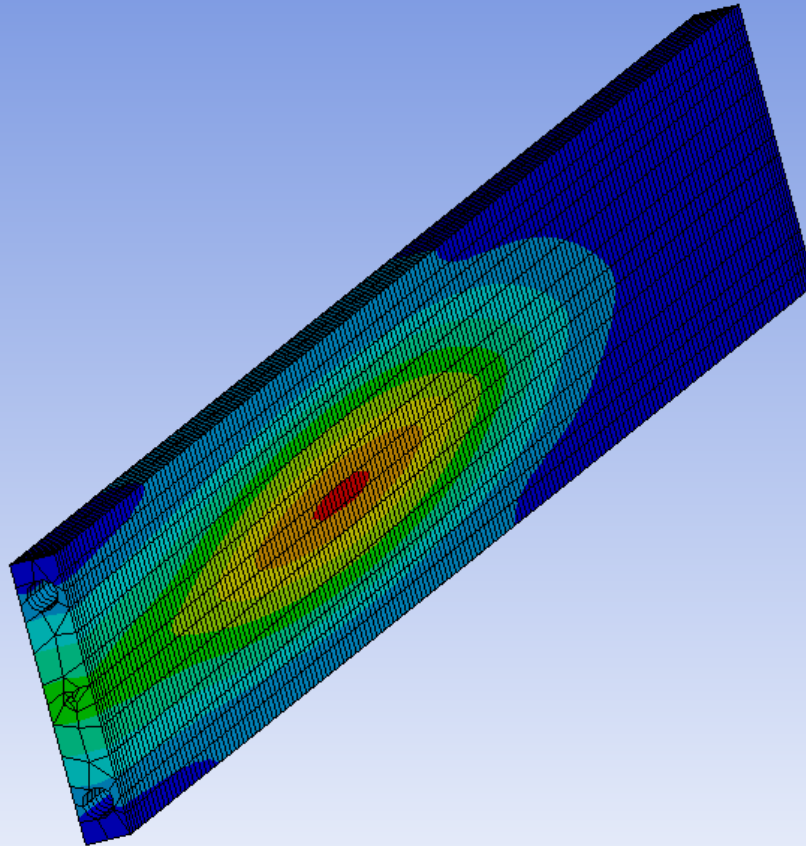
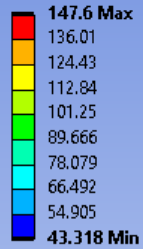
Summer Student Intern Final Presentations - Session 4
now
<https://jab-org.zoomgov.com/my/j75...>
Join Dismiss

All data imported (3.8M nodes – large mesh)

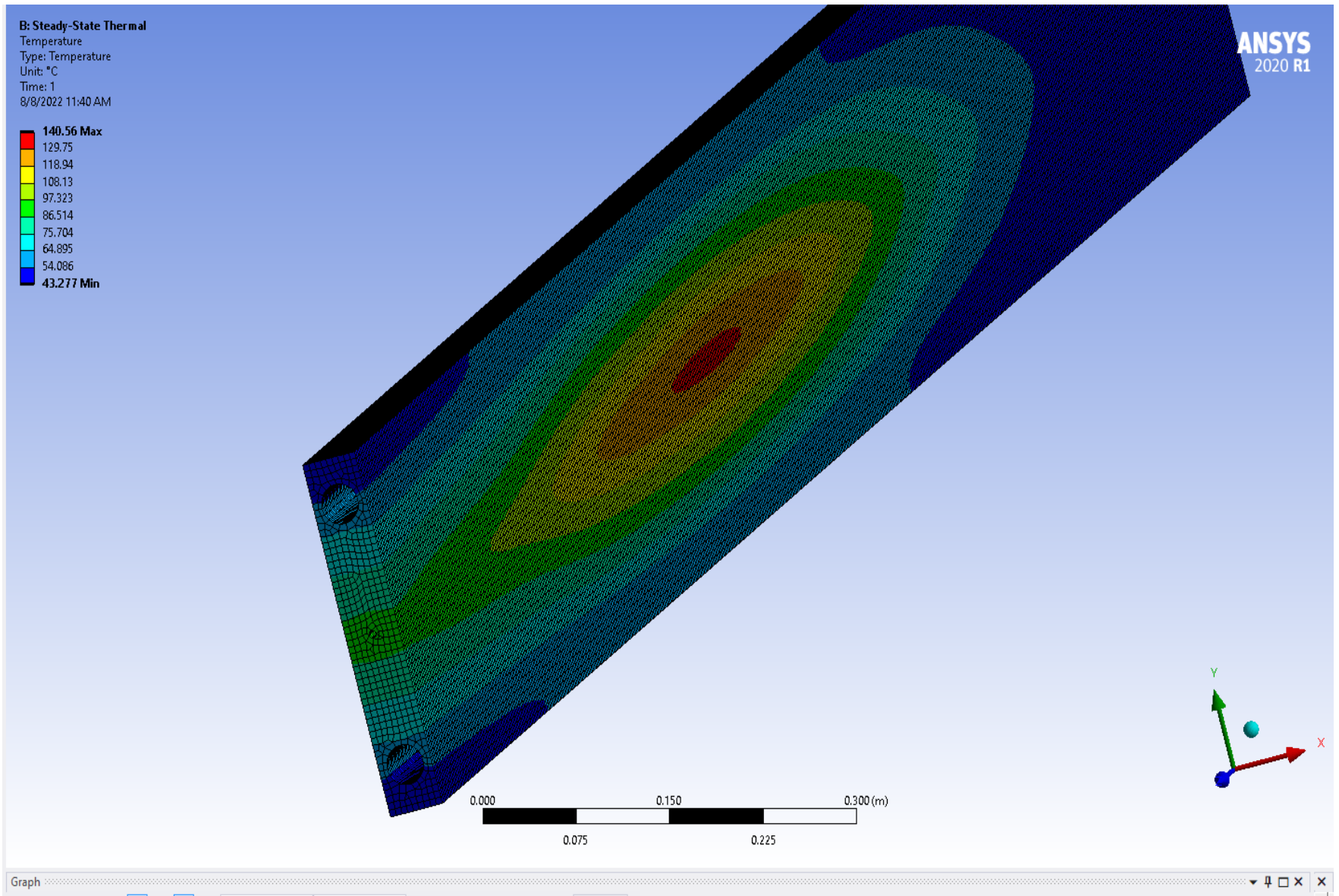
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Temperature
Type: Temperature
Unit: °C
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8/6/2022 2:02 PM

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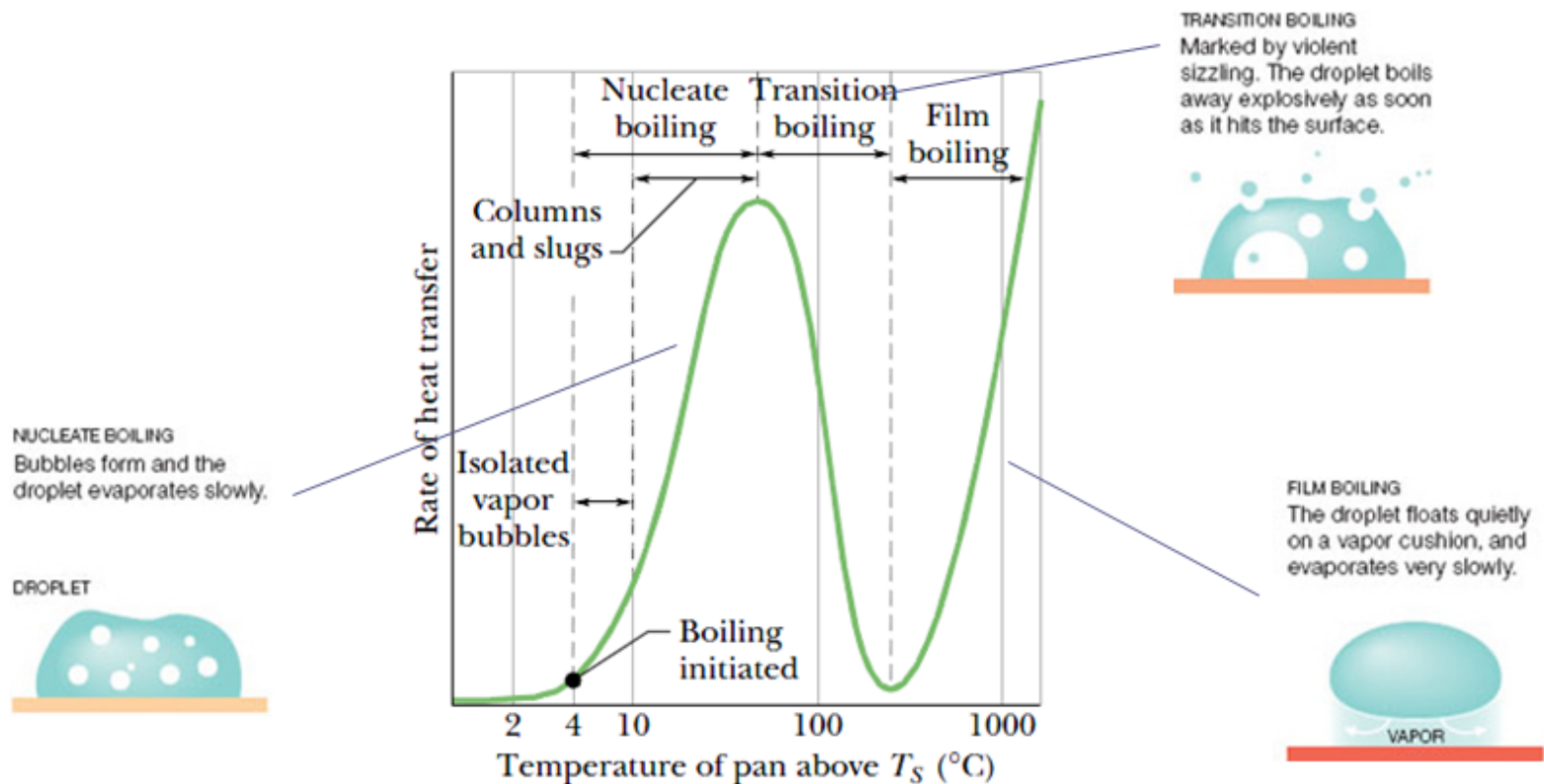
All data imported (3.8M nodes – smaller mesh – 42KW



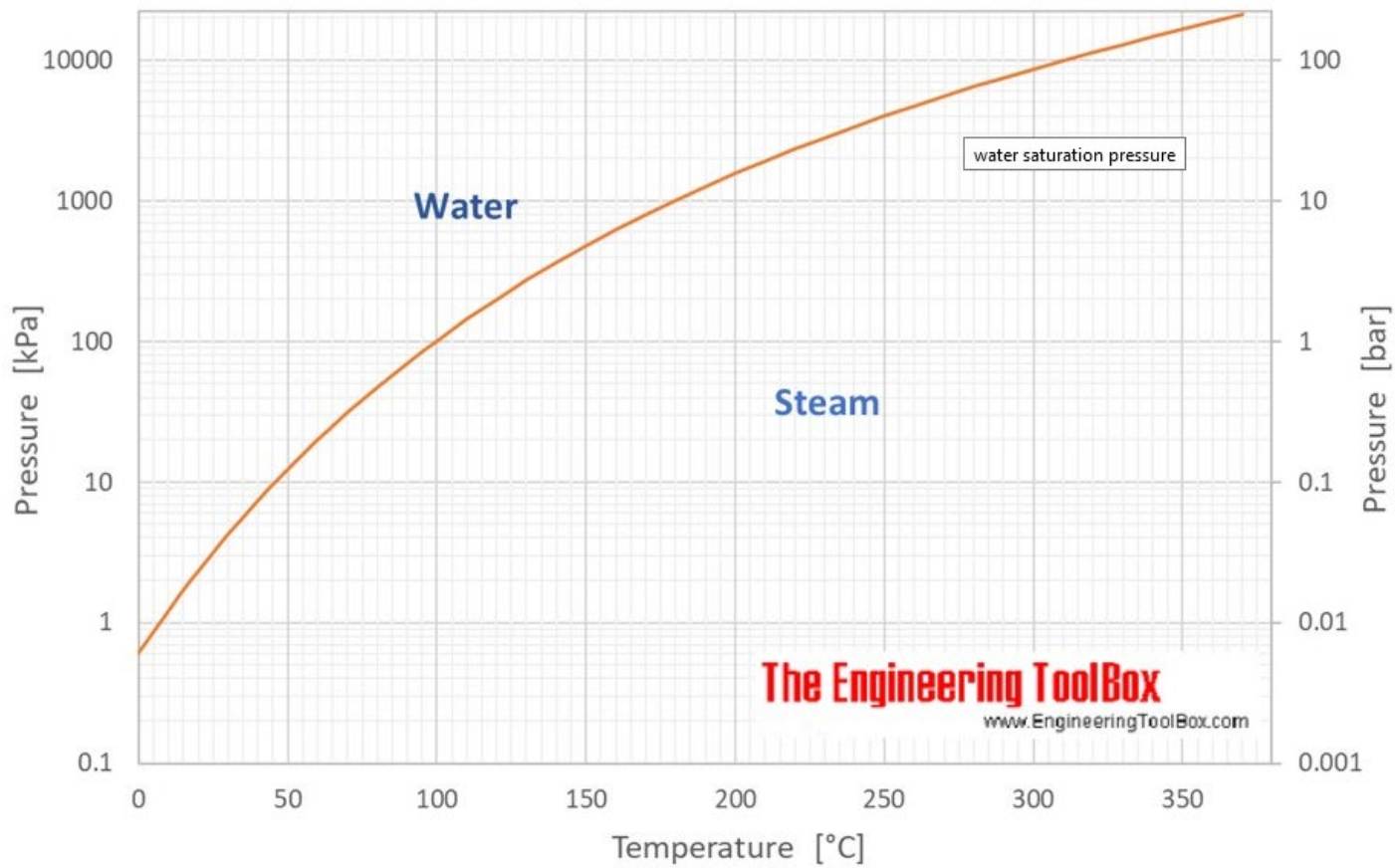
Generic Heat Transfer rate - water

Heat transfer for water (@ 1 atm)

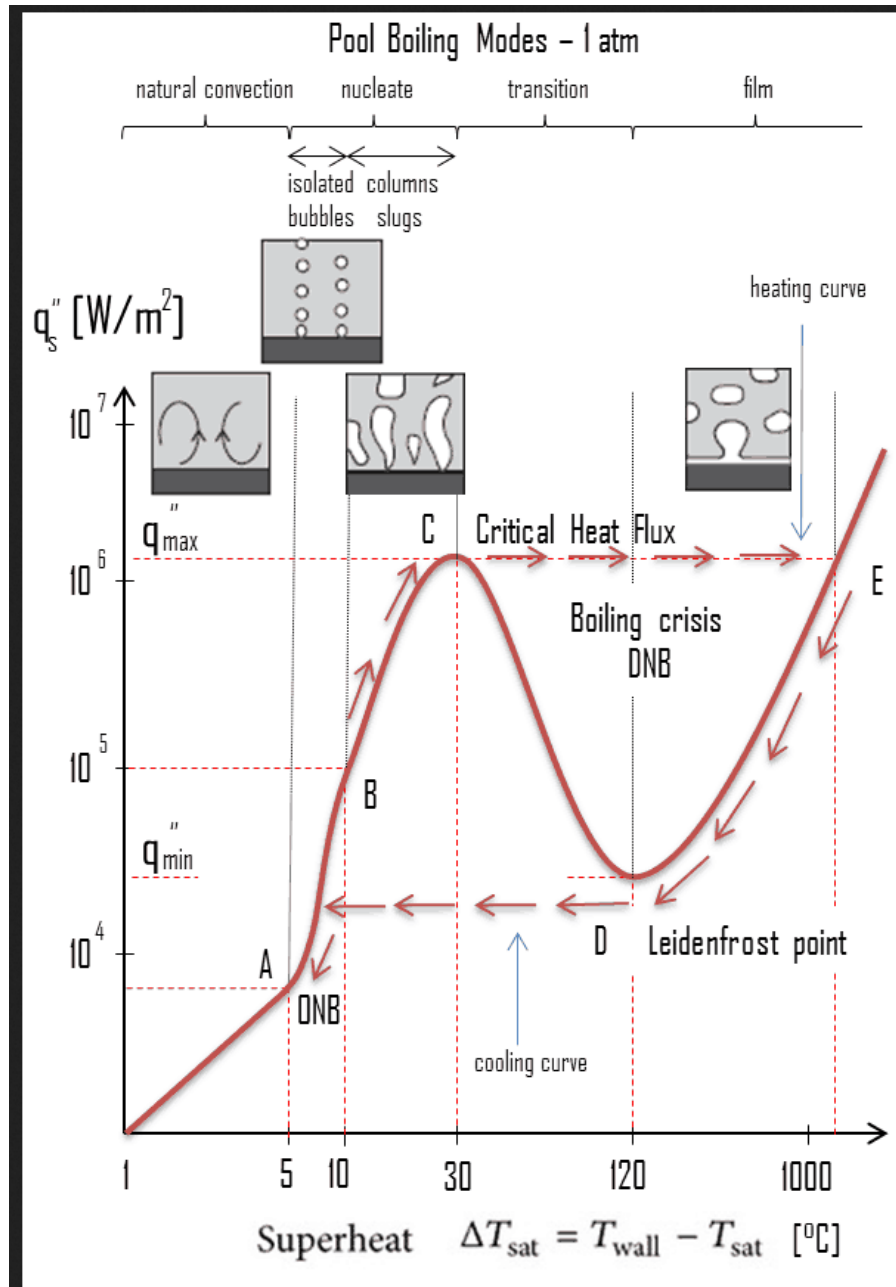
S-shaped graph when heat flux (q'') is compared to temperature.



Water saturation pressure



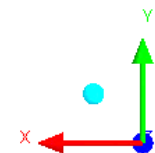
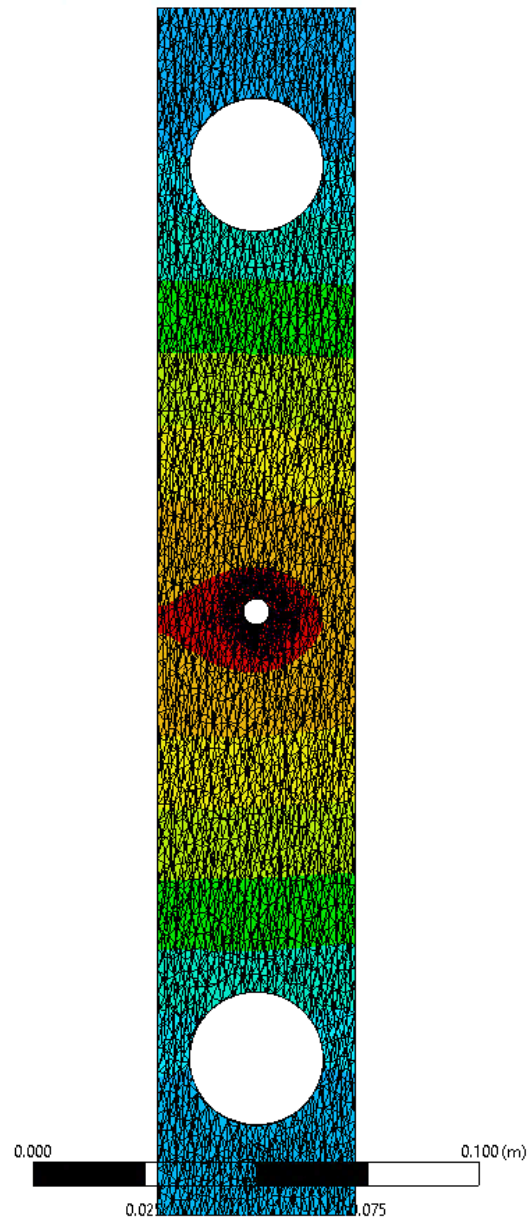
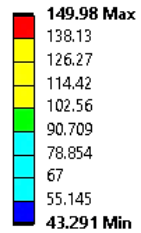
Nucleate Boiling



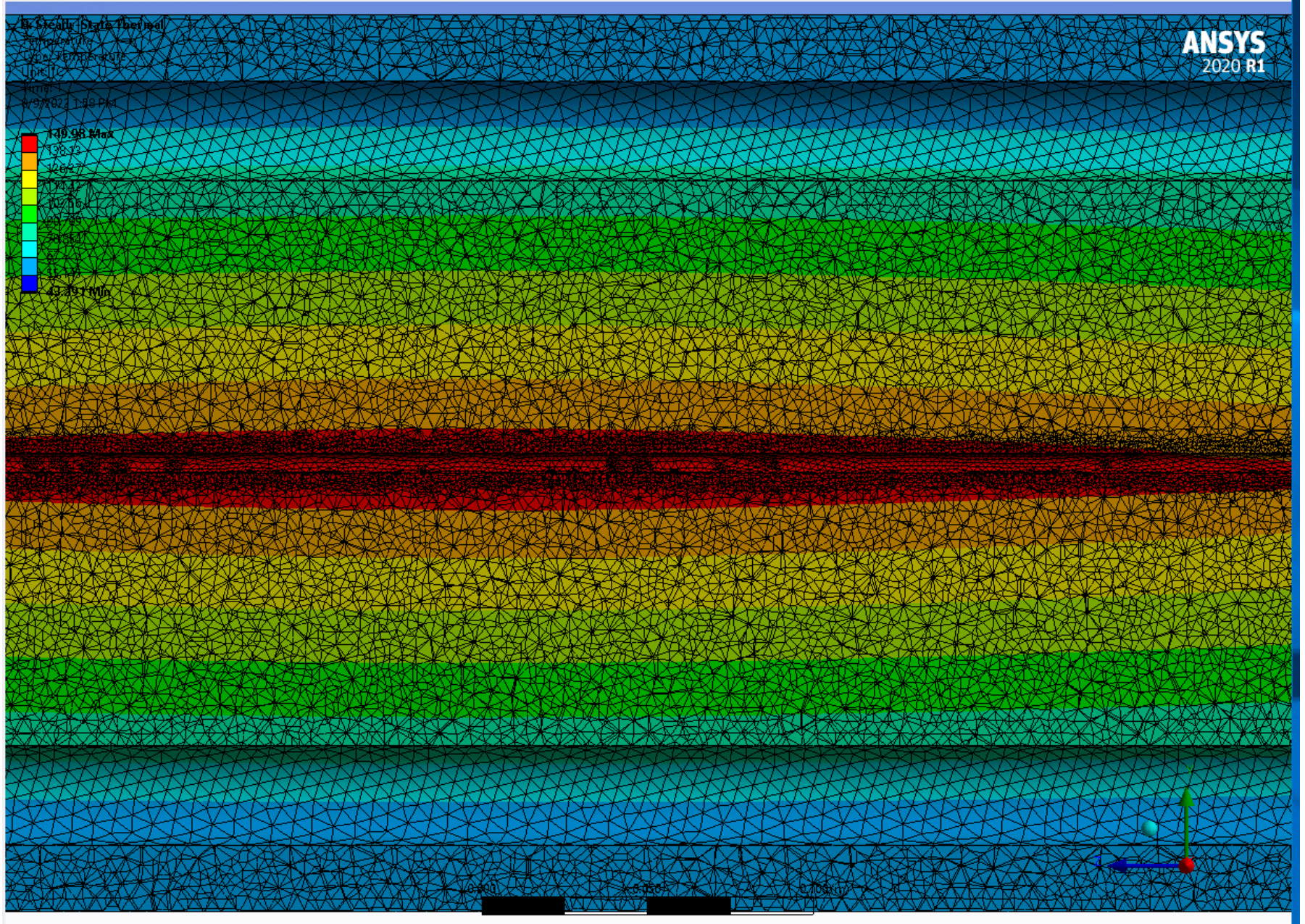
Refined mesh #2 inner hole

B: Steady-State Thermal

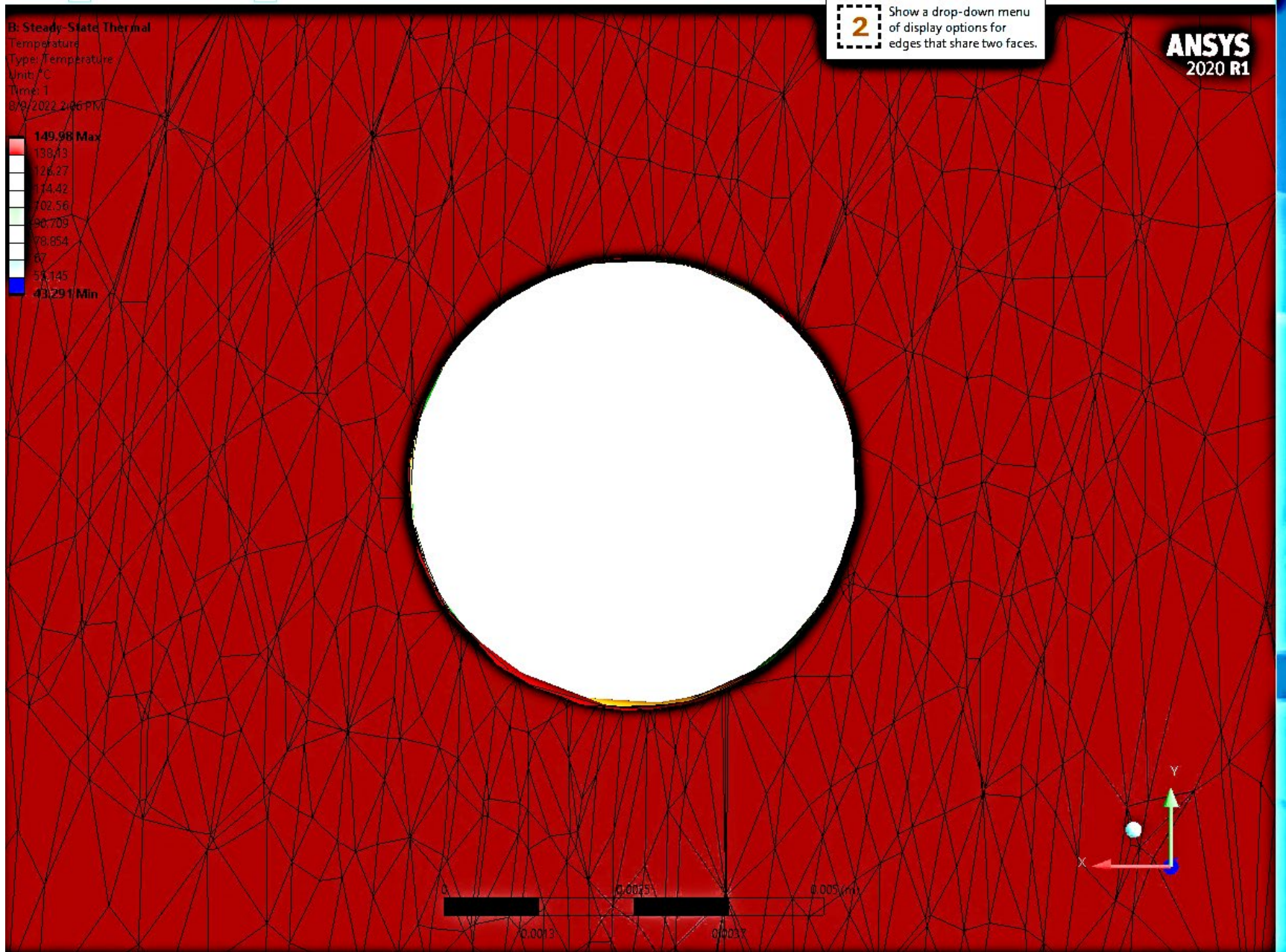
Temperature
Type: Temperature
Unit: °C
Time: 1
8/9/2022 1:42 PM



Refined mesh #2 inner hole



Refined mesh #2 inner hole



Refined Mesh 3– total 44.3KW

Comment

Verdana 2 (10 pt) **B** *I* U | [List Icon] [List Icon] | [Text Icon] [Color Icon] [Image Icon] | [Cut Icon] [Copy Icon] [Paste Icon]

Tue Aug 09, 2022 14:44:45

> Using multiple cores: [Yes]
< Number of cores requested: 24

Maximum source mesh bounding box length: 3.15 (m)
Maximum range used in sorting closest nodes: 0.063 (m)

Number of source nodes: 3754081
Number of target nodes: 5027818

Number of nodes mapped : 5027818
Number of nodes not mapped : 0
Number of nodes outside : 4668992

Percent nodes mapped: 100%
Weight calculation time: 193.857 (s)
Number of variables to interpolate: 1.
Interpolation time: 0.494 (s)

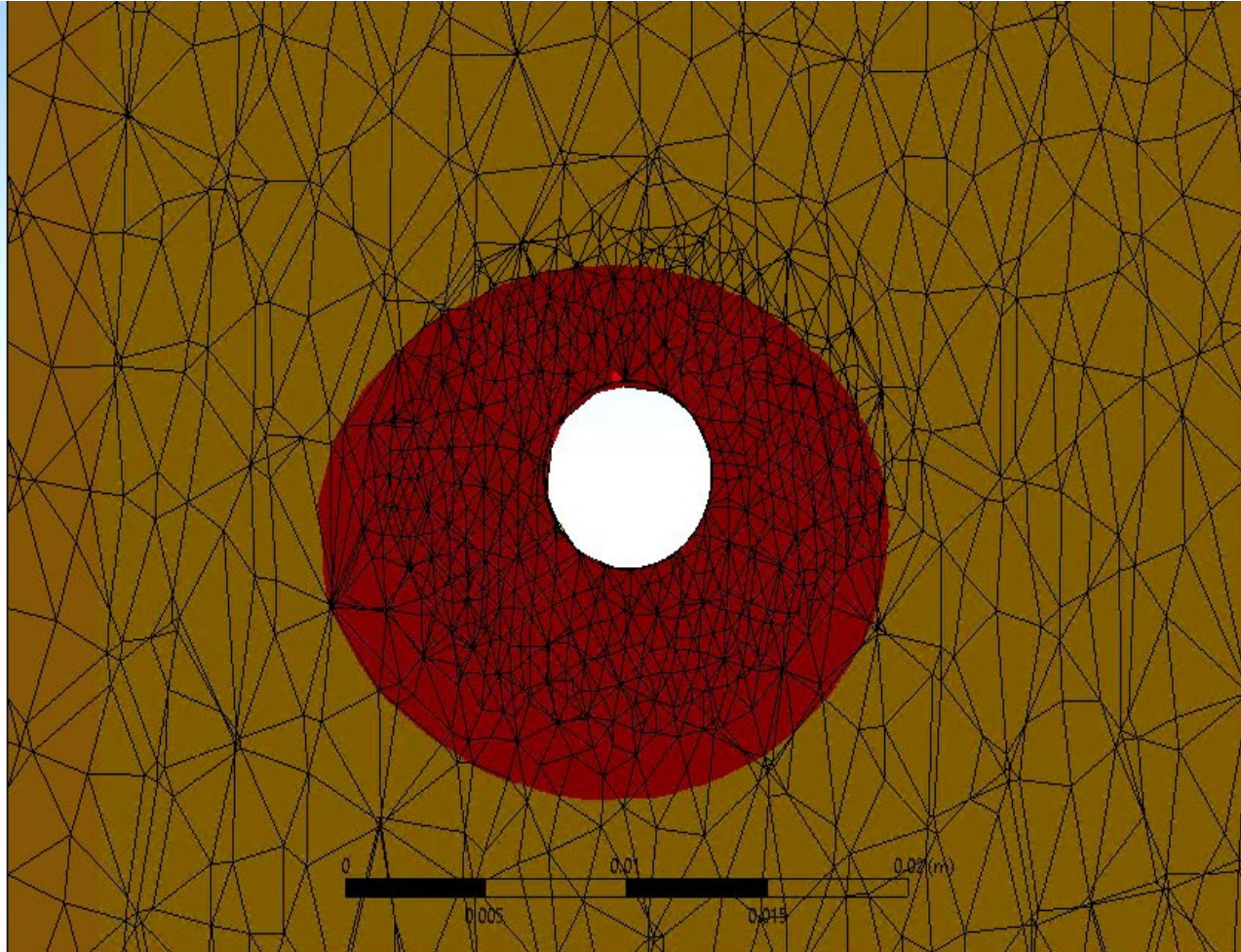
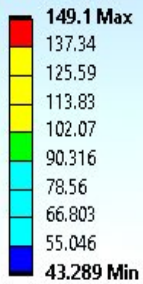
Results:

Row	Target
	Total Heat Rate (W)
1	44325

Note: Results reported do not include any Scale or Offset values specified in the worksheet.

Refined Mesh #3

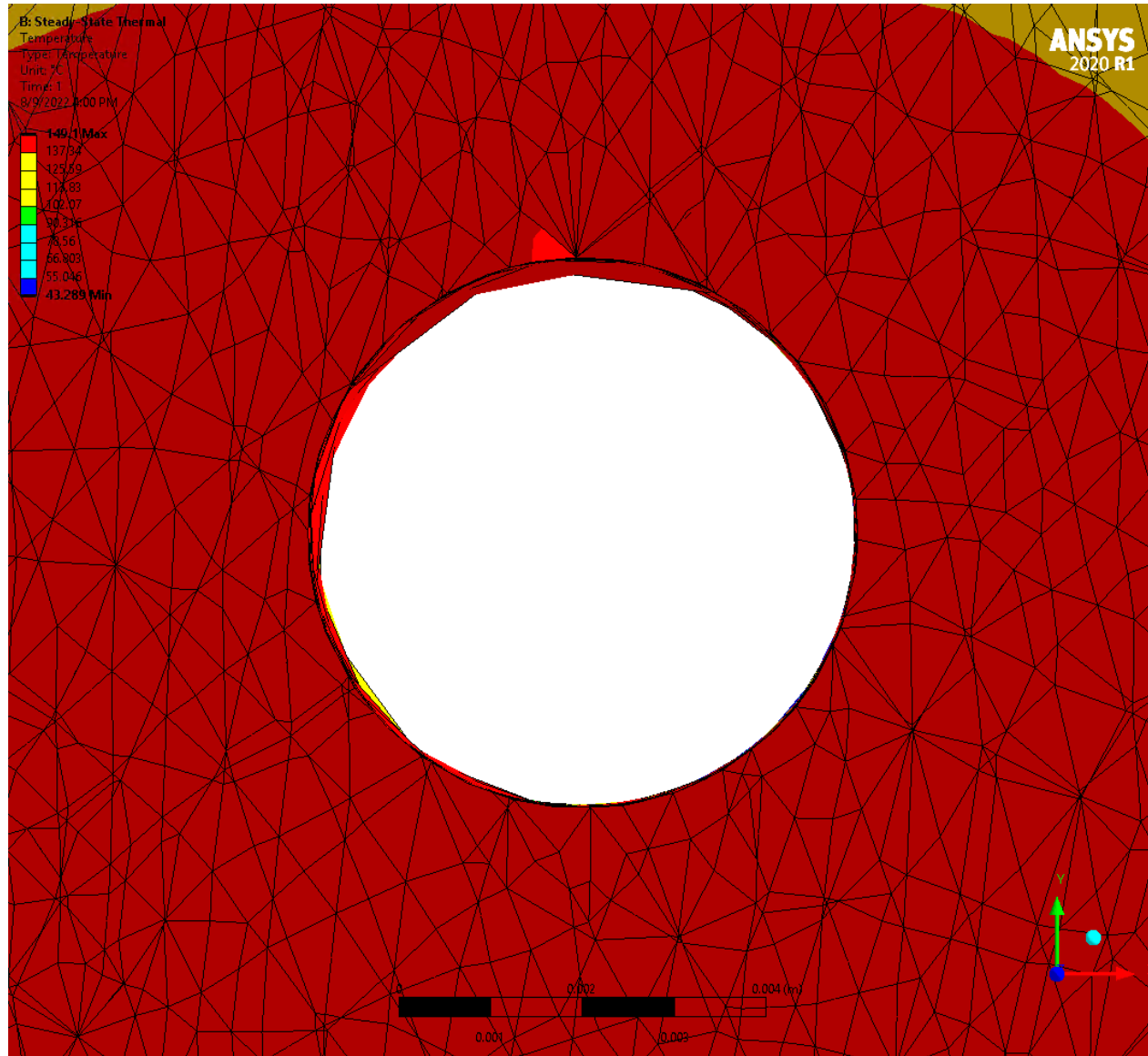
B: Steady-State Thermal
Temperature
Type: Temperature
Unit: °C
Time: 1
8/9/2022 3:45 PM



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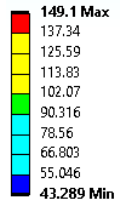


Refined Mesh #3 inner hole

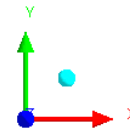
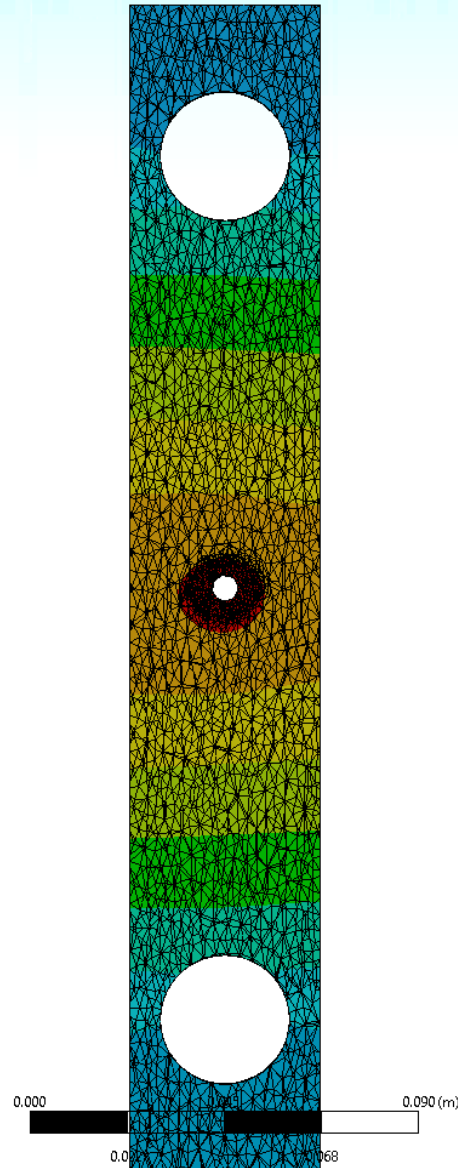


Refined Mesh #3

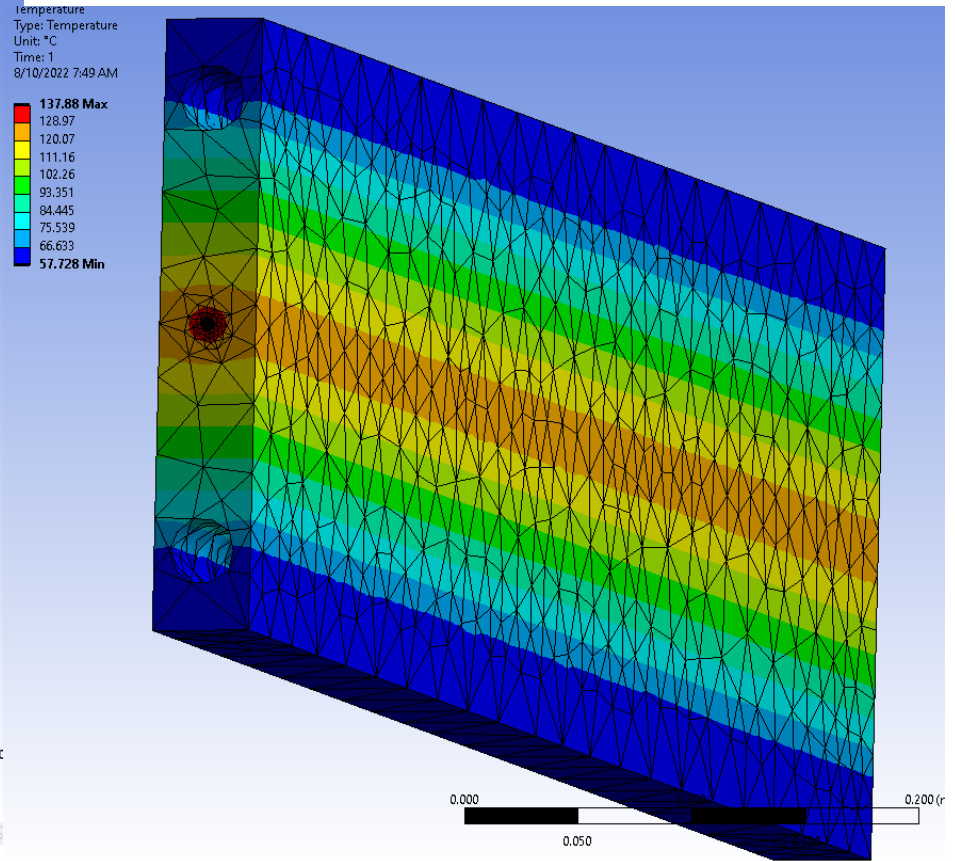
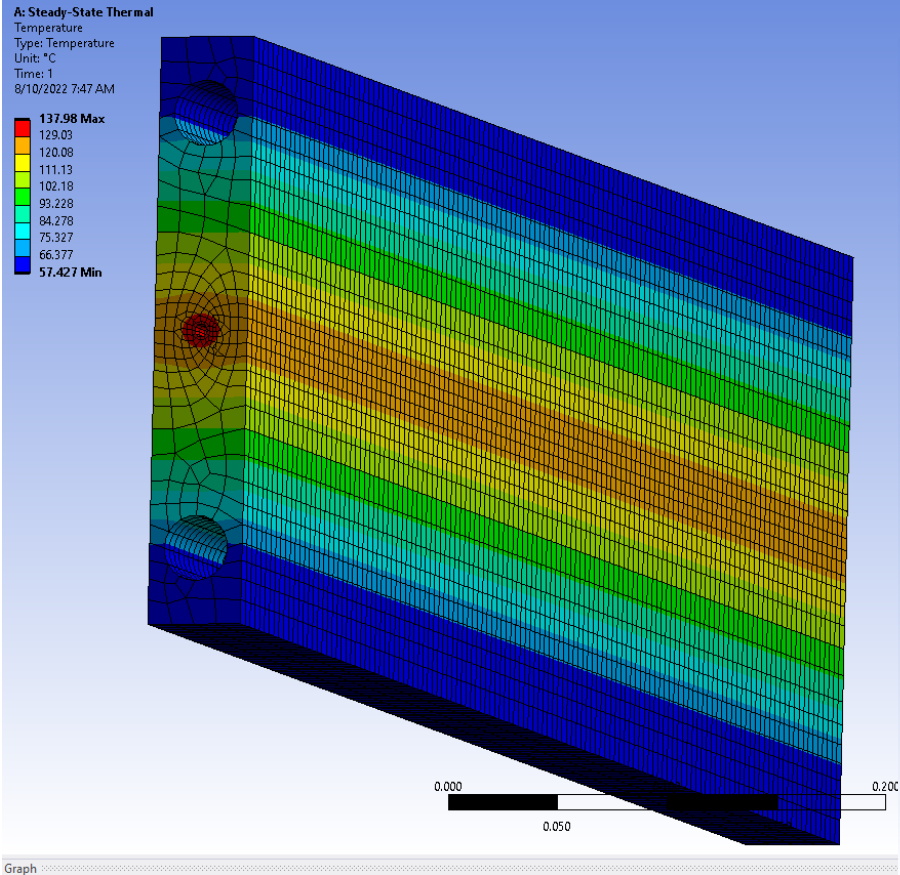
B: Steady-State Thermal
Temperature
Type: Temperature
Unit: °C
Time: 1
8/9/2022 4:00 PM



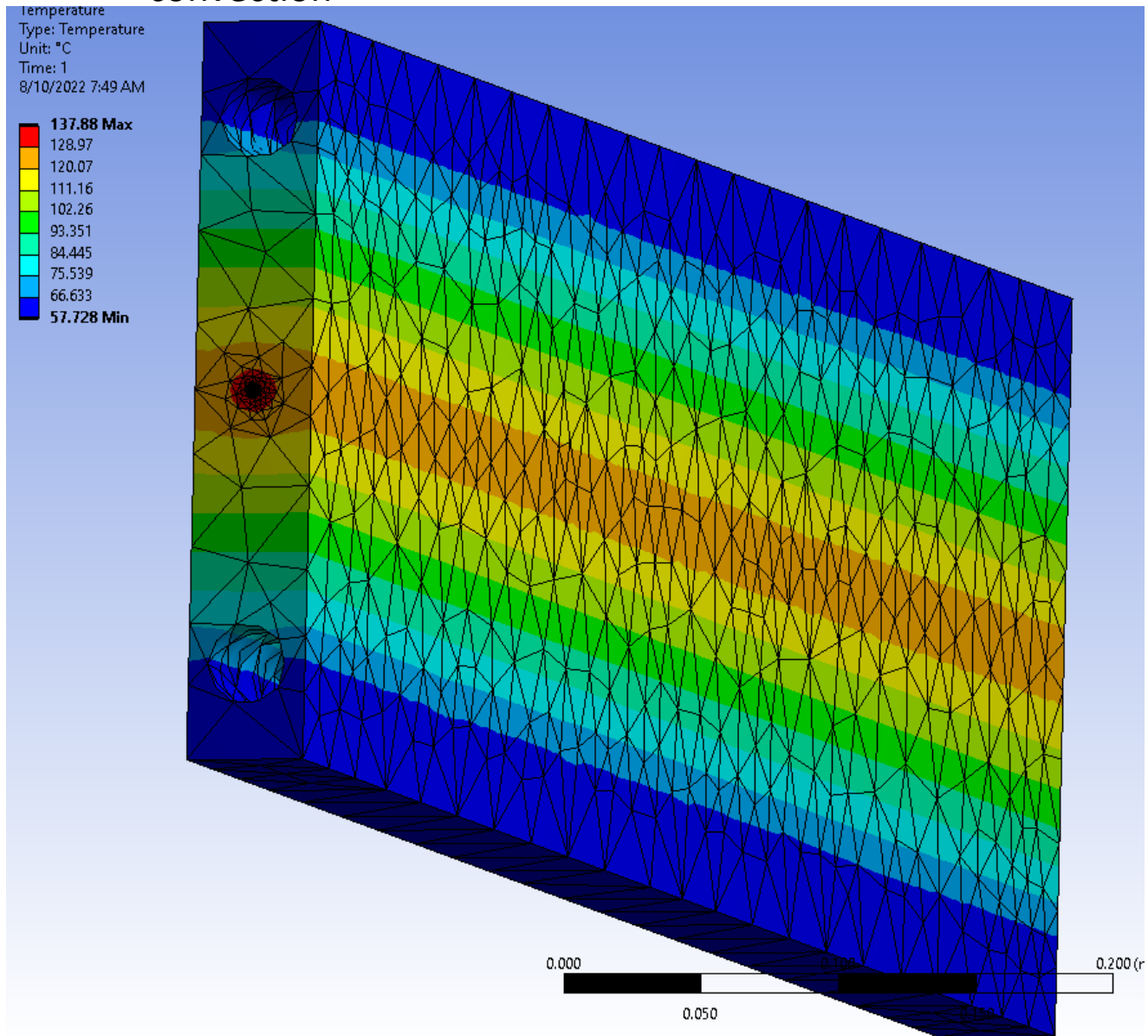
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22kw inner hole-1m long 5KW/m²C convection

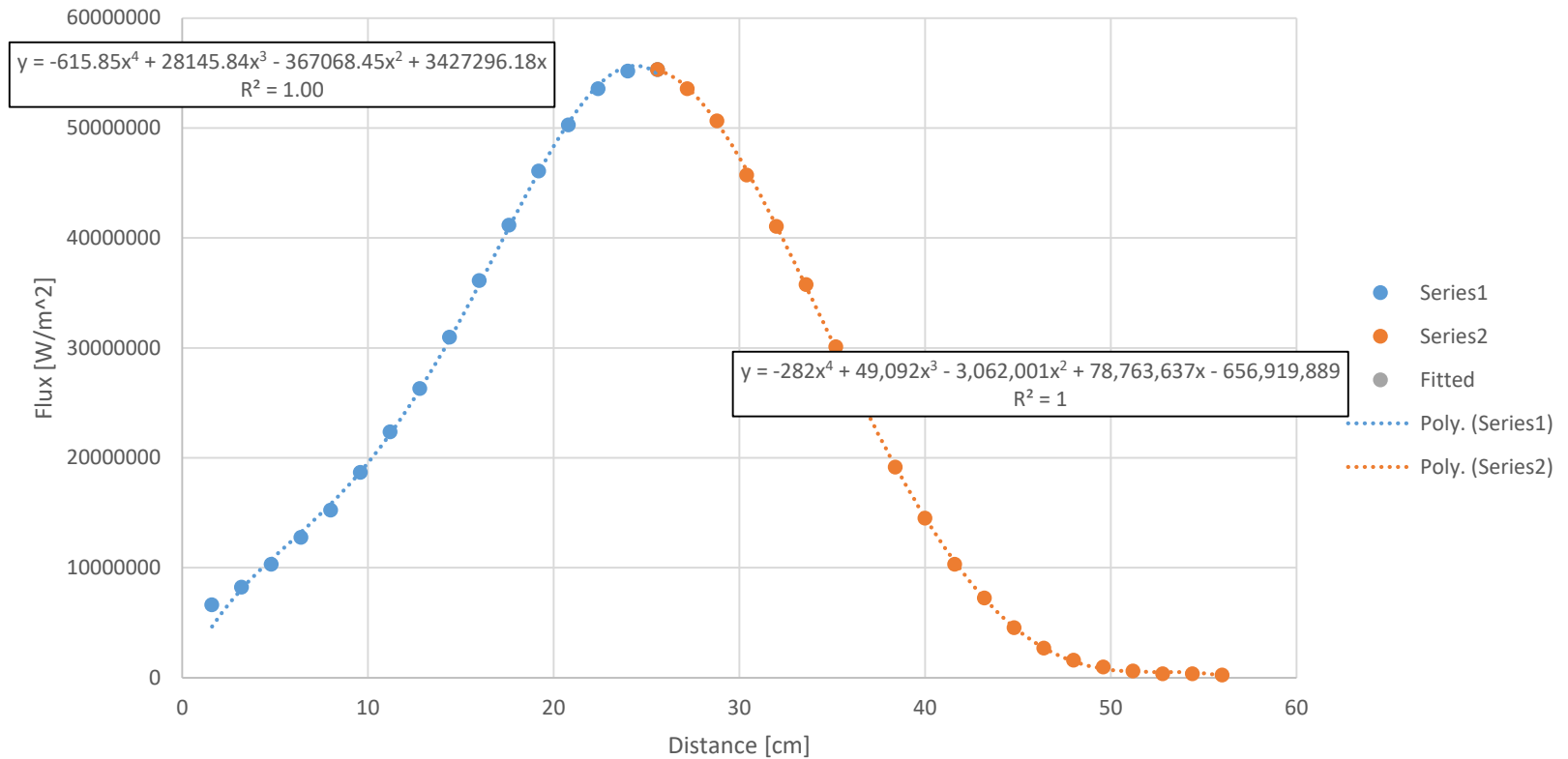


22kw inner hole-1m long 5KW/m²C convection



Hall C power absorption curve

Rastered Beam Deposited



Hall D CPS with $5.3e7 \text{ W/m}^2$ at center 10 cm – 100KW total – similar to Hall C power

A: Steady-State Thermal

Temperature

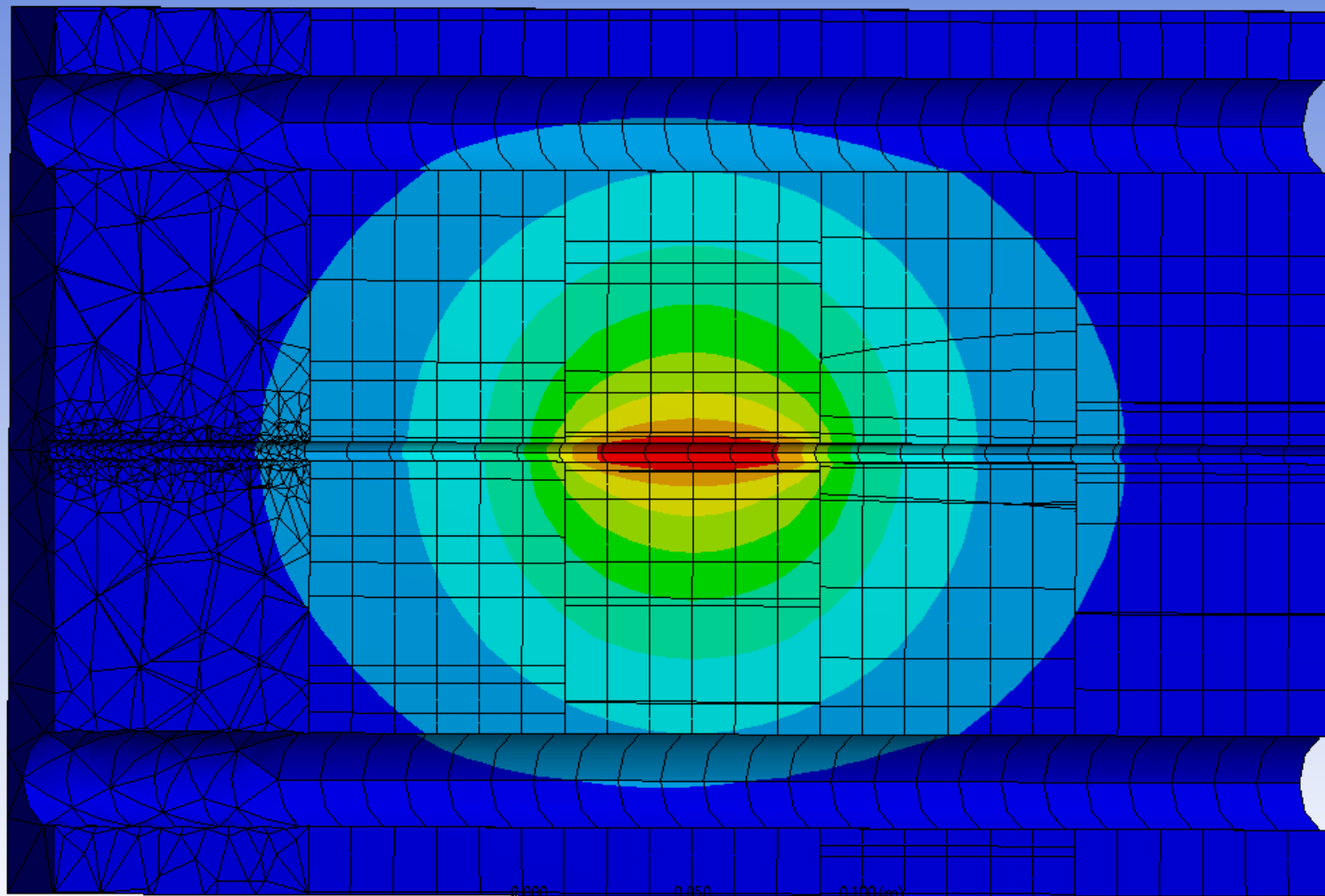
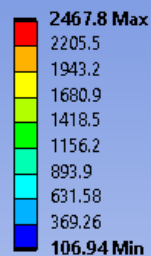
Type: Temperature

Unit: °C

Time: 1

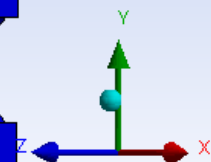
8/13/2022 10:30 AM

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2020 R1



0.000 0.050 0.100(m)

0.025 0.075



Hall D CPS with $7.7e6 \text{ W/m}^2$ at center 10 cm (15KW), $2.4e6 \text{ W/m}^2$ on each 10cm side – 24KW total

A: Steady-State Thermal

Temperature
Type: Temperature
Unit: °C
Time: 1
8/20/2022 9:40 AM

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2020 R1

