



NUREG/CR-7152

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Rod Bundle Heat Transfer Facility – Steady-State Steam Cooling Experiments

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ABSTRACT

As part of the Nuclear Regulatory Commission safety analysis computer code development efforts, the Rod Bundle Heat Transfer Test (RBHT) facility has been designed and constructed at The Pennsylvania State University. The test series described in this report is the steam cooling tests. A total of 35 steady-state steam cooling experiments was performed in the RBHT. The purpose of the experiments was to examine the steady-state convective heat transfer from the heater rods to single-phase superheated steam in prototypical rod bundle geometry for computer code model development and validation.

The Rod Bundle Heat Transfer Facility has a full length, 3.66 m (12 ft), 7 by 7 rod array with typical Pressurized Water Reactor rod diameters of 9.49 mm (0.374 in) and a rod pitch of 12.59 mm (0.496 in). The heater rods had a top skewed power shape with a peak to average power of 1.5 at the 2.74 m (9 ft) elevation. The RBHT facility has been designed using prototypical mixing vane spacer grids.

The bundle inlet steam temperature was held at saturation for the given test pressure and the inlet Reynolds number ranged from 1,400 to 30,000 with most of the experiments at the lower Reynolds number range. The facility was instrumented to measure the quantities necessary for determining local convective heat transfer coefficients that reflect the heat transfer enhancement caused by mixing vane grids. The measured quantities include vapor temperatures at sub-channel centerlines, mixing vane grid temperatures, a detailed axial pressure drop along the bundle length, absolute pressure in the upper plenum, rod temperatures upstream and downstream of mixing vane grids, and vapor flow rates in and out of the bundle.

FOREWORD

A loss-of-coolant accident (LOCA) is one of the primary postulated accidents that must be considered in the design of nuclear power plants. The plant response to such an accident, including the performance of safety systems that are designed to mitigate the accident, is mainly analyzed using computer codes. For effective analyses of accidents and operational transients, the U.S. Nuclear Regulatory Commission (NRC) consolidated earlier thermal-hydraulics analysis codes into one called TRACE.

The NRC is now assessing and improving the TRACE code as weaknesses are identified. One such weakness is inaccurate prediction of peak clad temperatures of fuel rods, particularly in the later stage of a large-break (LB)LOCA, called the reflood phase. Specifically, the reflood models currently employed in the TRACE code are not sufficiently accurate and, consequently, improved models must be developed to provide necessary support for risk-informed regulations. Accurate prediction of the consequences of an LBLOCA is important because this is one of the limiting postulated accidents used to determine whether plant design parameters (such as power densities, equipment sizes, etc.) have been appropriately selected to ensure safety. As the NRC places increasing emphasis on risk-informed regulations, the agency needs a more accurate and reliable computer code to obtain realistic (rather than conservative) predictions.

To develop better computer code models for an LBLOCA, we need detailed, fundamental data that show heat, mass, and momentum exchanges. Some of these detailed data have only recently become possible because of recent advances in instrumentation technology for two-phase flow measurements. Consequently, to acquire detailed, fundamental data for use in developing models for an LBLOCA, the NRC sponsored the construction of a rod bundle heat transfer (RBHT) test facility and completion of four test series; reflood tests, liquid-gas interfacial drag tests, steam cooling tests without liquid droplet injection, and steam cooling tests with liquid droplet injection.

This report presents the results of steam cooling tests without liquid droplet injections. The data from these tests will be used to develop and assess a steam cooling model which is a component of a LOCA model for the TRACE code. The results of other test series will be reported in separate reports.

With improved data and code models for an LBLOCA, we can more accurately predict the consequences of LBLOCA accidents and provide better technical bases for regulations associated with such accidents. As a result, this study will help to achieve the NRC's strategic performance goals of making the agency's regulations more effective, efficient, and realistic.

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EXECUTIVE SUMMARY

A series of steady-state, low to intermediate Reynolds number steam cooling experiments have been performed in the Nuclear Regulatory Commission/Penn State University Rod Bundle Heat Transfer (RBHT) Test Facility. As part of the Nuclear Regulatory Commission safety analysis computer code development efforts, the Rod Bundle Heat Transfer test facility has been designed and constructed at The Pennsylvania State University. The Rod Bundle Heat Transfer (RBHT) Facility is a full length simulation of a portion of a Pressurized Water Reactor (PWR) fuel assembly. The bundle is a 7 by 7 rod array with four unheated corner rods and 45 heated electrical rod which simulate a 17 by 17 PWR fuel assembly. The rod Bundle Heat Transfer Facility is full length, 3.66 m (12 ft), with typical PWR rod diameters of 9.49 mm (0.374 in) and a rod pitch of 12.59 mm (0.496 in). The heater rods had a top skewed power shape with a peak to average power of 1.5 at the 2.74 m (9 ft) elevation. The experiments were performed using saturated to slightly superheated steam at the bundle inlet which then became superheated along the bundle length. The ranges of conditions for the experiments were pressures from 137.9 to 413.7 kpa (20 to 60 psia), steam inlet Reynolds numbers from 1400 to 30,000. Peak heater rod temperatures varied approximately from 400 to 650 degrees C (750 to 1200 degrees F), and bundle powers from 10 kw to 140 kw. Typical PWR mixing vane spacer grids were simulated in the RBHT bundle.

There were approximately 500 channels of transient data recorded for each test including the bundle power, heater rod temperatures, upper plenum pressure, inlet steam flow rate, superheated vapor temperatures in the bundle, spacer grid temperatures, and the detailed axial bundle pressure drop. There were a total of 12 experiments that were performed and reported to the Nuclear Regulatory Commission. There are 35 data sets from these experiments were qualified and submitted to the Nuclear Regulatory Commission data bank for analysis and code validation purposes.

The steam cooling data was reduced to calculate the convective heat transfer coefficient for the instrumented heater rods. To obtain an expression for the sub-channel bulk fluid temperature, the steam probe sub-channel measurements at the center of the sub-channel were analyzed using an expression that was derived based on the heat/momentum transfer analogy approach. Using this methodology, the vapor temperature point measurements were used to calculate the bulk sub-channel vapor temperature.

The local heat transfer coefficients and Nusselt number values were calculated axially along the rod bundle. The increased heat transfer effects downstream of the mixing vane spacer grids used in the RBHT was clearly observed from the data. The fully-developed heat transfer data was compared to several single phase heat transfer correlations and best correlation that represented the RBHT data was recommended.

The measured axial pressure drop data was also analyzed to calculate the mixing vane grid loss coefficient as a function of Reynolds number.

ABBREVIATIONS

ACRONYMS:

LOCA - Loss of Coolant Accident
NRC - Nuclear Regulatory Commission
RBHT - Rod Bundle Heat Transfer
LMFBR - Liquid Metal Fast Breeder Reactor

GREEK SYMBOLS:

Δ - difference
 μ - viscosity
 v - specific volume
 ρ - density
 u - kinematic viscosity
 α - thermal diffusivity
 ϵ - spacer grid blockage
 ϕ - mixing vane angle

SYMBOLS:

A - area
 B_B - general constant for general void fraction correlation
c - specific heat
 D_h - hydraulic diameter
 D_e - hydraulic equivalent diameter
F - correlation factor for bulk mean temperature
f - friction factor
g - acceleration due to gravity
 g_c - gravitational constant
h - heat transfer coefficient
k - thermal conductivity

1. INTRODUCTION

The Pennsylvania State University and United States Nuclear Regulatory Commission (NRC) have designed and built a Rod Bundle Heat Transfer (RBHT) facility to investigate the thermal hydraulic behavior of a nuclear fuel assembly. [1] The goal was to obtain heat transfer and pressure drop data during steady state superheated steam flow, using an electrically heated rod bundle. The experiments will provide insight into the physical phenomena occurring in a nuclear fuel assembly during a postulated loss-of-coolant-accident (LOCA).

Best estimate thermal hydraulic safety codes are currently used to evaluate accident scenarios and predict the behavior of the reactor core. [2,3] The codes in use have uncertainties and conservatism and may not accurately represent the thermal hydraulic phenomena during a postulated LOCA. Improved experimental data from the RBHT facility will help reduce these uncertainties and improve the accuracy of the computer codes and models. Therefore, the experiments performed in the RBHT facility were specifically designed for model development and computer code validation.

Steady state steam cooling experiments have been performed in the RBHT facility to obtain single-phase heat transfer coefficients within the rod bundle that reflect the heat transfer enhancement caused by mixing vane grids. Mixing vane grids improve heat transfer by providing subchannel blockage, which creates additional turbulence, flow separation, and mixing. The RBHT steam cooling experiments were performed at various powers, pressures, and a wide range inlet Reynolds numbers. The measured quantities include vapor temperatures at subchannel centerlines, mixing vane grid temperatures, a detailed axial pressure drop along the bundle length, absolute pressure in the upper plenum, rod temperatures upstream and downstream of mixing vane grids, and vapor flow rates in and out of the bundle. Inlet and outlet conditions as well as fluid and rod temperatures were monitored during the experiments to ensure accurate quasi-steady state data was collected.

The data was reduced and heat transfer coefficients were calculated on a subchannel basis at heater rod thermocouple locations within the inner 5x5 bundle. The heat transfer coefficient is a function of the subchannel mean bulk fluid temperature, heater rod outside wall temperature, and surface heat flux. The mean bulk temperature could not be measured directly. Thus, in order to calculate the local heat transfer coefficient, a method based upon the analogy of momentum and heat transfer was developed to correlate the local mean bulk temperature with respect to the local subchannel centerline temperature, which could be measured.

Mixing vane grid loss coefficients were calculated using the detailed axial pressure drop data. Pressure drop measurements were taken across bare bundle spans and spans which contained one or more mixing vane grids. Pressure drop data was only used from the beginning of experiments because it was seen that water was evaporating out of the pressure cell reference legs as the test progressed. This does not invalidate any steady-state windows achieved at least in terms of heat transfer, it does however limit the pressure drop data available for calculating mixing vane loss coefficients.

This report provides a summary of the data obtained, the data reduction methods and assumptions used in reducing the data as well as the uncertainty in the experimental data and the derived quantities from the data. A full set of the experimental data has been transmitted to the NRC data bank.

2. TEST FACILITY DESCRIPTION

The RBHT facility was developed by PSU and the NRC. The facility was designed to conduct systematic separate effects tests under well-controlled laboratory conditions in order to generate fundamental rod bundle heat transfer data including: single-phase steam cooling tests, two-phase level swell, steam flow tests with and without droplet injection, inverted annular film boiling tests, and dispersed flow film boiling reflood heat transfer tests. The facility is capable of operating in steady-state forced and variable reflood modes covering a wide range of flows and heat transfer conditions at pressures from 1.0 to 4.02 bars (20 to 60 psia).

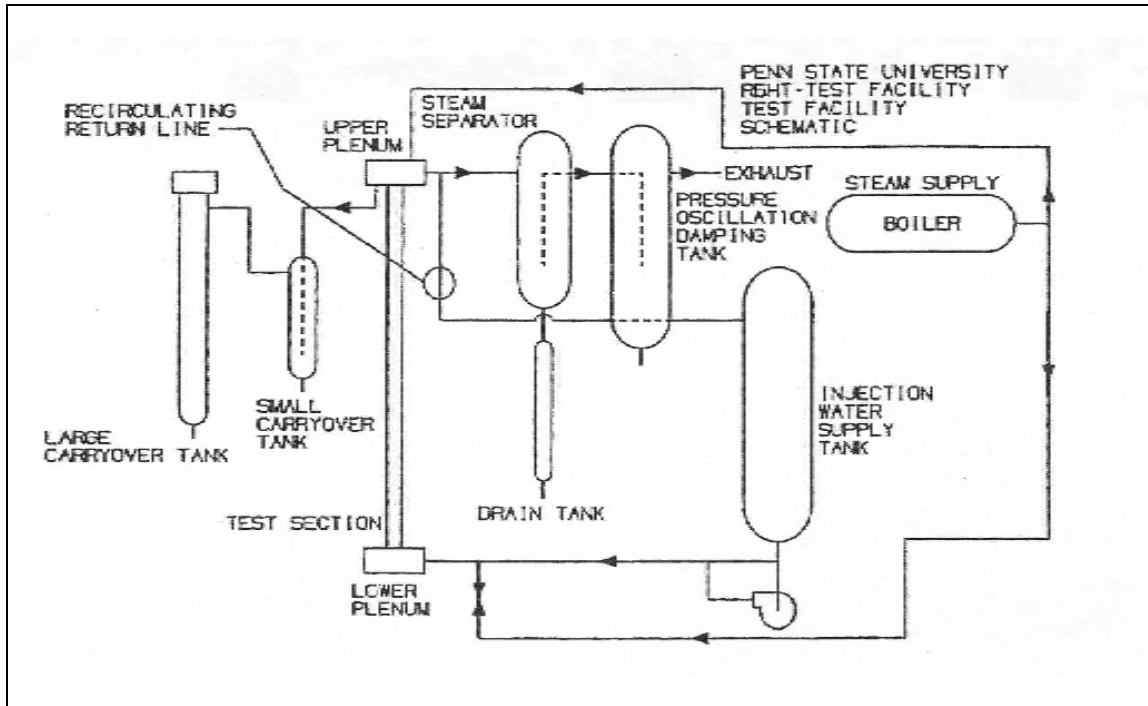


Figure 2-1: RBHT Test Facility Schematic.

The test facility, as shown in Figure 2-1 and Figure 2-2, is a once-through flow facility in which either water or steam can enter the lower plenum and flow upward through the rod bundle. The lower plenum is attached to the bottom of the flow housing and is used as a reservoir for the coolant prior to injection into the rod bundle during reflood. The upper plenum serves as the first stage for phase separation and liquid collection of the two-phase effluent exiting the rod bundle. The liquid phase separates from the flow due to the sudden expansion from the bundle to the larger plenum flow area.

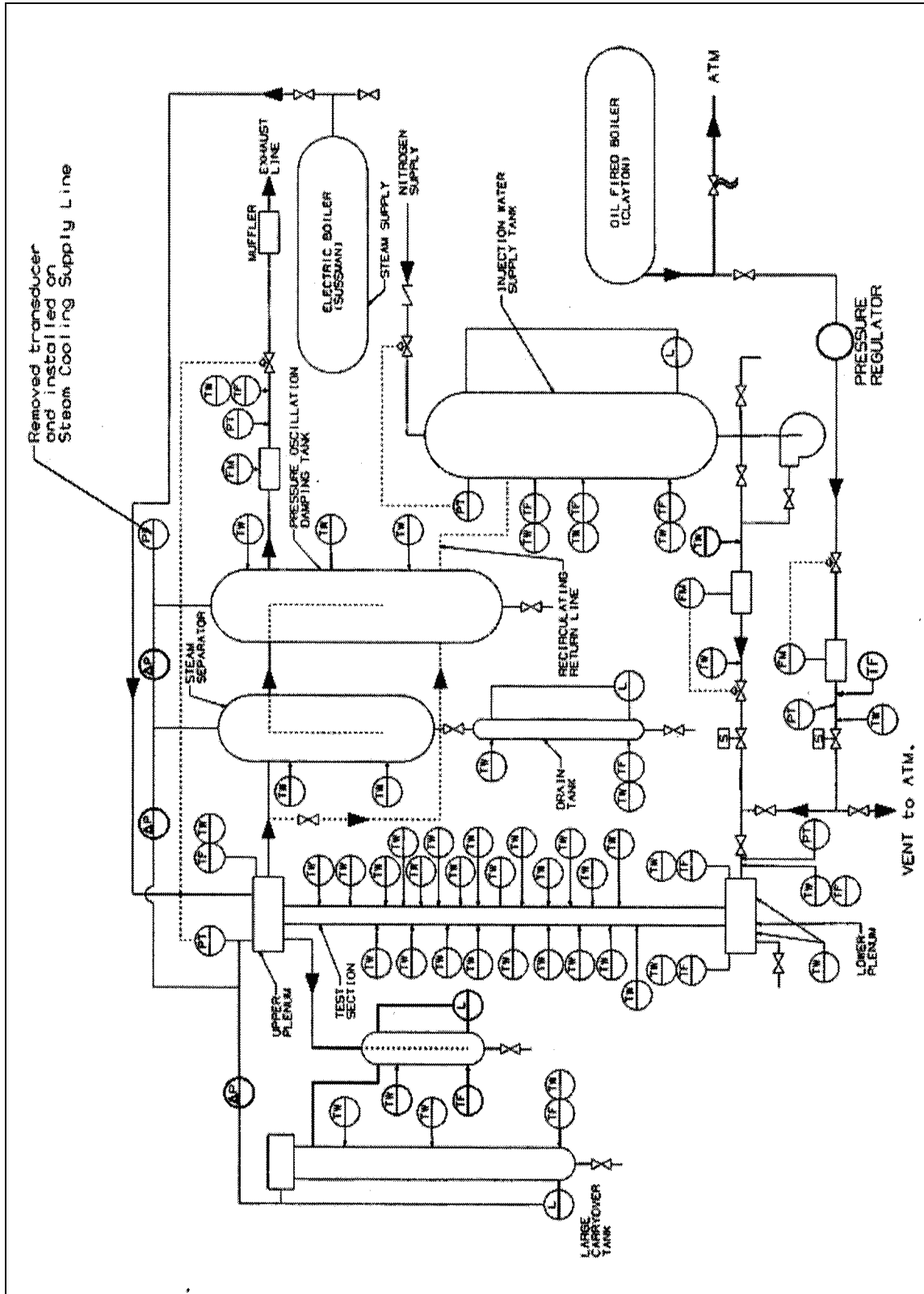


Figure 2-2: Test Facility Schematic with Instrumentation Locations.

The facility has a large and small liquid carryover tank provided to collect the liquid carryover in the fluid flow in order to measure the amount of entrainment in the flow. The de-entrained liquid from the upper plenum drains into the top of a 25.6 mm tube, which extends inside a small carryover tank to detect and measure the carryover liquid. This tank collects and measures the amount of liquid overflow from the smaller carryover tank. A centrifugal two-phase separator is located downstream of the upper plenum also acts to separate out the remaining liquid flow from the vapor flow such that the vortex meter at the exit of the steam pipe will measure single phase vapor flow. There is a third liquid collection tank on the phase separator, which measures the separated liquid.

A pressure-damping tank located before the vortex flow meter and pressure control valve acts to damp out any pressure oscillations to maintain tight pressure control on the facility. Separating the exit flows from the bundle provides a means of calculating a transient mass balance as well as an energy balance on the facility.

The RBHT facility consists of a 7x7 bundle with 45 heated full-length electrical heater rods, which simulates a portion of a 17x17 similar fuel rod assembly, as shown in Figure 2-3. The letters in the figure indicate whether a heater rod is instrumented (I), not instrumented (U), or a support rod (S). The electrically powered heater rods have a diameter of 9.49 mm (0.374 in) and a square pitch of 12.59 mm (0.496 in). There are four unheated Inconel support tubes, one in each corner, which provide structural support for the bundle. Mixing vane grid instrumentation is routed out of the rod bundle via the support rods. The heater rods have a 3.66 m (144 in) heated length with a skewed axial power profile with the peak power located at the 2.74 m (108 in) elevation, as seen in Figure 2-4.

The spacer grids, which are used in the bundle have mixing vanes, as seen in Figure 2-5, which improves heat transfer downstream of the grids. These grids have high blockage, the projected area of the mixing vanes on the top plane of the grid is 39 percent of the total flow area such that the flow is accelerated through the grids and entrained droplets can be shattered.

In the RBHT facility, subchannel instrumentation is used to measure the local vapor temperature at subchannel centers. Measurements of the subchannel vapor temperature were made using two types of miniature thermocouple probes. The first type of miniature thermocouple used is suspended from the mixing vane grids and faces into the flow. The thermocouples have a 0.38 mm diameter and are supported by 2.44 mm long Inconel tubes which are tack welded to the mixing vane grids. The thermocouple leads are routed along the grid straps to the corner support tubes and out of the bundle.

The same type of thermocouples are spot welded to the mixing vane grid walls which measure the grid temperature to determine if the grid is dry or quenched. These thermocouple leads are also routed to the corner support tubes and out of the bundle.

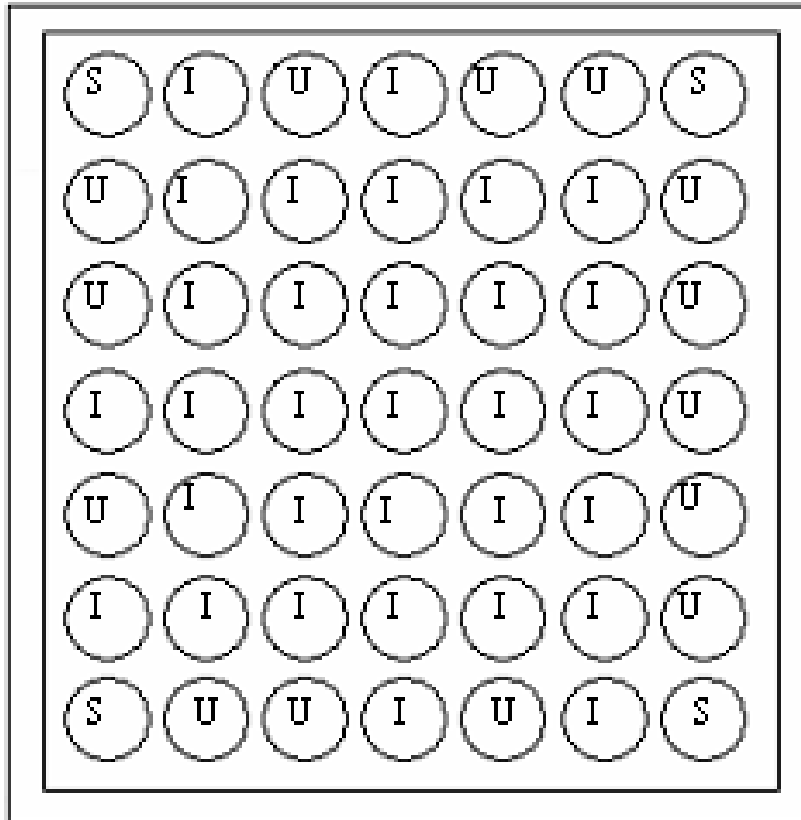


Figure 2-3: Rod Bundle Array.

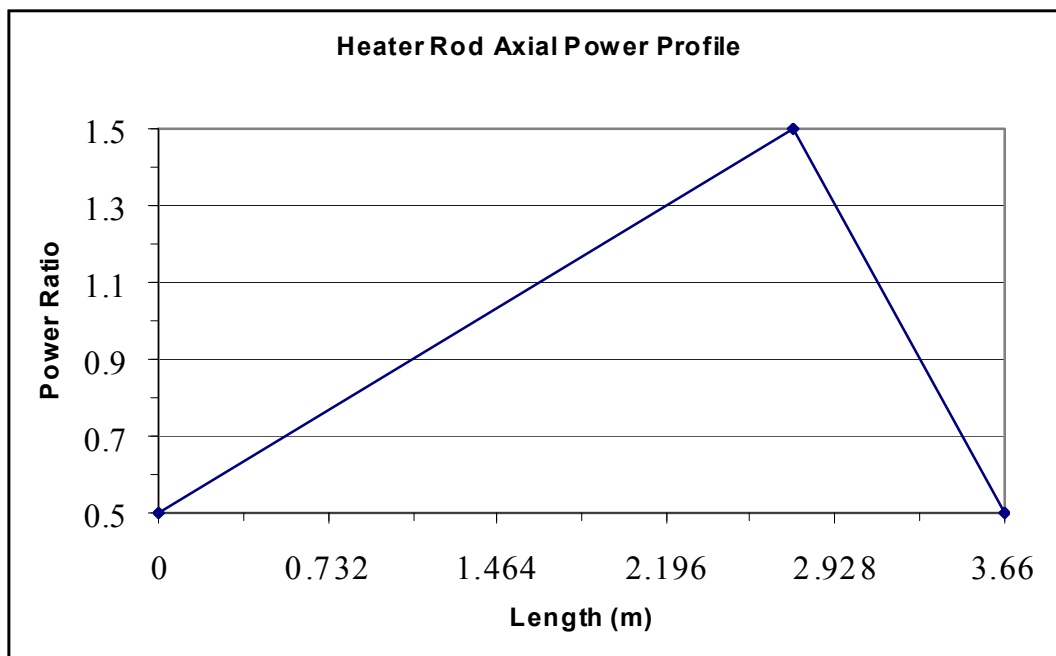


Figure 2-4: Power Profile for RBHT Rod Bundle.

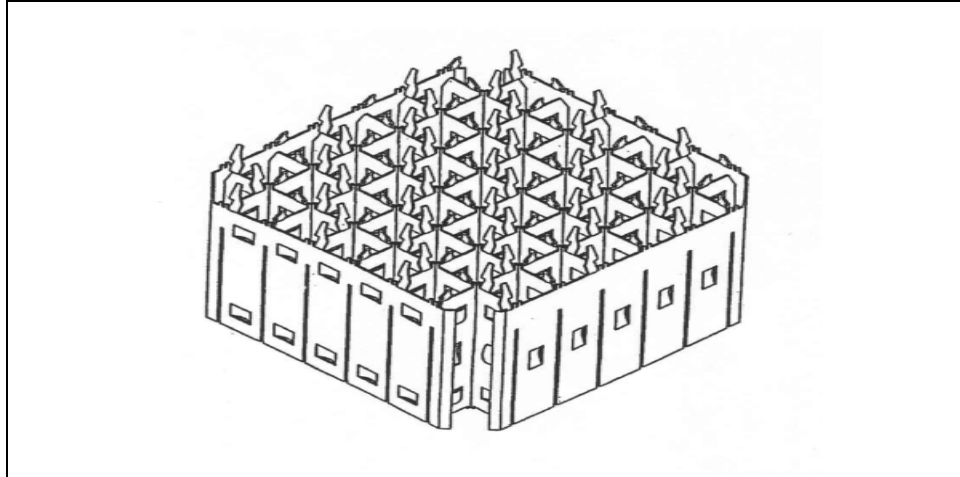


Figure 2-5: Mixing Vane Grid.

The second subchannel vapor measurement is made using traversing thermocouple rakes which consist of three 0.38 mm diameter thermocouples attached to a thin piece of Inconel shim that is welded to a small tube that can be moved to different radial positions within the bundle, as shown in Figure 2-6. The thermocouples are located one rod pitch (12.6 mm) apart on the Inconel shim and can measure vapor temperatures at three different subchannel centers within the bundle. There are 13 traversing thermocouple rakes at different axial positions, most of which are powered by a stepping motor that allows the rake to traverse across a subchannel centerline.

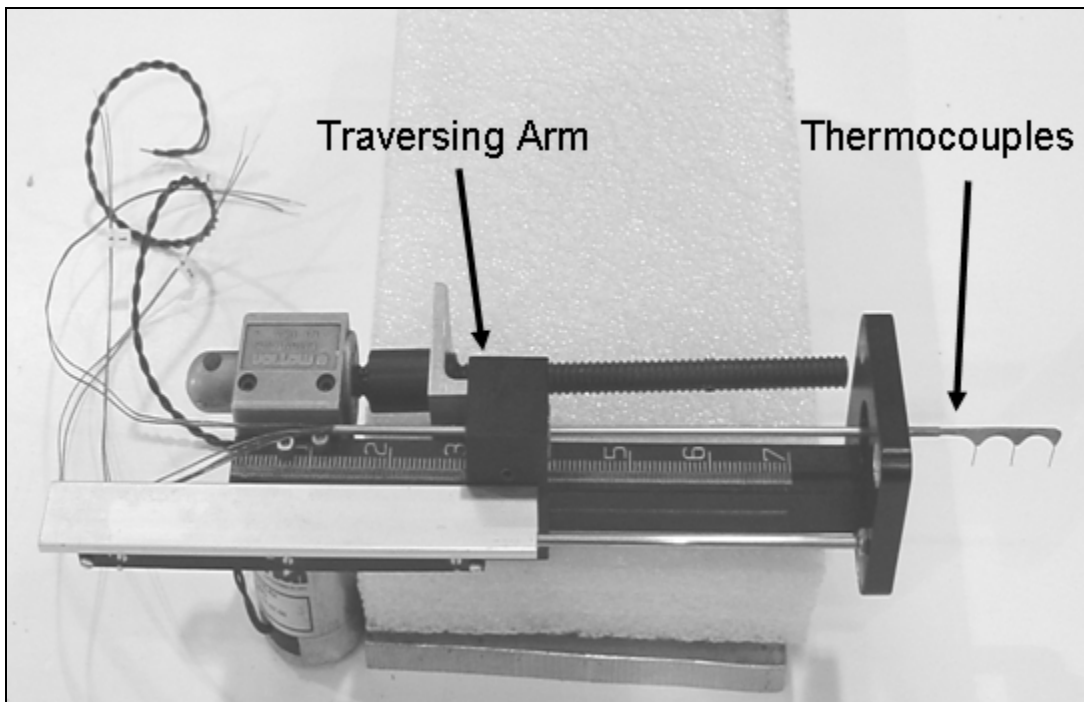


Figure 2-6: Traversing Steam Probe Rake.

A boiler with a capacity of 2613 kg per hour at 10.3 bars provides steam for the experiments. The boiler is connected to the lower plenum by means of stainless steel piping equipped with a Vortex flow meter to measure steam flows. The piping also has fluid and wall thermocouples, a V-ball control valve, and a quick acting solenoid valve. Electrical heaters on the outside of the flow housing perform preheating of the facility test components prior to each experiment.

The test facility instrumentation is designed to measure temperatures, power, flows, liquid levels, pressures, void fractions, droplet sizes, droplet distribution, and droplet velocities. There are approximately 500 channels of instrumentation for the facility. Overall and transient mass and energy balances, mass inventories, carryover liquid, and steam flows can be calculated.

Steady state steam cooling experiments were performed with steam at superheated conditions. Steam entered the rod bundle through the lower plenum, passed through the heater rods, and exited via the upper plenum to the exhaust piping. The boiler steam injection rate was computer controlled and was verified for the correct pressure and temperature. The steam injection line was preheated to avoid any condensation. After approximately fifteen minutes of preheating the injection line, the inlet valve to the bundle was opened slightly to preheat the bundle and exit lines. The bypass lines around the rod bundle were closed during this procedure. The lower plenum, carryover tanks, and steam separator tanks were also drained at this time. In order to account for any carryover from the boiler, the tanks had to be drained to accurately measure the liquid. Once the bundle was preheated to saturated vapor conditions, the bundle power was set at the desired power level. As the fluid flow stabilized for each matrix test condition, steady-state flow conditions were approached. Data was recorded for the entire length of the test duration, which included warm-up through shutdown.

Table 2-1 below shows the RBHT steam cooling test matrix which indicates the actual boundary conditions of these 21 unique tests. The test matrix was made prior to conducting the steam cooling experiments and was used as a guide to ensure the experiments would cover the full range of conditions shown in the test matrix. Note that the real conditions achieved during the experiments are close to the as designed conditions however, they do not match exactly and the real test conditions should and are used in this report for any data manipulation. The real conditions achieved for each valid steady-state window can be found on the summary and comment sheets in Appendix A.

Table 2-1: Test Matrix Summary of as Designed Boundary Conditions

NRC Matrix Test Number	Upper Plenum Pressure [kPa (psia)]	Bundle Power (kW)	Inlet Reynolds Number
1	275.8 (40)	10	1400
2	275.8 (40)	15	2000
3	275.8 (40)	20	4000
4	275.8 (40)	30	6000
5	275.8 (40)	40	8000
6	275.8 (40)	50	10000
7	275.8 (40)	70	15000
8	275.8 (40)	95	20000
9	275.8 (40)	140	30000
10	137.9 (20)	15	2000
11	137.9 (20)	30	6000
12	137.9 (20)	70	15000
13	413.7 (60)	14	2000
14	413.7 (60)	30	6000
15	413.7 (60)	70	15000
16	275.8 (40)	10	2000
17	275.8 (40)	10	4000
18	275.8 (40)	15	2000
19	137.9 (20)	95	20000
20	413.7 (60)	140	30000
21	413.7 (60)	95	20000

3. CALCULATION METHODS

3.1 Heater Rod Outside Wall Temperature and Heat Flux

The DATARH program was used to calculate the transient heater rod outside surface temperatures, and the total surface heat flux. The surface heat flux and the outside wall temperature represent a total heat transfer from the heater rod surface and would include radiation heat transfer as well as convection. The transient results from DATARH were time averaged to get steady state values which were used in subsequent calculations. Note that the steam cooling tests were performed under quasi-steady conditions. As such, DATARH was used mainly to account for the resistance across the cladding in determining the surface temperatures and to assure that steady-state conditions existed.

Program DATARH.F contains the source code to perform an inverse heat conduction calculation in an electrically heated rod, in which internal cladding thermocouples exist.

The purpose of the code is to calculate the surface temperature and the surface heat flux for the heater rods. The program uses experimental data, heater rod dimensions, and material properties to perform calculations. The mathematical model for the calculations is described in Section 3.1.1 below.

The program input described herein has been modified for the RBHT experiments from the DATARH.F program used for the FLECHT-SEASET experiments. [4] Differences between heater rods used in the FLECHT-SEASET experiments and the RBHT experiments (e.g., rod dimensions, differences in rod internal materials) have been accounted for in this version of the program.

The sections that follow describe the structure of the source program, RBHT rod geometry and materials, and the input files required for executing the current version of the program.

3.1.1 Mathematical Model

DATARH program calculates the surface temperature, the surface heat flux and the transient heat transfer coefficient for heater rods by solving the "Inverse Heat Conduction Problem" (IHCP). The IHCP is basically the determination of the surface temperature, therefore the surface heat flux can be determined from the transient temperatures measured at an interior location of a heated structure. In the problem solved by DATARH, the initial temperature distribution is known.

The IHCP is an ill-posed problem and in order to overcome the ill-posedness, several methods have been developed [9]. One method of solving IHCP problems is the Beck method which requires the knowledge of the initial wall temperature and proceeds sequentially. In this method, the equations are only solved for a few future times while the wall temperature and the wall heat flux is only taken up to the next time step, and the sequential procedure is started again by shifting it one time step further [9].

The finite difference approximation in implicit form of a one-dimensional heat conduction equation in cylindrical coordinates is typically [10]

$$B(n)T(n-1) + A(n)T(n) + C(n)T(n+1) = -T'(n) - Q(n); 1 \leq n \leq N \quad (3-1)$$

where

$$B(n) = \frac{\Delta\theta}{(\Delta r)^2} \frac{r(n-1/2)}{r(n)} \cdot \frac{k(n-1/2)}{\rho(n)c(n)} \quad (3-2)$$

$$C(n) = \frac{\Delta\theta}{(\Delta r)^2} \frac{r(n+1/2)}{r(n)} \cdot \frac{k(n+1/2)}{\rho(n)c(n)} \quad (3-3)$$

$$A(n) = -B(n) - C(n) - 1 \quad (3-4)$$

$$Q(n) = \frac{q(n)\Delta\theta}{\rho(n)c(n)} \quad (3-5)$$

where $T(n)$ is the unknown temperature at node point n

$T'(n)$ is the known temperature at node point n . This is also the "initial value".

r is the spatial variable.

Δr is the spatial increment.

$\Delta\theta$ is the time increment.

Here, K , ρ , c are the thermal conductivity, density and specific heat, respectively. Their numerical values are computed at T' . If values at half intervals are required, they are evaluated at the average of two adjacent temperatures.

q is the volumetric heat generation rate.

N is the number of internals. Hence, there are $N+1$ node points.

For $n = 1$, the node point is at the centerline of the rod, $T(n-1)=T(n+1)$, since at this point the symmetry requires the flux be zero. At the point $n=M$, $T(M)$ is the known measured temperature and finally, at the outer boundary point, $n=N$, $T(n+1)$ is the desired wall temperature. If the heat conducting body is made up by composite material, the temperature at the interface can be handled by usual means, i.e. both the temperature and flux must be continuous. However, in this case, the spatial interval size, Δr , would vary from region to region such that particular node points coincide with the material interfaces and $T(M)$.

Apply Equation (3-1) to node points $n=1,2,\dots,N$ and, combining the boundary condition $T(0) = T(2)$ with the finite difference equation at $n=1$ to eliminate $T(0)$, we have a set of N linear simultaneous equation with N unknown temperatures, $T(n)$; $n=1,\dots, N+1$, $n \neq M$. The solution of this set of equations define the temperature field at a given time step, θ . The transient solution can thus be obtained by repeating the same procedure with successive increment of $\Delta\theta$.

The method outlined above is simple-minded in principle and straightforward in practice. Because of the implicit finite difference scheme, the stability of the computation is guaranteed. As long as reasonable increment sizes, Δr and $\Delta\theta$, are chosen, acceptable numerical accuracy can be expected.

It is noticed that if $M=N+1$, the inverse heat conduction problem is reduced to a more conventional type with a flux condition specified on one boundary (centerline) and a temperature condition specified on the other (wall). In this case, the coefficient matrix for the linear equations, as defined by Equation (3-1), is tri-diagonal. However, the presence of a known temperature, $T(M)$, $M \neq N+1$, in the linear set to replace the wall temperature, $T(N+1)$, destroys the tri-diagonality and consequently complicates the solution procedure since for linear equations with a tri-diagonal coefficient matrix, the solution can be obtained by a time saving matrix resolution technique which is not applicable to any other form of matrix.

Let us, for the time being, ignore the fact that $T(M)$, $M \neq N+1$, is known and assume that $T(N+1)$ is known instead. The linear equation, written in the usual manner is:

$$[J]\vec{T} = \vec{F} - C(N)T(N+1)\vec{G} \quad (3-6)$$

where $[J]$ is the tri-diagonal coefficient matrix defined by Equations (3-1) through (3-4).

\vec{T} is the solution vector with N components

\vec{F} is the "source" vector with the components defined by the quantities on the right-hand side of Equation (3-1).

\vec{G} is a vector with first $N-1$ components equal to zero and the N -th component equal to one, i.e. $q(i)=0$, $i \neq N$, $q(i)=1$, $i=N$

If \vec{X} and \vec{Y} are, respectively, solutions of

$$[J]\vec{X} = \vec{F} \quad (3-7)$$

$$[J]\vec{Y} = -\vec{G} \quad (3-8)$$

then the linearity of Equation (3-6) leads to

$$\vec{T} = \vec{X} + C(N)T(N+1)\vec{Y} \quad (3-9)$$

Equation (3-9), in scalar form for $n=M$, gives

$$T(M) = X(M) + C(N)T(N+1)Y(M) \quad (3-10)$$

or

$$T(N+1) = \frac{T(M) - X(M)}{C(N)Y(M)}, Y(M) \neq 0 \quad (3-11)$$

Since all the quantities on the right hand side of Equation (3-10) are known, the wall temperature $T(N+1)$, can be computed. The remaining temperature field can be obtained by repeated application of Equation (3-9).

If the temperature measurement $T(M)$ as a function of time is both accurate and frequent enough, the method outlined above would produce acceptable results. In practice, however, such accuracy and frequency as demanded by the numerical method is almost impossible to achieve. Any error in $T(M)$, either due to instruments or due to interpretation, would be amplified in this numerical process. An error is usually propagative and oscillatory and results from a successive over and under correction of the heat balance as demanded by the governing heat conduction equation.

Therefore, it is desirable to devise a numerical method such that the input error of $T(M)$ could be damped during the subsequent computation steps. One such method is programmed in DATARH. It must be stressed that damping of input error can only improve the accuracy of the computed results by reducing the input error amplification. The inherent error due to inaccurate input data still remains.

The basic principle of the method is to utilize the information of $T(M)$ available over an open time span when the computation is just entering this time span. Let the parenthesized superscript denote a relative time step then the computation of $\bar{T}^{(1)}$ would not only involve an initial value $\bar{T}^{(0)}$, but also $\bar{T}^{(2)}(M), \bar{T}^{(3)}(M), \dots$. This calculation is followed by an optimization process to minimize the error amplification. This optimization can be accomplished in, although not restricted to, a least-squared sense.

Following Equation (3-1) and the subscript notation defined above, we have:

$$B(n)T^{(1)}(n-1) + A(n)T^{(1)}(n) + C(n)T^{(1)}(n+1) = -Q(n) - T^{(0)}(n) \quad (3-12)$$

$$B(N)T^{(1)}(N-1) + A(N)T^{(1)}(N) = -Q(N) - T^{(0)}(N) - C(N)T(N+1) \quad (3-13)$$

The solution using Equation (3-9) is;

$$\bar{T}^{(1)} = \bar{X}^{(1)} + C(N)T(N+1)\bar{Y}^{(1)} \quad (3-14)$$

In the above equation, all the components in $\bar{X}^{(1)}$ and $\bar{Y}^{(1)}$ are known and $\bar{T}^{(1)}$ is not known since the wall temperature $T(N+1)$ is needed to be determined.

The computation can be carried out for one more time step as below:

$$\begin{aligned}
& B(n)T^{(2)}(n-1) + A(n)T^{(2)}(n) + C(n)T^{(2)}(n+1) \\
& = -Q(n) - T^{(1)}(n) \\
& = -Q(n) - \bar{X}^{(1)}(n) - C(N)T(N+1)\bar{Y}^{(1)}
\end{aligned} \tag{3-15}$$

$$\begin{aligned}
& B(N)T^{(2)}(N-1) + A(N)T^{(2)}(N) \\
& = -Q(N) - T^{(1)}(N) - C(N)T(N+1) \\
& = -Q(N) - X^{(1)}(N) - C(N)T(N+1)Y^{(1)}(N) - C(N)T(N+1) \\
& = -Q(N) - X^{(1)}(N) - C(N)T(N+1)\{Y^{(1)}(N) + 1\}
\end{aligned} \tag{3-16}$$

The above equations form a linear system which is the same as that defined in Equation (3-6) provided the vectors \bar{F} and \bar{G} . The linear set has the solution of the form of Equation (3-9):

$$\bar{T}^{(2)} = \bar{X}^{(2)} + C(N)T(N+1)\bar{Y}^{(2)} \tag{3-17}$$

For the other time steps, similar equations can be written:

$$\bar{T}^{(3)} = \bar{X}^{(3)} + C(N)T(N+1)\bar{Y}^{(3)} \tag{3-18}$$

$$\bar{T}^{(j)} = \bar{X}^{(j)} + C(N)T(N+1)\bar{Y}^{(j)}; j = 1, 2, \dots, J \tag{3-19}$$

In the above equation, the vectors $\bar{X}^{(j)}$ and $\bar{Y}^{(j)}$ are known for all j. The computation can terminate at any value of J. This set of equations are to be optimized to obtain the value of T(N+1).

At a location where the measurements are recorded for $T^{(0)}(M)$, Equations (3-18) and (3-19) gives

$$T^{(j)}(M) = X^{(j)}(M) + C(N)T(N+1)Y^{(j)}(M) \tag{3-20}$$

The measured temperatures $u^{(j)}$ are known for all values of j. The error between the computed and measured temperature is

$$\begin{aligned}
\theta(j) & = T^{(j)}(M) - u^{(j)} \\
& = X^{(j)}(M) + C(N)T(N+1)Y^{(j)}(M) - u^{(j)}; j = 1, 2, \dots, J
\end{aligned} \tag{3-21}$$

The problem is now reduced to finding a T(N+1) such that θ is at a minimum. This can be accomplished by a least-squares method:

$$\begin{aligned}
E^2 & = \sum_j \{\theta^{(j)}\}^2 = \sum_j \{X^{(j)}(M) + C(N)T(N+1)Y^{(j)}(M) - u^{(j)}\}^2 \\
dT(N+1) & \geq 0
\end{aligned} \tag{3-22}$$

$$\tag{3-23}$$

$$\sum_j \frac{X^{(j)}(M) - u^{(j)}}{Y^{(j)}(M)} + C(N)T(N+1) = 0 \quad (3-24)$$

$$T(N+1) = \frac{1}{C(N)} \sum_j \frac{u^{(j)} - X^{(j)}(M)}{Y^{(j)}(M)} \quad (3-25)$$

Therefore, the desired temperature field can be calculated by,

$$\vec{T}^{(1)} = \vec{X} + C(N)T(N+1)\vec{Y}^{(1)} \quad (3-26)$$

Above equation defines the initial values for the computations of the subsequent time step. The computation can be carried out repeatedly for each advance of time increment.

3.1.2 Structure of the Source Program DATARH.F

This section briefly describes the structure of the source program. Detailed comments may be found within the body of the source program as well. The reader is advised that it will be helpful if a listing of the program DATARH.F is referenced as the remainder of this section is being read, since this will enhance the reader's understanding of the description of the program structure that follows.

All real variables used in the program have been declared double precision numbers, as indicated by the use of the implicit double precision (a-h, o-z) statement. The program reads two character variables, TITLE1 and RLOC, that may each be up to 15 alphanumeric characters in length. These are intended to be identifiers of a test case. No intermediate spaces may be present within each set of alphanumeric characters. However, each identifier may be of length less than 15 alphanumeric characters if desired.

The program utilizes a number of data arrays, which may be identified by examining the dimension statements within the main program and sub-programs. It is important to note that some of these arrays have been declared to be of length 2000, while others have been declared to be of length 10 or 50. There are several arrays that have multiple dimensions; e.g., array ti is seen to be of dimension 10x10. These numerical figures are indicative of limits built into the program.

The length 10,000 indicates that the current version of the program is capable of reading in up to a maximum of 10,000 sets of input data, each comprising time, clad temperature and power to the rod being analyzed. (See input file in1.dat described below.) It also indicates that the maximum number of points in time for which the program is capable of computing heat flux and heat transfer coefficient values is limited to 10,000.

The length 10 indicates that the region between two adjacent conduction nodes may be divided into a maximum of 10 sub-regions. As seen by the data (r(i), i=1,5) statement, the program is capable of handling five outer conduction nodes and one implied conduction node at the rod-center, and hence five regions. Thus, the length 50 arises from the fact that the total number of sub-regions that may be handled by this version of the program is 10x5.

The radial distance from the center of a heater rod to each outer conduction node is initialized by the data (r(i), i=1,5) statement. Currently, this statement contains radial data for RBHT heater rods, and values are in ft.

The program reads input data via two input files. The file names are expected to be in1.dat and in2.dat. These files must exist at the time the executable is run. The required contents of these files are described in a section that follows. The program will write output data to a file by the name of out1.dat. This file will be created by the executable during a run, and a file by this name must not be present in the working directory at run-time. (If the output file from a previous run exists, it must either be deleted, or be renamed.)

The program will terminate upon reaching the end of the input file in1.dat. As described in the section on input files that follows, the end of input data is signaled to the executable program by the use of characters END (case sensitive) in the input file in1.dat as input to character variable title1.

Initializing the number of sub-regions within the region between a given pair of conduction nodes is accomplished by the array intv(i), i = 1 through 5. As discussed above, the maximum number of sub-regions within any region is limited to 10. The heater-rod length is set to be 3.66 m (12 ft) by means of variable tlength.

After all input data has been read, and once the initialization of the conduction region dimensions and heater rod length has been completed, the program will write a summary of the input data to the output file. It is after this that the computational procedures begin.

The first step is to convert the input time scale (array timer) so that the time of flood is treated as zero-time. This is accomplished by a do loop that causes the time of flood, tflood, to be subtracted from each time value (array timer) that was read by the program. Next, the number of data points that would be output by the program, jtime, is computed using the last value of input time, timer(nscan), the first value of input time, timer(1), and the value of dt (which is the time interval between results computed by the program). Note that nscan is the number of sets of input data points; see description of input file in1.dat below. Now, an array of time values at which results will be computed, array time, is computed. This too is accomplished by a do loop, and is performed by first setting time(1) equal to timer(1), and then successively adding the value of dt to the current value of time to get the next value of time.

The next step is to compute an array of sink temperatures, Tsink. This array will have nscan number of values. It should be noted that the current version of the program treats the saturation temperature corresponding to the operating pressure as the sink temperature throughout the length of the heater rod. Thus, all values in array Tsink will numerically be the same.

The program will now access an interpolation subroutine (a subroutine tbl in DATARH) to compute the saturation temperature, rod power, and the clad temperature at each value in array time (the time values at which results are desired). The value of sink temperature computed, Tsink, will be written to the output file at this time as well.

Preparation of an array q that will contain volumetric heat generation rates at each value of array time is performed next. Each interpolated value of rod power (at a given value of time) is multiplied by the axial power factor, fax, and the radial power factor (if applicable), fp, and is

divided by the total rod length. Then, each resulting value of q is converted to a volumetric heat generation rate in Btu/hr.ft².s by means of appropriate conversion factors and rod dimensions.

It should be noted that if the total power supplied to the rod that is being analyzed is input in file in2.dat (values of variable po11), then fp should be input as 1.0. (Zone power differences will be accounted for when total rod power is input.) It is important to note also that the value of fax is dependent on the axial height of the thermocouple from which clad temperatures have been obtained for input (values of variable tclad in file in2.dat). These have been calculated for each thermocouple location and for each rod in the RBHT rod bundle.

The program investigates the curvature of the future three data points next. The subroutine that performs the inverse conduction calculation is called after this computation. Once the inverse conduction calculation is completed for all time values desired, values of heat flux and heat transfer coefficient at the rod surface are computed. These values along with the computed rod surface temperature at each time value are then written to the output file. The program will then continue onto the next case (if input data are present), or will terminate if the end of input data has been reached.

It is important to note that the program limits the values of nscan and jtime to be 2000 at most. See statements if (nscan .gt. 2000) nscan=2000 and if(jtime .gt. 2000) jtime=2000 that appear within the source program. This is in accordance with the limitation in the dimensioning of some arrays, as described previously. It should also be noted that the maximum time up to which the program will compute results is limited to 2000 s after reflood. See statement tfinal=dmin1(2.0d+03, timer(nscan)) within the program.

3.1.3 RBHT Rod Geometry and Materials

The RBHT bundle and rod geometry is described in Section 2 of the report. Figure 2-3 shows the cross section of the RBHT bundle. The bundle has 45 heater rods and four unheated corner rods. The corner rods are used to support the bundle, grids and the thermocouple leads. The support rods are made from Inconel 600 tubing having a diameter of 9.525 mm (0.375 in.), a wall thickness of 2.108 mm (0.083 in.) and a form length of 3.96 m (156 in.). The heater rods are 3.657 m (12 ft) in heated length with a skewed axial power profile, as shown in Figure 2-4, with the peak power located at 2.74 m (9 ft) elevation. The bundle has a uniform radial power distribution. The maximum to average power ratio (P_{max}/P_{avg}) is 1.5, and the minimum to average power ratio (P_{min}/P_{avg}) is 0.5 at both ends of the heated length.

Figure 3-1 shows the description of the geometry for the RBHT heater rod geometry and dimensions.

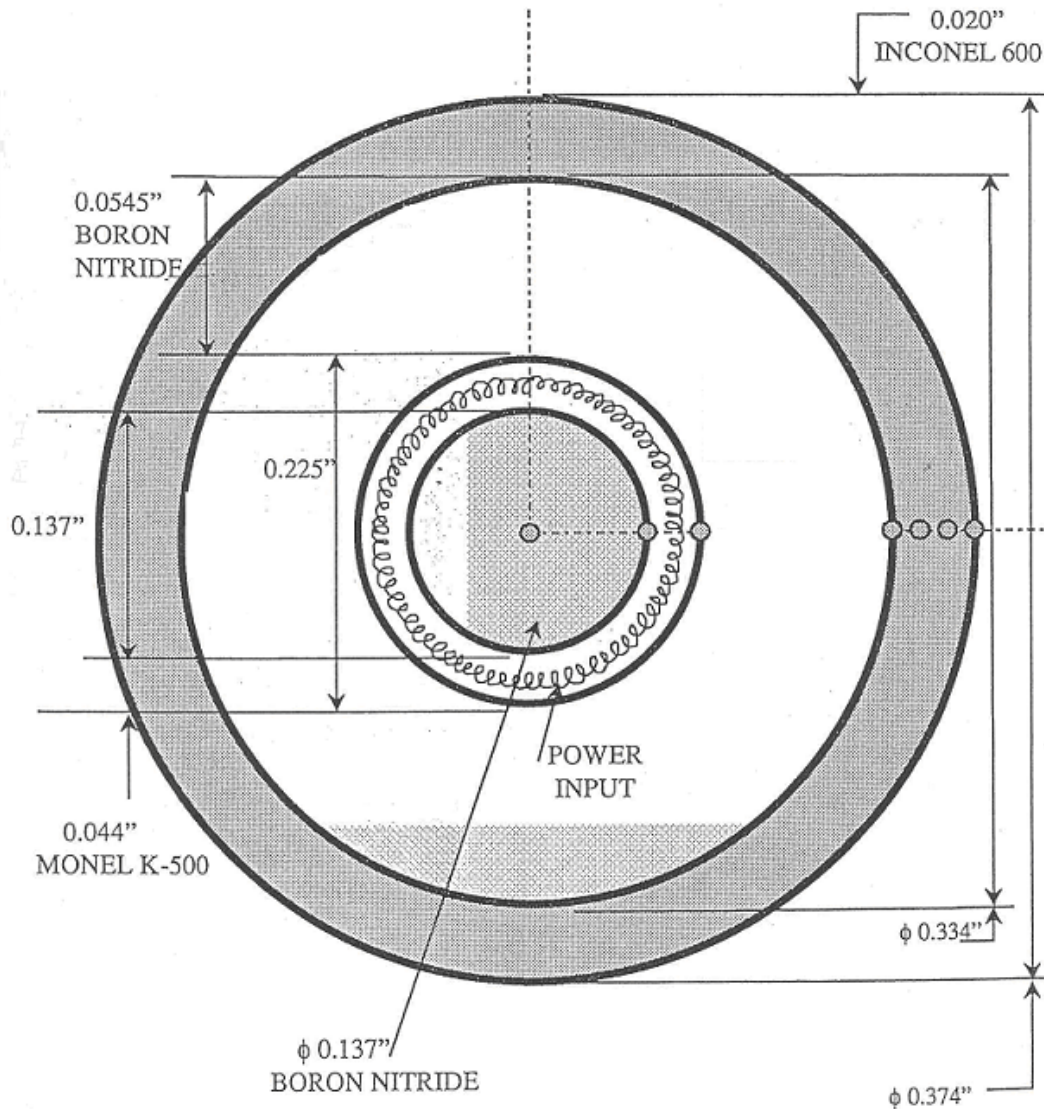


Figure 3-1: Geometry, Materials and Dimensions of RBHT Heater Rod.

3.1.4 Required Input Files

The program reads input data via two input files. The file names are expected to be in1.dat and in2.dat. These files must exist at the time the executable is run.

File in1.dat should contain sets of input data arranged in lines, one line being required per reflood experiment analyzed. Each line must have values for the following input variables in the specified format, separated by one or more spaces:

TITLE1	Character, A15	Identifier for each experimental run.
RLOC	Character, A15	Rod location/elevation.
NSCAN	Integer	Number of data points per channel.
FAX	Real	Axial power factor.
FP	Real	Fraction of zone power to this rod.
FKA	Real	Volumetric fraction of KANTHAL.
PRES	Real	System pressure, psia.
TFLOOD	Real	Time of flood, s.
DT	Real	Desired time interval between successive values of heat flux and heat transfer coefficient calculated by this program, s.

After the last set of values, a final additional line with 'END' (case sensitive) as the first two entries and zeros (in required format, real or integer) as remaining entries must be present. This signals end of input data to the executable program.

File in2.dat should contain nscan sets of time, rod power and clad temperature values per line of data in file in1.dat. (The value of nscan appears as an input in file in1.dat.) One set of values must appear on one line, each value separated by at least one space. A description of the data required follows:

timer	Real	Array of time values, s.
po11	Real	Rod power from decay power table at each TIMER value, kW. Note that the power input into the individual rod under consideration, corrected for decay, must be input here.
tclad	Real	Clad temperature, deg. F, at each timer value.
nscan	Integer	Number of data points per channel. Value is given as an input in file in1.dat

The calculation of the axial power factors for the RBHT heater rods is given in Section 3.1.5. The sample input and output files from DATARH are given at the end of the section.

3.1.5 Calculation of the Power Factor at Each Thermocouple Location

Stern Lab measured the resistance of each heater rod filament beginning from the bottom of the heated length to the end of the heated length. The measurements were made over increments of one tenth of the length of the rod and the cumulative resistances were reported. Table 3-1 shows a sample table of data from Stern Lab.

Table3-1. Heater Number 1

Length (in)	Resistance (Ohm)
0	0.000
14.28	0.018
28.55	0.040
42.83	0.066
57.1	0.096
71.38	0.129
85.65	0.166
99.93	0.211
114.20	0.258
128.48	0.291
142.75	0.315

WINDOWS (EAST)

Rod A1 Support Rod	Rod B1 GR-7 PSP-15	Rod C1 GR-0 PSP-45	Rod D1 GR-7 PSP-16	Rod E1 GR-0 PSP-48	Rod F1 GR-0 PSP-42	Rod G1 Support Rod
Rod A2 GR-0 PSP-40	Rod B2 GR-1 PSP-36	Rod C2 GR-2 PSP-32	Rod D2 GR-6 PSP-12	Rod E2 GR-8 PSP-6	Rod F2 GR-1 PSP-37	Rod G2 GR-0 PSP-47
Rod A3 GR-0 PSP-49	Rod B3 GR-8 PSP-27	Rod C3 GR-5 PSP-4	Rod D3 GR-3 PSP-21	Rod E3 GR-4 PSP-7	Rod F3 GR-8 PSP-28	Rod G3 GR-0 PSP-43
Rod A4 GR-7 PSP-17	Rod B4 GR-3 PSP-22	Rod C4 GR-3 PSP-23	Rod D4 GR-3 PSP-25	Rod E4 GR-3 PSP-24	Rod F4 GR-5 PSP-2	Rod G4 GR-0 PSP-44
Rod A5 GR-0 PSP-41	Rod B5 GR-2 PSP-33	Rod C5 GR-4 PSP-8	Rod D5 GR-8 PSP-29	Rod E5 GR-4 PSP-9	Rod F5 GR-2 PSP-34	Rod G5 GR-0 PSP-50
Rod A6 GR-7 PSP-18	Rod B6 GR-1 PSP-38	Rod C6 GR-2 PSP-35	Rod D6 GR-6 PSP-13	Rod E6 GR-8 PSP-30	Rod F6 GR-1 PSP-39	Rod G6 GR-0 PSP-3
Rod A7 Support Rod	Rod B7 GR-0 PSP-1	Rod C7 GR-6 PSP-11	Rod D7 GR-7 PSP-19	Rod E7 GR-0 PSP-46	Rod F7 GR-7 PSP-20	Rod G7 Support Rod

WINDOWS (WEST)

Figure 3-2. RBHT- Test Facility, Heater Rod Locations (Looking down from Top).

Figure 3-2 shows the schematic of the RBHT test facility heater rod layout. The 7x7 bundle consists of 8 groups of rods as indicated by GR - # (group number), these are instrumented rods while GR-0 rods are un-instrumented. The PSP - # is the serial number of the rods as given by Stern Labs.

The heater rod is composed of a series of resistances along the length. The power shape that is required is obtained by appropriately changing the pitch of the heater element.

Using the data, the resistance for every incremental length (one tenth of the total length) is calculated by subtracting the value of resistance over the total length (0 to that axial location) from the previous value (0 to the previous axial location). This would give the resistance of the filament portion for that region (one-tenth of the total length). The incremental length over which the measurements are made is also calculated. This is a constant (14.28 in or 14.27 in).

The axial power ratio is defined as the ratio of the incremental resistance for that incremental length over the incremental length to the total resistance of the rod over the total heated length. Using this definition, the axial power ratio over each incremental length is calculated.

This is plotted as a function of length to get the power shape for each rod. Since the measurements provided by Stern labs was over every tenth of the heated length, these points were plotted at an average axial position (for example – for the length between 14.28 in and 28.55 in, the incremental resistance and hence the power ratio over this span was plotted at a location of 21.415 in). Such a plot is shown in Figure 3-3, for Rod F4 (Stern lab heater number 2)

Measurements from Stern labs were such that they bypassed the peak power location, meaning – the measurement was taken at 99.93 in and 114.20 in elevations. The peak power location was 108 in. In order to calculate the power ratio at the peak power location and for any arbitrary location along the length of the heater rod, a straight line is fit for the power ratio calculated using the data points between 0 and 108 in. The equation for the power ratio is a function of length along the heater rod. Using this equation, the peak power ratio is calculated for each rod (i.e. the value of power factor is calculated at 108 in. location). This is then used along with the remaining calculated values of power ratio (for length beyond 108 in) and another such plot is made. An equation relating the power ratio and the heated length is obtained for the region beyond 108 in. Thus, for each heater rod, two plots are made, one for the length of the heater rod below the peak power location and the other beyond the peak power location to the end of the heated length. Using the equations for the power ratio as a function of axial position, the power ratio at any location along the heater rod is obtained.

This procedure is followed for each rod with thermocouples and the power ratio for every thermocouple location is obtained.

Table 3-2 shows a typical calculation for one rod (The resistances are values before swaging).

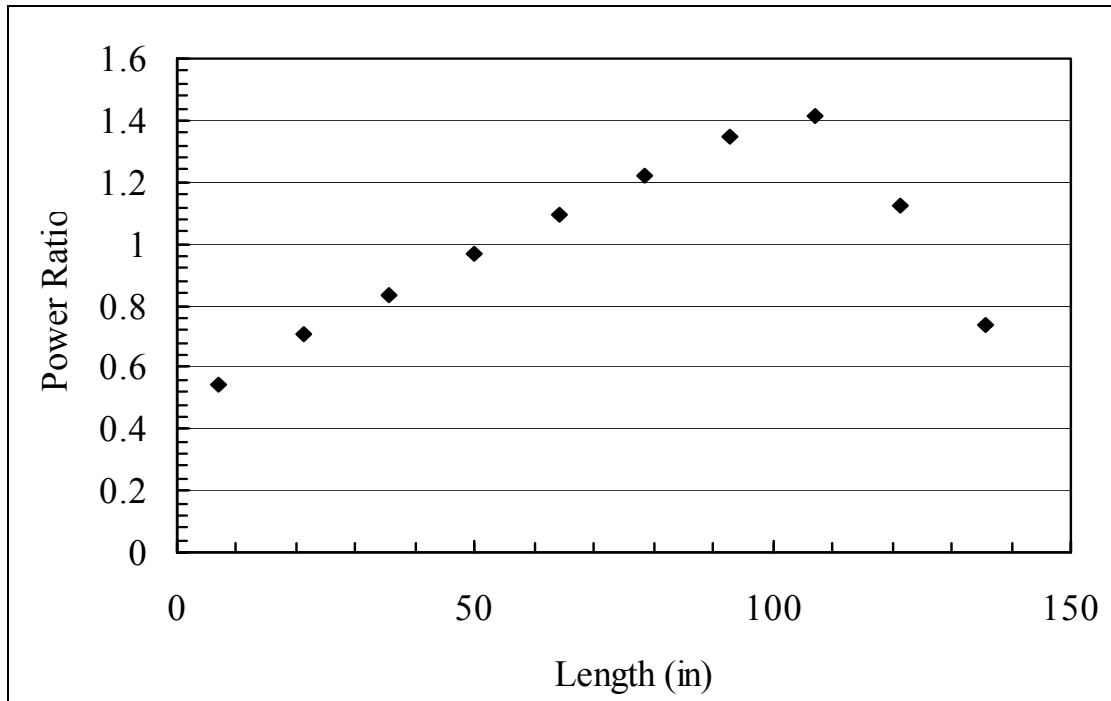


Figure 3-3 Thermocouple Locations for Rod F4, (Stern Heater number 2).

Table 3-2. Sample Power Factor Calculation for One Heater Rod

Stern Lab Heater Number 2: RBHT ROD F4								
Length	Increment	Averaged	Heater # 2	Difference	Power	Channel #	Instrument	Power
(in)	(in)	Length	Resistance	Ohm	Ratio		Location	ratio
0	14.28	7.14	0	0.017	0.55	98	85.6	1.29
14.28	14.27	21.415	0.017	0.022	0.71	99	88.4	1.31
28.55	14.28	35.69	0.039	0.026	0.84	100	92.4	1.35
42.83	14.27	49.965	0.065	0.03	0.96	101	94.3	1.37
57.1	14.28	64.24	0.095	0.034	1.09	102	97.2	1.39
71.38	14.27	78.515	0.129	0.038	1.22		108	1.49
85.65	14.28	92.79	0.167	0.042	1.35	103	108.8	1.47
99.93	14.27	107.065	0.209	0.044	1.42	104	111	1.41
		108			1.49			
114.2	14.28	121.34	0.253	0.035	1.13			
128.48	14.27	135.615	0.288	0.023	0.74			
142.75			0.311					

Figure 3-4 and Figure 3-5 show the plots of the power ratio as the function of length along the heater rod. Figure 3-4 is the plot from the beginning of the heated length to the peak power location (108 in.), while Figure 3-5 is the plot from the peak power location (108 in.) to the end of heated length.

The values of the axial power factor for all the thermocouples used in the RBHT facility is shown in Table 3-3. The values of the axial power factors range from 0 to 1.5, which is the value at peak power location of 108 in. For example: RodB1_47.9 refers to the thermocouple at 47.9 in elevation for rod B1. These values are directly used in DATARH for the local rod heat flux and heat transfer coefficient calculations.

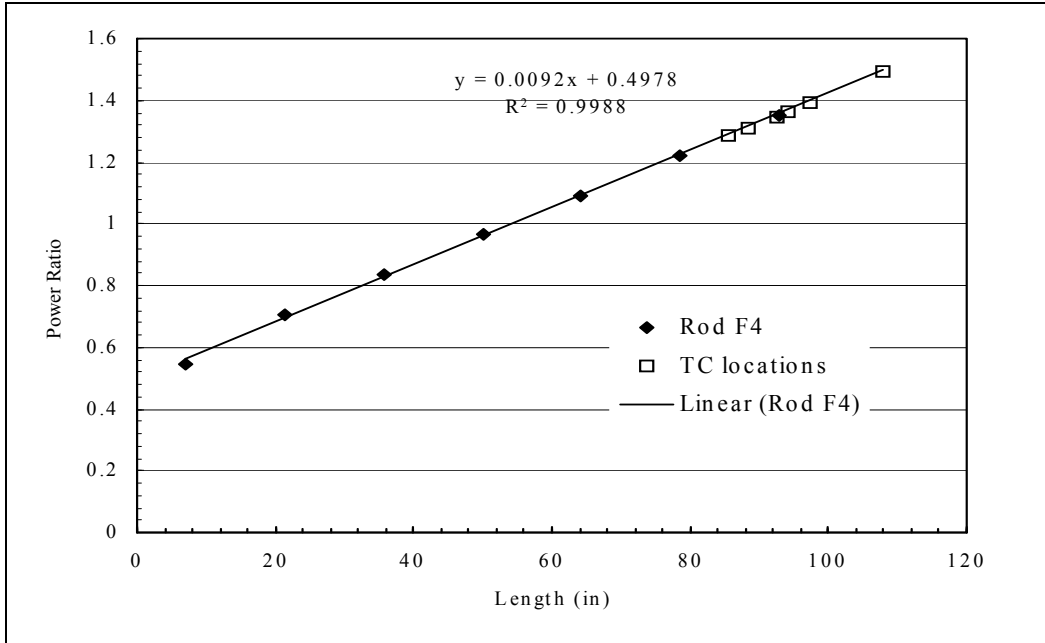


Figure 3-4. Power Ratio as a Function of Length (beginning of heated length to PCT location).

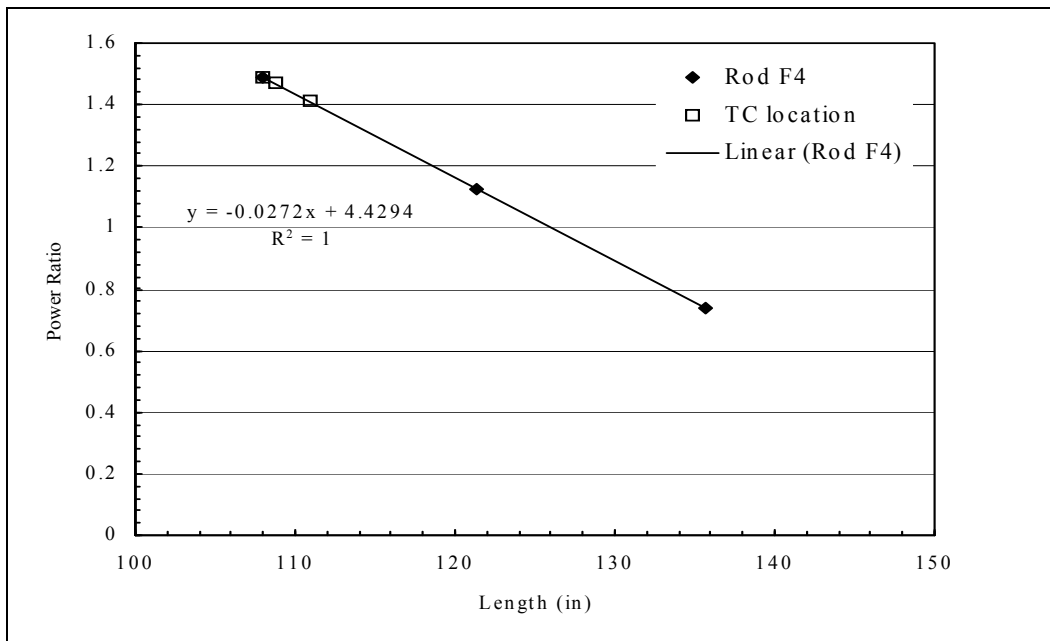


Figure 3-5. Power Ratio as a Function of Length (from PCT location to the end of heater length).

Table 3-3. Power Ratios at various axial the RBHT Heater Rods

Rod ID Elevation (inches)	Power Factor	Rod ID Elevation (inches)	Power Factor	Rod ID Elevation (inches)	Power Factor
RodB1_47.9	0.936	RodE2_66	1.111	RodF3_54	0.993
RodB1_63.6	1.082	RodE2_69.8	1.147	RodF3_57	1.022
RodB1_68.6	1.128	RodE2_72.9	1.176	RodF3_60	1.05
RodB1_79.7	1.231	RodE2_74.9	1.195	RodF3_66.1	1.108
RodB1_97.1	1.393	RodF2_4.1	0.519	RodF3_69.9	1.145
RodB1_114.8	1.314	RodF2_11.2	0.586	RodF3_73	1.174
RodB1_126.7	0.99	RodF2_16.2	0.634	RodF3_75	1.193
RodB1_139.4	0.644	RodF2_23.3	0.701	RodA4_48	0.94
RodD1_47.9	0.941	RodF2_29.2	0.757	RodA4_63.8	1.084
RodD1_63.8	1.093	RodF2_33.3	0.796	RodA4_68.8	1.13
RodD1_68.8	1.141	RodF2_35.3	0.815	RodA4_79.9	1.231
RodD1_79.9	1.248	RodF2_38.3	0.843	RodA4_97.1	1.387
RodD1_97.3	1.415	RodB3_50.2	0.956	RodA4_115	1.291
RodD1_115	1.317	RodB3_54.1	0.992	RodA4_126.8	0.977
RodD1_126.6	0.99	RodB3_56.9	1.018	RodA4_139.4	0.642
RodD1_139.4	0.629	RodB3_60.1	1.048	RodB4_88.4	1.303
RodB2_4.1	0.521	RodB3_66.1	1.104	RodB4_91.3	1.329
RodB2_11.2	0.589	RodB3_69.9	1.139	RodB4_93.3	1.347
RodB2_16.2	0.636	RodB3_73	1.168	RodB4_95.1	1.363
RodB2_23.3	0.704	RodB3_75	1.187	RodB4_100	1.407
RodB2_29.3	0.761	RodC3_79.8	1.228	RodB4_106	1.461
RodB2_33.3	0.799	RodC3_85.6	1.281	RodB4_109.9	1.414
RodB2_35.3	0.818	RodC3_88.5	1.308	RodB4_142.3	0.549
RodB2_38.4	0.847	RodC3_92.4	1.344	RodC4_88.4	1.328
RodC2_41	0.87	RodC3_94.4	1.362	RodC4_91.1	1.354
RodC2_53.1	0.983	RodC3_97.2	1.388	RodC4_93.4	1.376
RodC2_55	1	RodC3_108.8	1.463	RodC4_95.3	1.394
RodC2_57.8	1.026	RodD3_88.3	1.313	RodC4_100.1	1.439
RodC2_63.9	1.083	RodD3_91.3	1.341	RodC4_106.1	1.496
RodC2_73.8	1.175	RodD3_93.1	1.358	RodC4_110	1.448
RodC2_75.8	1.194	RodD3_95.3	1.378	RodC4_142.2	0.553
RodC2_76.8	1.203	RodD3_100.1	1.423	RodD4_88.3	1.323
RodD2_103.2	1.455	RodD3_106.1	1.479	RodD4_91.3	1.351
RodD2_106	1.481	RodD3_110	1.46	RodD4_93.2	1.369
RodD2_112.6	1.358	RodD3_142.1	0.51	RodD4_95.2	1.388
RodD2_114.9	1.295	RodE3_63.4	1.079	RodD4_100.1	1.434
RodD2_117.4	1.227	RodE3_113.6	1.331	RodD4_106.1	1.491
RodD2_120.8	1.134	RodE3_115.5	1.281	RodD4_110	1.44
RodD2_124.8	1.024	RodE3_118.5	1.203	RodD4_142.1	0.534
RodD2_128.6	0.92	RodE3_122.7	1.094	RodE4_88.4	1.303
RodE2_50.1	0.962	RodE3_126.5	0.995	RodE4_91.2	1.329
RodE2_54	0.998	RodE3_131.7	0.86	RodE4_93.2	1.347
RodE2_56.9	1.025	RodE3_135.6	0.759	RodE4_95.3	1.365
RodE2_59.9	1.054	RodF3_50.1	0.956	RodE4_100.9	1.416

Table 3-3 Power Ratios for Thermocouple Locations for the RBHT Heater Rods (cont.)

Rod ID Elevation (inches)	Power Factor	Rod ID Elevation (inches)	Power Factor	Rod ID Elevation (inches)	Power Factor
RodE4_106.1	1.463	RodF5_57.8	1.022	RodE6_75	1.184
RodE4_110	1.428	RodF5_64	1.08	RodF6_4.1	0.528
RodE4_142.3	0.54	RodF5_73.8	1.171	RodF6_11.2	0.593
RodF4_85.6	1.285	RodF5_75.8	1.19	RodF6_16.3	0.639
RodF4_88.4	1.311	RodF5_76.8	1.199	RodF6_23.3	0.703
RodF4_92.4	1.348	RodA6_47.7	0.942	RodF6_29.3	0.757
RodF4_94.3	1.365	RodA6_63.6	1.085	RodF6_33.3	0.794
RodF4_97.2	1.392	RodA6_68.5	1.129	RodF6_35.3	0.812
RodF4_108.8	1.47	RodA6_79.8	1.231	RodF6_38.3	0.839
RodF4_111	1.41	RodA6_97.4	1.389	RodC7_112.6	1.323
RodB5_41	0.872	RodA6_115.1	1.29	RodC7_116.6	1.224
RodB5_52.9	0.982	RodA6_126.6	0.986	RodC7_124.4	1.03
RodB5_55	1.002	RodA6_139.9	0.633	RodC7_128.4	0.931
RodB5_57.8	1.028	RodB6_4.1	0.526	RodD7_47.9	0.948
RodB5_64	1.085	RodB6_11.2	0.592	RodD7_63.6	1.091
RodB5_73.9	1.177	RodB6_16.2	0.638	RodD7_68.8	1.138
RodB5_75.9	1.196	RodB6_23.3	0.703	RodD7_79.8	1.238
RodB5_76.9	1.205	RodB6_29.3	0.758	RodD7_97.1	1.396
RodC5_63.7	1.059	RodB6_33.3	0.795	RodD7_114.9	1.293
RodC5_113.6	1.298	RodB6_35.3	0.813	RodD7_126.7	0.958
RodC5_115.7	1.246	RodB6_38.4	0.842	RodD7_139.4	0.598
RodC5_122.7	1.073	RodC6_40.9	0.866	RodF7_47.9	0.946
RodC5_126.7	0.974	RodC6_52.8	0.981	RodF7_63.8	1.101
RodC5_131.6	0.853	RodC6_54.8	1.001	RodF7_68.9	1.15
RodC5_135.7	0.752	RodC6_57.8	1.03	RodF7_79.9	1.257
RodD5_50	0.959	RodC6_63.8	1.088	RodF7_97.2	1.425
RodD5_54.1	0.996	RodC6_73.7	1.184	RodF7_114.9	1.333
RodD5_56.9	1.022	RodC6_75.8	1.204	RodF7_126.8	0.953
RodD5_60	1.051	RodC6_76.8	1.214	RodF7_139.4	0.551
RodD5_66.1	1.107	RodD6_103.1	1.457		
RodD5_69.9	1.142	RodD6_106	1.484		
RodD5_72.9	1.169	RodD6_112.9	1.354		
RodD5_74.9	1.188	RodD6_114.9	1.298		
RodE5_63.6	1.085	RodD6_116.8	1.246		
RodE5_113.6	1.339	RodD6_120.9	1.132		
RodE5_115.4	1.292	RodD6_124.8	1.024		
RodE5_118.7	1.208	RodD6_128.7	0.916		
RodE5_122.6	1.108	RodE6_50.2	0.956		
RodE5_126.6	1.006	RodE6_54.1	0.992		
RodE5_131.6	0.878	RodE6_57	1.018		
RodE5_135.6	0.775	RodE6_60.2	1.048		
RodF5_41	0.866	RodE6_66.1	1.102		
RodF5_53.1	0.978	RodE6_70	1.138		
RodF5_55	0.996	RodE6_73.1	1.166		

Sample input file: in1.dat

```
RodD4_110 RodD4_110 8656 1.4396 1 0.863844 40 0 0.5
END END 0 0.00 0.0 0.00 0.0 0.0 0.0
```

This input file should contain values of the following variables, each value separated by one or more spaces:

TITLE1, RLOC, NSCAN, FAX, FP, FKA, PRES, TFLOOD, DT

TITLE1 Character, A15 Identifier for each experimental run.
RLOC Character, A15 Rod location/elevation.
NSCAN Integer Number of data points per channel.
FAX Real Axial power factor.
FP Real Fraction of zone power to this rod.
FKA Real Volumetric fraction of KANTHAL.
PRES Real System pressure, psia.
TFLOOD Real Time of flood, s.
DT Real Desired time interval between successive values of heat flux and heat transfer coefficient calculated by this program, s.

One line of values per test case should be present.

After the last set of values, a final additional line with 'END' as the first two entries and zeros (in required format, real or integer) as remaining entries must be present.

Table 3-4 Sample Input File: in2.dat*

0	3.194	1290.706	871.8	3.201	274.289
0.1	3.196	1290.153	871.9	3.202	275.174
0.2	3.196	1291.238	872	3.201	274.204
0.3	3.194	1292.015	872.1	3.203	274.057
0.4	3.193	1292.547	872.2	3.202	274.162
0.5	3.196	1293.427	872.3	3.202	274.014
0.6	3.197	1294.061	872.4	3.202	273.951
0.7	3.196	1294.470	872.5	3.201	273.382
0.8	3.199	1295.165	872.6	3.200	273.361
0.9	3.198	1296.147	872.7	3.201	273.930
1	3.197	1296.454	872.8	3.202	273.234
1.1	3.197	1297.313	872.9	3.202	273.234
1.2	3.197	1297.538	873	3.202	274.162
1.3	3.198	1298.623	873.1	3.202	274.310
1.4	3.199	1298.909	873.2	2.543	274.774
1.5	3.198	1299.647	873.3	0.021	273.445
1.6	3.195	1300.490			
1.7	3.195	1300.901			
1.8	3.200	1301.291			
1.9	3.200	1302.195			
2	3.200	1303.079			

* Note: This input file is truncated between the two columns of entries in view of saving paper for print out. The file continues in steps of 0.1 s. Obviously, this text line portion will not appear in the actual input file. This file is usually created in EXCEL and saved as in2.dat

SAMPLE OUTPUT FILE

***** RBHT EXPERIMENTS *****

***** Test ID : RodD4_110

***** Rod : RodD4_110

Initial Run Conditions :

No. of data points per Channel: 8656
 Axial Power Factor: 1.43960
 Fraction of Zone Power to rod: 1.00000
 Volumetric fraction of KANTHAL: 0.86384
 System pressure: 40.00000 psi
 Time of Flood: 0.00000 sec
 Desired time interval between successive values of results: 0.50000 sec

Saturation Temperature is: 264.51414 deg. F

** Summary of Results **

** Test ID : RodD4_110 **

Time (s)	Data Temp (F)	Calculated Surface Temp	Heat Flux (F) (Btu/hr.ft^2)	Heat Transfer Coefficient (Btu/hr.ft^2.F)
0.00	1290.71	1290.18	0.5879E+04	0.5731E+01
0.50	1293.43	1292.26	0.3568E+04	0.3472E+01
1.00	1296.45	1295.18	0.1908E+04	0.1851E+01
1.50	1299.65	1298.13	0.1502E+04	0.1453E+01
2.00	1303.08	1301.33	0.7332E+03	0.7072E+00
2.50	1305.71	1304.41	0.7259E+03	0.6980E+00
3.00	1309.39	1307.64	0.2868E+03	0.2749E+00
3.50	1312.12	1310.69	0.5431E+03	0.5191E+00
4.00	1315.61	1313.85	0.2996E+03	0.2855E+00
4.50	1318.33	1316.86	0.5821E+03	0.5531E+00
5.00	1321.74	1319.73	0.9626E+03	0.9123E+00

Note: The results are truncated in view of saving paper for print-out. Time results continue in steps of 0.5 s until here. Obviously this text line will not appear in the actual output file. This file can be opened in EXCEL or a program like notepad.

868.50	273.23	268.20	0.1270E+05	0.3448E+04
869.00	273.99	269.13	0.1178E+05	0.2549E+04
869.50	274.82	269.64	0.1211E+05	0.2364E+04
870.00	276.38	269.50	0.1314E+05	0.2636E+04
870.50	275.79	269.18	0.1375E+05	0.2949E+04
871.00	274.79	268.79	0.1408E+05	0.3289E+04

This is the end of RodD4_110

The format of input for file in1.dat has already been described in the write-up for DATARH.F.

What follows now is all the information pertaining to RBHT heater rods that need to be input into the file in1.dat, used for running DATARH.F.

For each experiment, the value of NSCAN (set as 8656), PRES (set as 40), TFLOOD (set as 0) and DT (set as 0.5) in the sample listing below, need to be changed prior to running the code to reflect the number of values of NSCAN, the experimental pressure and time of flood.

TITLE1, RLOC, FAX, FP and FKA are fixed values for the RBHT heater rods.

Note that file in1.dat contains ONLY one line of input for each test case. Please refer to the sample file in1.dat that has been provided.

RodB1_47.9	RodB1_47.9	8656	0.936	1	0.859	40	0	0.5
RodB1_63.6	RodB1_63.6	8656	1.082	1	0.866	40	0	0.5
RodB1_68.6	RodB1_68.6	8656	1.128	1	0.867	40	0	0.5
RodB1_79.7	RodB1_79.7	8656	1.231	1	0.869	40	0	0.5
RodB1_97.1	RodB1_97.1	8656	1.393	1	0.867	40	0	0.5
RodB1_114.8	RodB1_114.8	8656	1.314	1	0.867	40	0	0.5
RodB1_126.7	RodB1_126.7	8656	0.990	1	0.860	40	0	0.5
RodB1_139.4	RodB1_139.4	8656	0.644	1	0.816	40	0	0.5
RodD1_47.9	RodD1_47.9	8656	0.941	1	0.859	40	0	0.5
RodD1_63.8	RodD1_63.8	8656	1.093	1	0.866	40	0	0.5
RodD1_68.8	RodD1_68.8	8656	1.141	1	0.867	40	0	0.5
RodD1_79.9	RodD1_79.9	8656	1.248	1	0.869	40	0	0.5
RodD1_97.3	RodD1_97.3	8656	1.415	1	0.867	40	0	0.5
RodD1_115	RodD1_115	8656	1.317	1	0.867	40	0	0.5
RodD1_126.6	RodD1_126.6	8656	0.990	1	0.860	40	0	0.5
RodD1_139.4	RodD1_139.4	8656	0.629	1	0.816	40	0	0.5
RodB2_4.1	RodB2_4.1	8656	0.521	1	0.792	40	0	0.5
RodB2_11.2	RodB2_11.2	8656	0.589	1	0.811	40	0	0.5
RodB2_16.2	RodB2_16.2	8656	0.636	1	0.822	40	0	0.5
RodB2_23.3	RodB2_23.3	8656	0.704	1	0.835	40	0	0.5
RodB2_29.3	RodB2_29.3	8656	0.761	1	0.843	40	0	0.5
RodB2_33.3	RodB2_33.3	8656	0.799	1	0.847	40	0	0.5
RodB2_35.3	RodB2_35.3	8656	0.818	1	0.849	40	0	0.5
RodB2_38.4	RodB2_38.4	8656	0.847	1	0.852	40	0	0.5
RodC2_41	RodC2_41	8656	0.870	1	0.854	40	0	0.5
RodC2_53.1	RodC2_53.1	8656	0.983	1	0.862	40	0	0.5
RodC2_55	RodC2_55	8656	1.000	1	0.863	40	0	0.5
RodC2_57.8	RodC2_57.8	8656	1.026	1	0.864	40	0	0.5
RodC2_63.9	RodC2_63.9	8656	1.083	1	0.866	40	0	0.5
RodC2_73.8	RodC2_73.8	8656	1.175	1	0.868	40	0	0.5

3.2. Subchannel Mean Bulk Fluid Temperature

In order to calculate the local heat transfer coefficient in terms of the local bulk mean temperature of the flow, a method based upon the analogy of momentum and heat transfer was developed to correlate the local bulk mean temperature to the local subchannel centerline temperature, which was measured in the experiments [5]. Steam cooling data covering a wide range of Reynolds numbers were used to obtain a correlation factor for determining the local bulk mean temperature.

The analogy between momentum and heat transfer is widely recognized for internal flows.

From this, at a given elevation of a rod bundle, the expected relationship is:

$$\frac{T - T_w}{T_c - T_w} = \frac{u}{u_c} = f(\eta) \quad (3-27)$$

where T is the local temperature, u the local velocity, T_c the subchannel center temperature, u_c the subchannel center velocity, T_w the rod temperature, and η the dimensionless radial coordinate (r/r₀)

The local bulk mean temperature is defined as:

$$T_b = \frac{\int_0^{r_0} uTrdr}{\int_0^{r_0} urdr} \quad (3-28)$$

where r is the measured distance from the subchannel center and r₀ is the distance to the wall (heater rod surface)

Substituting Equation (3-27) into (3-28) gives

$$T_b = T_w + (T_c - T_w)/F \quad (3-29)$$

where F, the correlation factor, is given as:

$$F = \frac{\int_0^1 f(\eta)\eta d\eta}{\int_0^1 f^2(\eta)\eta d\eta} \quad (3-30)$$

For a given system pressure and bundle power, the local temperature profile, f(η), was measured at various axial locations for different Reynolds numbers. The Reynolds number is based on the local properties of steam evaluated at the local temperature. The correlation factor F was evaluated from the steam cooling test data as shown in Figure 3-6. Also shown in the figure are values of F obtained from the local velocity profiles reported in the literature for channel flows [6]. For turbulent flows, f(η) has been shown to satisfy a 1/n power-law relationship with n equal to 7 over a wide range of Reynolds numbers. However, for Reynolds numbers between 2300 and 5000, n has a value very close to 5. When the Reynolds number is greater than 10⁶, the value of n is close to 9. For Reynolds numbers below 2300, the flow becomes laminar and the correlation factor has a value of 1.5.

The “F” method has been presented at an ANS meeting by Cheung et al. [5] and described in detail in the thesis work of McLaughlin [11]. The uncertainty in F depends, of course, on the uncertainty in the measured temperature profile using the steam probes as discussed in Appendix B.

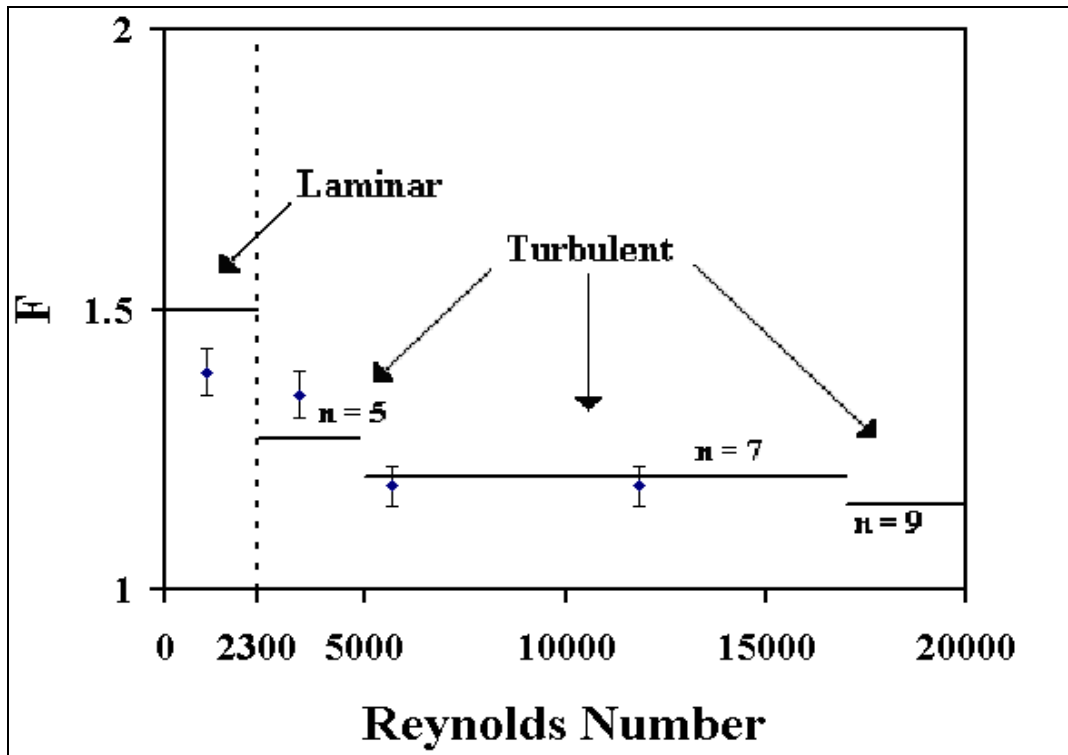


Figure 3-6. Variation of the Correlation Factor with the Reynolds Number.

A method based upon momentum and heat transfer analogy has been successfully developed to correlate the local bulk mean temperature to the local subchannel centerline temperature by use of a correlation factor. The correlation factor is a function of the Reynolds number alone, which can be used to determine the local bulk mean temperature.

Since the subchannel center temperature is used to calculate the mean bulk fluid temperature it is necessary to have a subchannel center temperature at every heater rod thermocouple location in which a heat transfer coefficient is to be calculated. To accomplish this, the thirteen subchannel center temperature measurements were plotted axially and a third order polynomial curve fit was generated such that the center temperature could be estimated at any elevation in the bundle. Figure 3-7 shows a sample axial plot of the subchannel centerline fluid temperature along with the third order data fit.

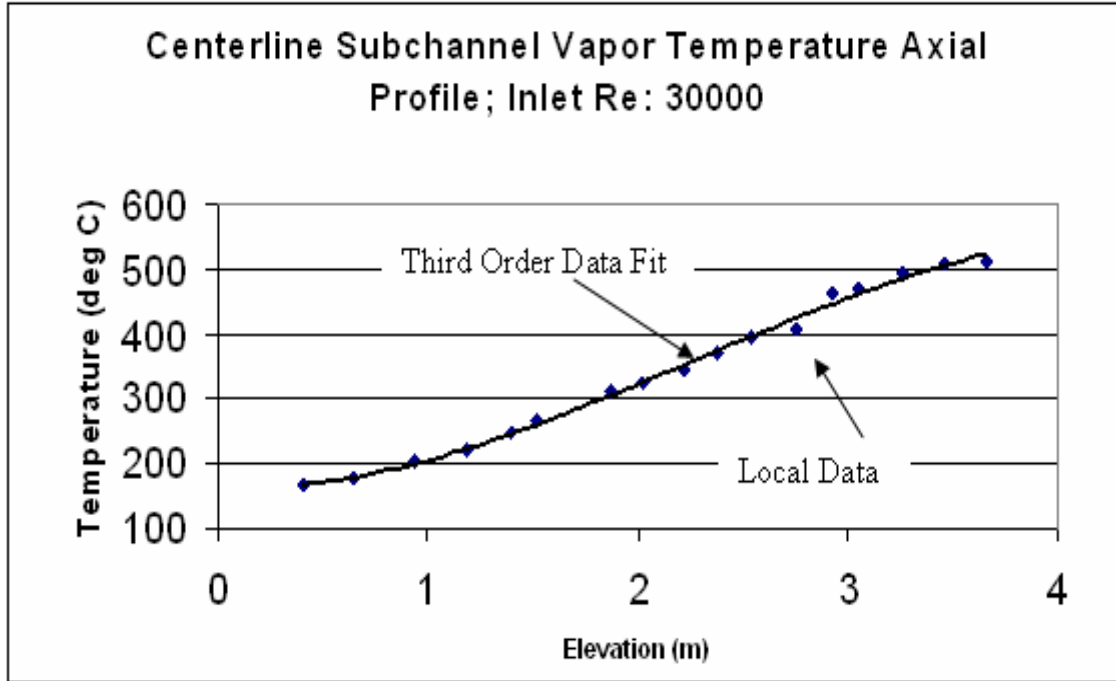


Figure 3-7. Subchannel Center Vapor Temperature.

3.3. Subchannel Reynolds Number

Using the calculated mean bulk fluid temperature, the steam fluid properties were found and local subchannel Reynolds numbers were calculated along the axial length of the bundle. In order to calculate the local Reynolds number, the subchannel mass flow is calculated, assuming a uniform mass flow distribution of the steam through each subchannel:

$$\dot{m}_{SC} = \frac{A_{SC}}{A_f} * \dot{m} \quad (3-31)$$

where \dot{m}_{SC} is the subchannel mass flow rate, \dot{m} is the bundle mass flow rate, A_f the bundle flow area, and A_{SC} the subchannel flow area.

The local Reynolds number is a function of the hydraulic diameter. In order to calculate the local Reynolds number in a subchannel, the local hydraulic diameter had to be calculated from the subchannel geometry as:

$$D_H = \frac{4 * A_{SC}}{WP_{SC}} \quad (3-32)$$

where D_H is the subchannel hydraulic diameter, and WP_{SC} the subchannel wetted perimeter. In this case the wetted perimeter is equal to the heated perimeter of the heater rods.

The local Reynolds numbers were then calculated from Equation 3-33, where the properties for

the local viscosity of the steam are at the mean bulk temperature of the subchannel. That is:

$$\text{Re}(z) = \frac{\dot{m}_{sc} D_H}{A_{sc} \mu(z)} \quad (3-33)$$

where $\text{Re}(z)$ is the local subchannel Reynolds number and μ the local viscosity.

3.4. Heat Transfer Coefficient and Nusselt Number

Heat transfer coefficients and resulting Nusselt numbers are calculated at all heater rod thermocouple locations within the inner 5x5 bundle, except for the corner rods. The rod outside wall temperature and local heat flux are calculated by DATARH and the mean bulk fluid temperature is found using the measured subchannel centerline vapor temperature and the heat transfer/momentum analogy as described in Section 3.2. With these three quantities known the heat transfer coefficient is found from:

$$h(z) = \frac{q''(z)}{(T_w(z) - T_b(z))} \quad (3-34)$$

where $h(z)$ is the local heat transfer coefficient, $q''(z)$ is the local heat flux, $T_w(z)$ the local wall temperature, and $T_b(z)$ the local mean bulk temperature.

From the local heat transfer coefficient, the local Nusselt number can be calculated using the local vapor thermal conductivity of the steam evaluated at the mean bulk temperature. The expression for the Nusselt number becomes:

$$\text{Nu}(z) = \frac{h(z) D_H}{k_v(z)} \quad (3-35)$$

where $\text{Nu}(z)$ is the local Nusselt number and $k_v(z)$ the local vapor thermal conductivity.

3.5. Mixing Vane Grid Loss Coefficient

Pressure drop measurements were made along bare bundle lengths (no grids within the pressure drop measurement span) and along spans that contained one or more grids using Differential Pressure (DP) cells. Grid loss coefficients were calculated across DP spans that contained one grid.

The measured pressure drop across a span containing a spacer grid has two components; a single-phase frictional pressure drop caused by the bare bundle and a pressure drop related to the grid loss coefficient:

$$\Delta P_{\text{measured}} = \Delta P_{\text{bare}} + \Delta P_{\text{grid}} \quad (3-36)$$

where $\Delta P_{\text{measured}}$ is the measured pressure drop across a span containing a spacer grid, ΔP_{bare} is

the single-phase frictional pressure drop, and ΔP_{grid} is the pressure drop caused by the grid itself. The single-phase pressure drop is related to the friction factor f by:

$$\Delta P_{bare} = \frac{\rho f L V^2}{2 D_H} \quad (3-37)$$

where L is the DP span length, V the average velocity across the span, ρ the density evaluated at the average bulk fluid temperature across the DP span, and D_H the bundle hydraulic diameter. The pressure drop created by the grid is a function of the grid loss coefficient (k_{grid}):

$$\Delta P_{grid} = \frac{k_{grid} \rho V^2}{2} \quad (3-38)$$

where ρ and V are the same as in Equation 3-37.

Combining Equations 3-36 through 3-38, an expression for the grid loss coefficient can be found:

$$k_{grid} = \left[\frac{2 \Delta P_{measured}}{\rho V^2} - \left(\frac{f L}{D_H} \right) \right] \quad (3-39)$$

Review of Equation 3-39 shows that the grid loss coefficient is a function of the measured pressure drop, the DP span length, the bundle hydraulic diameter, the fluid density and velocity, as well as the single-phase friction factor. In this case the frictional pressure drop is calculated across the entire bundle length, including grids.

The bundle hydraulic diameter is easily calculated and span length is known, however, determination of the average fluid density and velocity require an energy balance on the system. Knowing the inlet flow conditions and the bundle power, the fluid enthalpy as a function of bundle length is found from:

$$h(z) = \frac{P \int_0^z P.F.(z) dz}{\dot{m}} + h_{inlet} \quad (3-40)$$

where P is the bundle power, \dot{m} the inlet steam flow, P.F. the axial peaking factor shown in Figure 2-4, and h_{inlet} the inlet enthalpy. With the fluid enthalpy known at a certain elevation, the bundle bulk fluid temperature can be determined:

$$T_{bulk}(z) = \frac{(h(z) - h_{inlet})}{C_p} + T_{inlet} \quad (3-41)$$

where C_p is the fluid specific heat. For this calculation C_p is assumed constant and is evaluated at the steam inlet temperature, and upper plenum pressure.

Using Equations 3-40 and 3-41, the enthalpy and bulk steam temperature can be calculated at the ends of a DP span. The steam temperature is then averaged across the span and the

average span fluid density is found for this temperature and the specified upper plenum pressure.

With the average fluid density known for a given DP span, the average fluid velocity across that span is found by assuming a constant bundle flow rate:

$$V = \frac{\dot{m}}{A_f \rho} \quad (3-42)$$

where A_f is the bundle flow area and ρ the average fluid density across the DP span in question.

3.5.1 Single-Phase Friction Factor

As mentioned previously, DP measurements were made along bare bundle spans that do not contain a spacer grid. These measurements can be used with Equation 3-37 to determine single-phase friction factors:

$$f = \frac{2\Delta P_{bare} D_H}{\rho L V^2} \quad (3-43)$$

where the variables are the same as in Equation 3-37 and the fluid density and velocity are averaged across the span and are derived from the energy balance described above.

Figure 3-8 and Figure 3-9 below provide comparisons of the calculated friction factors from the RBHT data to several single-phase friction factor correlations. The Blasius correlation [7] was created for circular geometries and is valid for Reynolds numbers between 4000 and 10^5 . The Laminar correlation is taken from Moody [7] and is valid for Reynolds numbers below 2300. The correlation used by TRACE V4.160 [8] is a modification of the Churchill correlation and is used for all Reynolds numbers.

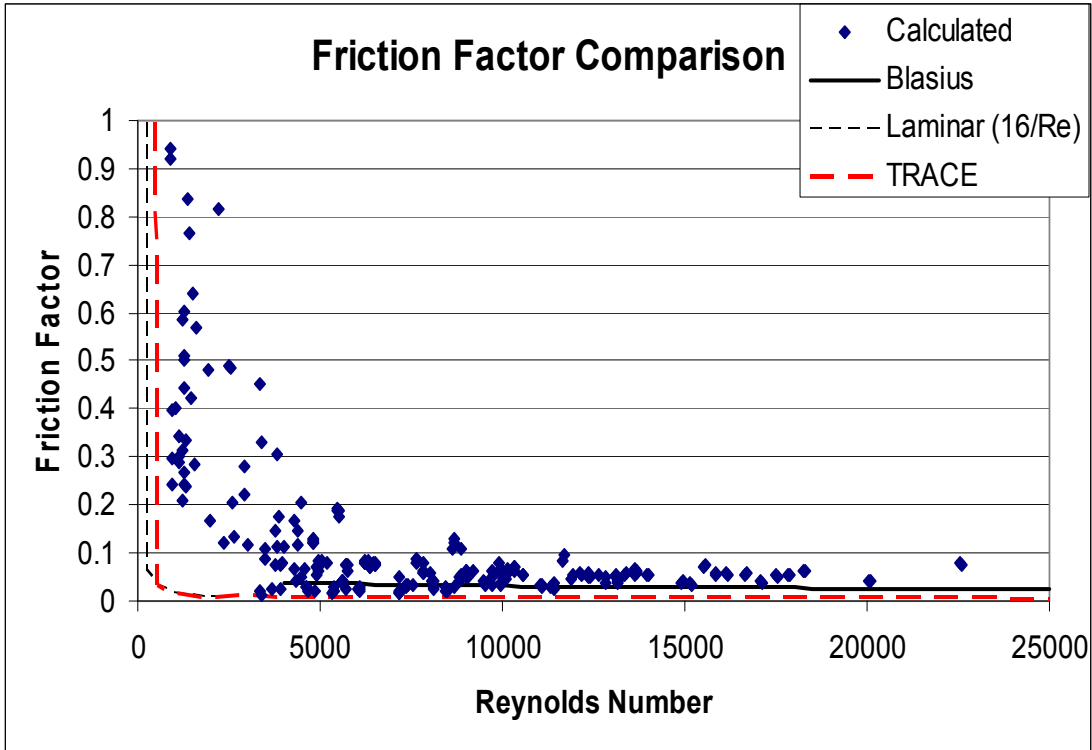


Figure 3-8. Friction Factor Comparison (Full Range).

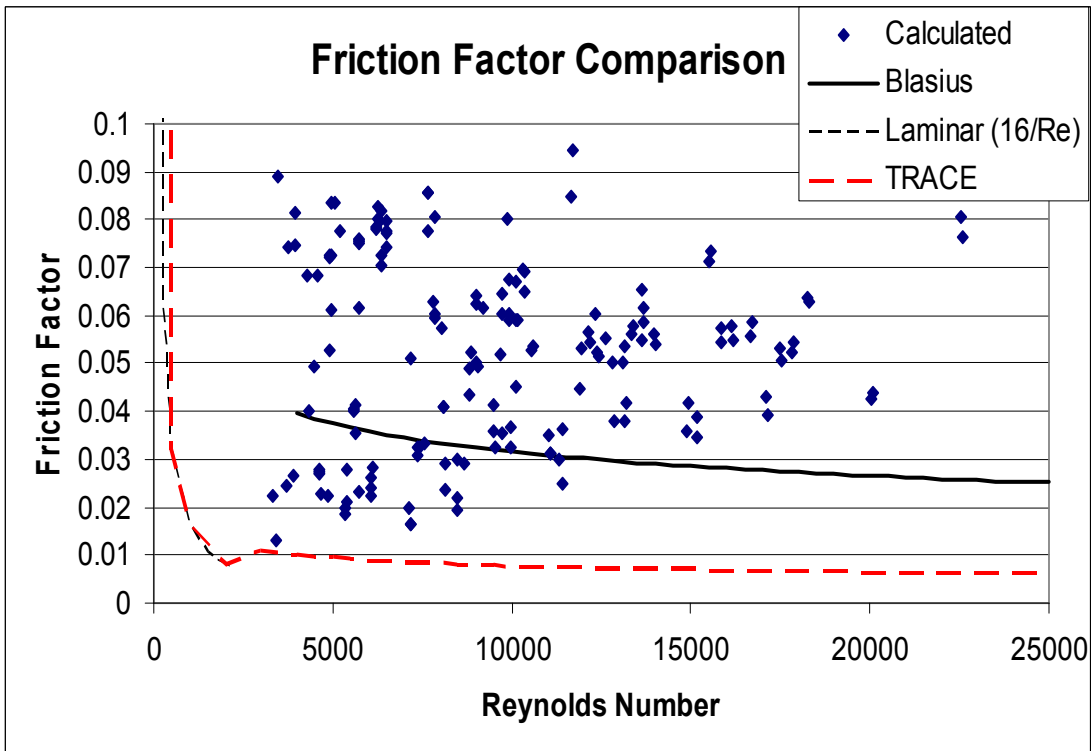


Figure 3-9. Friction Factor Comparison (Zoomed in).

Review of Figure 3-8 and Figure 3-9 reveals that the majority of the RBHT single-phase friction factor data falls above the presented correlations. This is expected since the spacer grid acts to disrupt the boundary layer on the heater rods such that the flow must redevelop downstream of the grid, resulting in higher effective frictional losses. This behavior was also seen in the separate effects single-phase pressure drop experiments used to characterize the RBHT bundle.

Due to the relatively large spread in the RBHT friction factor data and the fact that the calculated grid loss coefficients will be used to improve the models in TRACE, the single phase friction factors used for the grid loss coefficient calculation will be found from the correlation used by TRACE V4.160 instead of the relationship given in Equation(3-43). This is a modified Churchill correlation:

$$f = 2 \left(\left(\frac{8}{\text{Re}} \right)^{12} + \left(\frac{1}{(a+b)^{1.5}} \right) \right)^{1/12} \quad (3-44)$$

where:

$$a = \left(2.457 \ln \left(\frac{1}{\left(\frac{7}{\text{Re}} \right)^{0.9} + 0.27 \frac{\varepsilon}{D_H}} \right) \right)^{16} \quad (3-45)$$

$$b = \left(\frac{37530}{\text{Re}} \right)^{16} \quad (3-46)$$

and Re is the local bundle Reynolds number, ε the surface roughness and D_H the bundle hydraulic diameter. For the RBHT facility the ratio ε/D_H was found to be 1.6×10^{-4} and the local Reynolds number is found assuming a constant bundle flow rate:

$$\text{Re} = \frac{\dot{m} D_H}{\mu A_f} \quad (3-47)$$

Here the viscosity is evaluated at the average steam temperature for a given DP span and the terms D_H and A_f represent the bundle hydraulic diameter and bundle flow area.

3.5.2 Grid Loss Coefficient Results

Using the methodology described above, grid loss coefficients were calculated over a range of local Reynolds numbers spanning from approximately 800 – 2100. Each valid steady-state window allows a grid loss coefficient to be calculated for grids 2, 4, 5, and 6. A grid loss coefficient was not calculated for grid 1 because it is located close to the bundle inlet. Since the flow is not fully developed here the grid loss coefficient would be larger than expected. Loss coefficients were not calculated for grids 3 and 7 because these grids have moved, covering one of the DP taps which means the recorded pressure drop from these DP cells only reflects a partial grid loss.

Grid loss coefficient results are plotted with respect to local Reynolds number and are shown in Figure 3-10 and Figure 3-11. The results are also available in Table 3-5 which lists the loss coefficient uncertainties as well.

Table 3-5. Calculated Grid Loss Coefficients

Test #	Grid #	Avg. Re#	k_grid	±σ	% Uncertainty	Test #	Grid #	Avg. Re#	k_grid	±σ	% Uncertainty
SC-3163	2	3115	6.31	1.45	23.0	SC-3214-2	2	21120	2.15	0.07	3.1
	4	2404	4.27	0.92	21.5		4	16587	2.29	0.07	3.0
	5	2091	5.42	1.17	21.6		5	14544	2.60	0.08	3.0
	6	1753	7.73	1.66	21.5		6	12297	3.06	0.09	3.0
SC-3166	2	1597	26.70	10.71	40.1	SC-3216	2	15661	2.52	0.11	4.2
	4	1177	7.18	2.91	40.5		4	12447	2.50	0.10	4.1
	5	1005	12.32	4.94	40.1		5	10971	2.43	0.10	4.1
	6	827	15.24	6.11	40.1		6	9325	3.02	0.13	4.2
SC-3171	2	1762	26.21	10.57	40.3	SC-3242	2	11880	2.49	0.14	5.7
	4	1473	0.78	0.86	110.7		4	9456	2.17	0.12	5.5
	6	1159	9.41	4.02	42.7		5	8339	2.63	0.15	5.5
SC-3173	2	1562	13.38	5.75	42.9		6	7092	3.23	0.18	5.5
	4	1149	2.12	1.09	51.2	SC-3242-2	2	7547	3.09	0.28	9.2
	6	807	9.88	4.13	41.8		4	5874	2.32	0.20	8.7
SC-3178	2	1590	13.44	5.53	41.2		5	5128	2.74	0.24	8.8
	4	1162	3.35	1.40	41.7		6	4316	3.73	0.33	8.8
	5	988	3.25	1.40	43.1	SC-3242-3	2	7558	3.09	0.28	9.2
	6	809	10.53	4.30	40.8		4	5883	2.31	0.20	8.7
SC-3180	2	5153	6.17	0.85	13.8		5	5137	2.73	0.24	8.8
	4	4097	1.58	0.23	14.7		6	4323	3.71	0.32	8.8
	5	3613	3.18	0.44	13.8	SC-3242-4	2	11631	2.57	0.15	5.8
	6	3072	4.80	0.65	13.5		4	9238	2.20	0.12	5.6
SC-3205	2	4596	4.09	0.64	15.7		5	8139	2.65	0.15	5.6
	4	3577	2.23	0.33	14.8		6	6914	3.24	0.18	5.7
	5	3123	2.73	0.41	15.0	SC-3242-5	2	15699	2.16	0.09	4.3
	6	2628	4.49	0.66	14.7		4	12477	2.15	0.09	4.1
SC-3209	2	7585	3.25	0.30	9.1		5	10997	2.62	0.11	4.1
	4	5905	2.47	0.21	8.7		6	9347	3.05	0.13	4.2
	5	5156	2.65	0.23	8.8	SC-3242-6	2	21174	2.00	0.06	3.1
	6	4339	3.47	0.30	8.8		4	16631	2.27	0.07	3.0
SC-3209-2	2	11662	2.67	0.15	5.8		5	14582	2.75	0.08	3.0
	4	9263	2.36	0.13	5.6		6	12329	3.13	0.09	3.0
	5	8162	2.55	0.14	5.6	SC-3248	2	7592	2.86	0.27	9.3
	6	6935	3.04	0.17	5.6		4	5909	2.19	0.19	8.7
SC-3214	2	11608	2.36	0.14	5.9		5	5159	2.51	0.22	8.8
	4	9224	2.34	0.13	5.6		6	4341	3.54	0.31	8.8
	5	8128	2.50	0.14	5.6	SC-3248-2	2	6042	3.61	0.42	11.6
	6	6907	3.14	0.18	5.7		4	4700	2.22	0.24	11.0
							5	4103	2.71	0.30	11.1
							6	3452	3.80	0.42	11.0

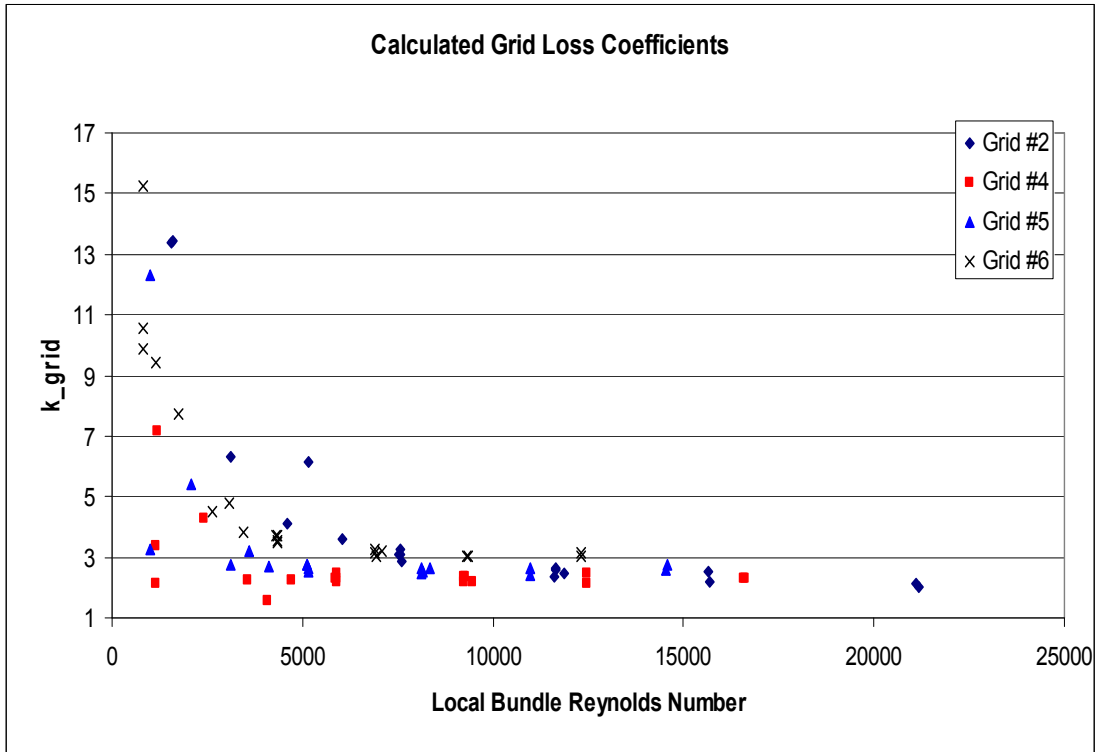


Figure 3-10. Calculated Grid Loss Coefficients (Full Range).

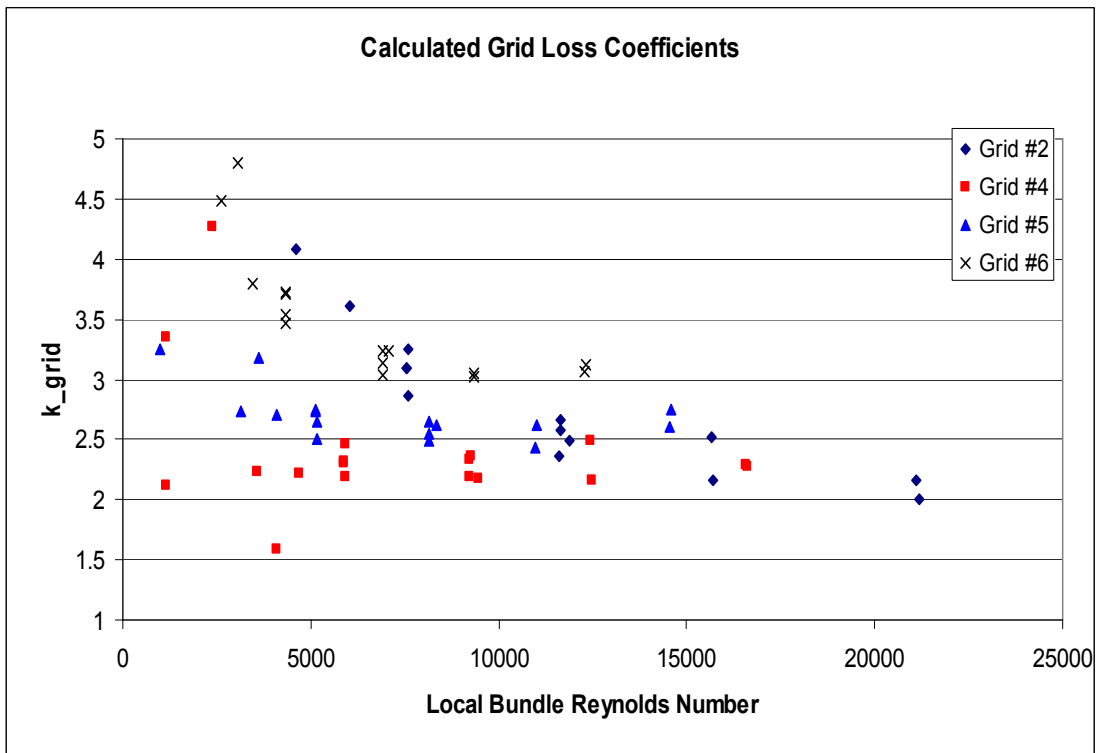


Figure 3-11. Calculated Grid Loss Coefficients (Zoomed in).

4. SUMMARY

Steam cooling experiments have been completed in the RBHT facility. The experiments were designed to collect quasi-steady state heat transfer data in which the working fluid was single-phase super-heated steam. The goal of the experiments was to collect the data necessary for the calculation of heat transfer coefficients that reflect the heat transfer enhancement caused by mixing vane grids. To accomplish this, heater rods were instrumented axially with thermocouples upstream and downstream of mixing vane grids. Steam temperatures were measured axially at subchannel centers and a method based on the momentum/heat transfer analogy was developed to relate the measured subchannel center temperature to the mean bulk steam temperature.

The results of the heat transfer coefficient calculations are contained in Appendix A. The results are broken down by steady state window. From twelve experiments, thirty-five steady state windows have been deemed valid. Each steady state window has its own summary of conditions contained in Appendix A as well as critical instrument plots to show steady state has been reached. Heat transfer coefficients are calculated at every heater rod thermocouple location within the inner 5x5 bundle, excluding the corner rods. The results of an uncertainty analysis on the calculated heat transfer coefficients is also contained in the heat transfer tables.

One should note that the heat transfer coefficients presented here are not “true” convective heat transfer coefficients since they were calculated using experimental measurements that reflect both convective and radiative heat transfer.

Along with collecting the measurements used for the heat transfer coefficient calculations, detailed axial pressure drop measurements were also made. These pressure drop measurements were made across both bare bundle spans and across spans that contain a mixing vane grid. The bare bundle span measurements were used to calculate single-phase friction factors and the spans that contained a mixing vane grid were used to calculate grid loss coefficients. The results of these calculations are shown in Table 3-5 and the grid loss coefficients are tabulated with the local bundle Reynolds number and the results of a grid loss coefficient uncertainty analysis. The table shows that the uncertainty increases substantially as the flow rate decreases. The grid loss coefficients are also plotted as a function of local bundle Reynolds number as shown in Figure 3-10 and Figure 3-11.

5. REFERENCES

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Appendix A. Heat Transfer Reduced Data

This appendix contains the data acquired in 12 RBHT steam cooling tests containing a total of 35 valid steady state windows. For each steady state window, the following plots and tables are included:

- **Summary and comment sheet** – lists the as-run conditions, presents the axial subchannel center steam temperature polynomial curve-fit equations used for data reduction, and notes any traversing operations made by the subchannel steam probe rakes.
- **Critical instrument plots** – verifies steady state was reached and maintained for boundary conditions and selected heater rod and steam temperature measurements. The following experimental data is plotted over the steady state time window:
 1. inlet and exhaust steam flow rates
 2. inlet steam temperature
 3. bundle power
 4. upper plenum pressure
 5. selected steam probe rake temperatures
 6. selected heat rod temperatures
 7. axial subchannel center steam temperature profiles
- **Data tables** – tabulations of the following:
 1. steam probe rake thermocouple positions and temperature measurements
 2. reduced data from DATARH, bulk steam temperature, heat transfer coefficient, and local Reynolds number calculations.

Reduced heat transfer data is presented at all heater rod thermocouple locations within the inner 5x5 bundle, excluding the corner rods. That is, 21 rods totaling 130 thermocouple locations. The results are organized by heat rod location and most heater rods have 8 thermocouples instrumented at various axial locations. Figure below provides the heat rod and subchannel identification diagram which indicates the location of heater rods within the bundle.

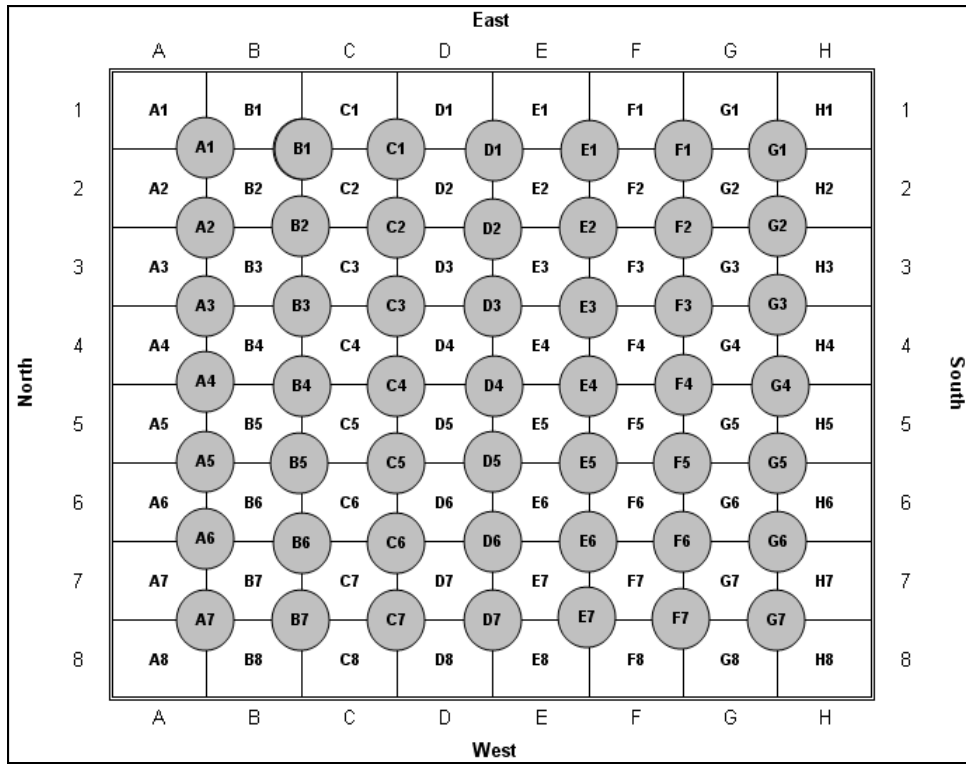


Figure A-1. Heater Rod and Subchannel Identification Diagram.

RBHT Steam Cooling Test SC-3163-A

Matrix test # 4

Test date – 3/15/2005

Steady state time window: 25920 - 26520 sec

Inlet flow: 1.35 m³/min (47.6 ft³/min)

Inlet steam temperature: 408 K (275 °F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 29.9 kW

Outlet steam temperature: 790 K (963 °F)

Bundle inlet Reynolds number: 5413

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

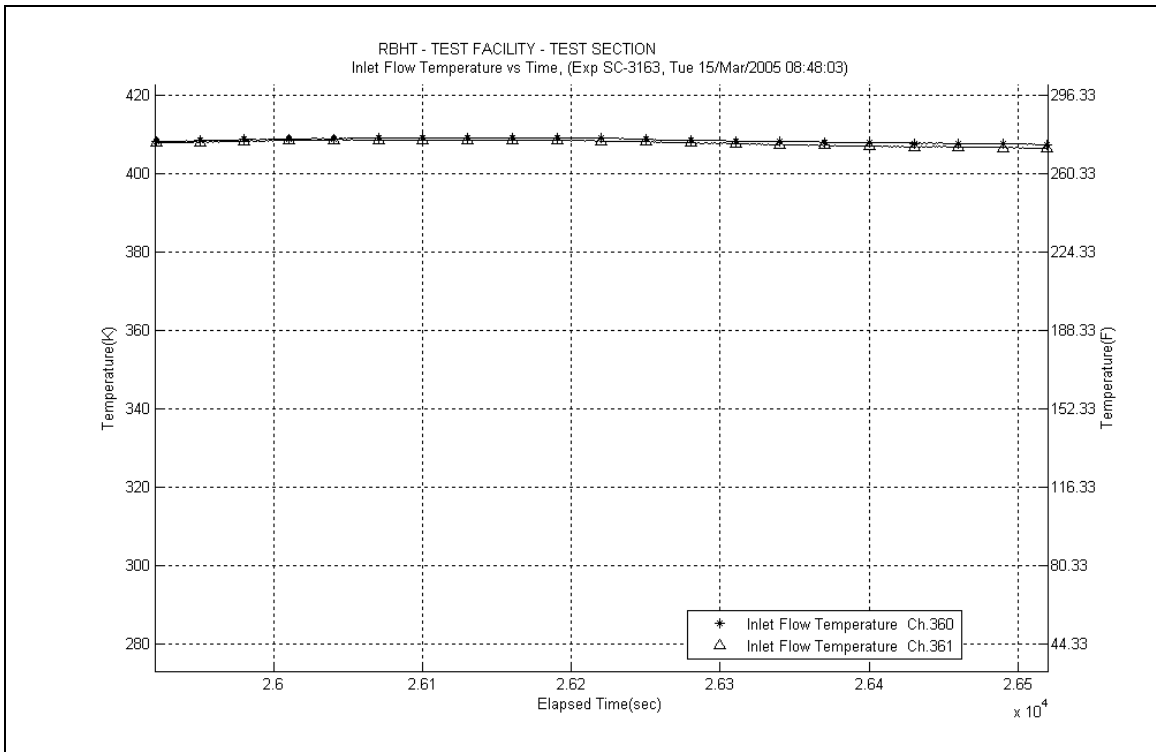
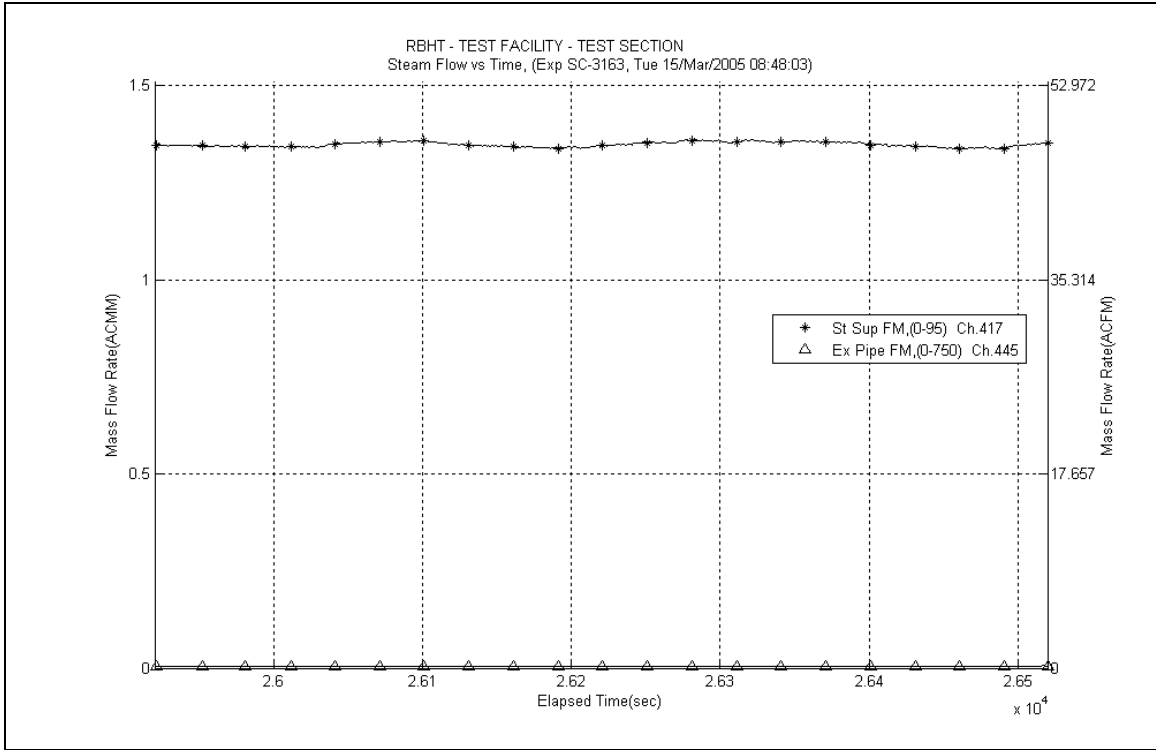
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

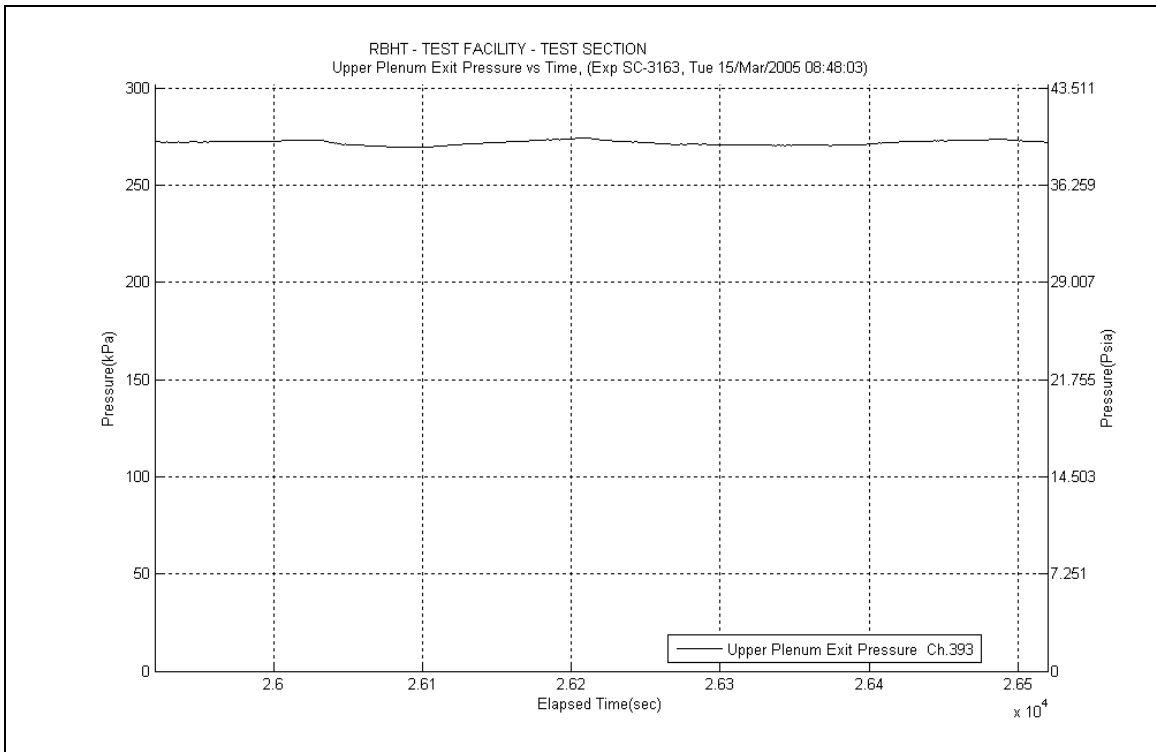
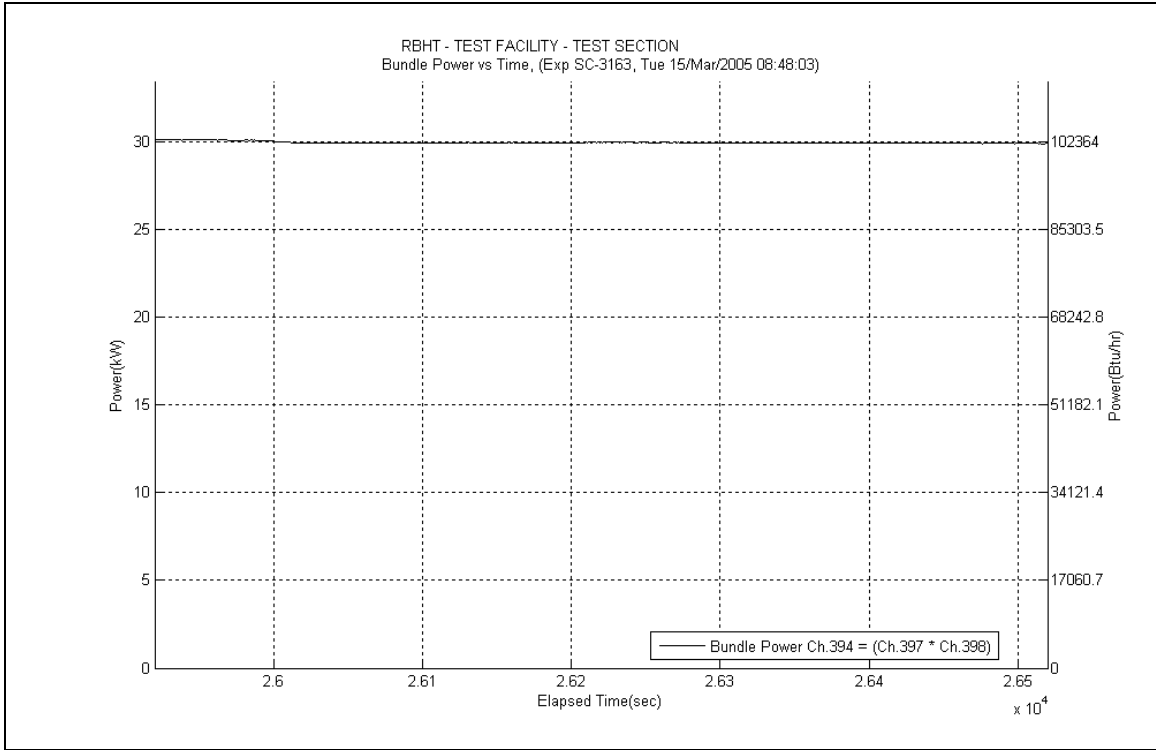
$$T_{cl} = -16.388x^3 + 100.57x^2 - 49.17x + 436.12$$

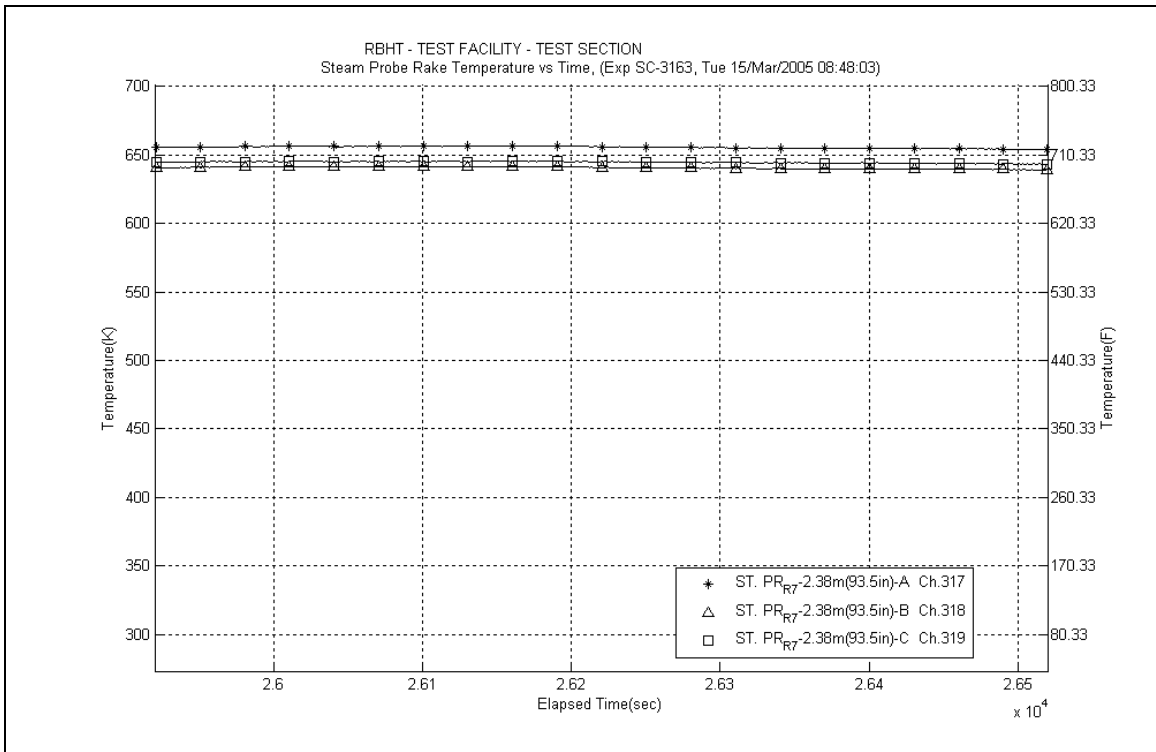
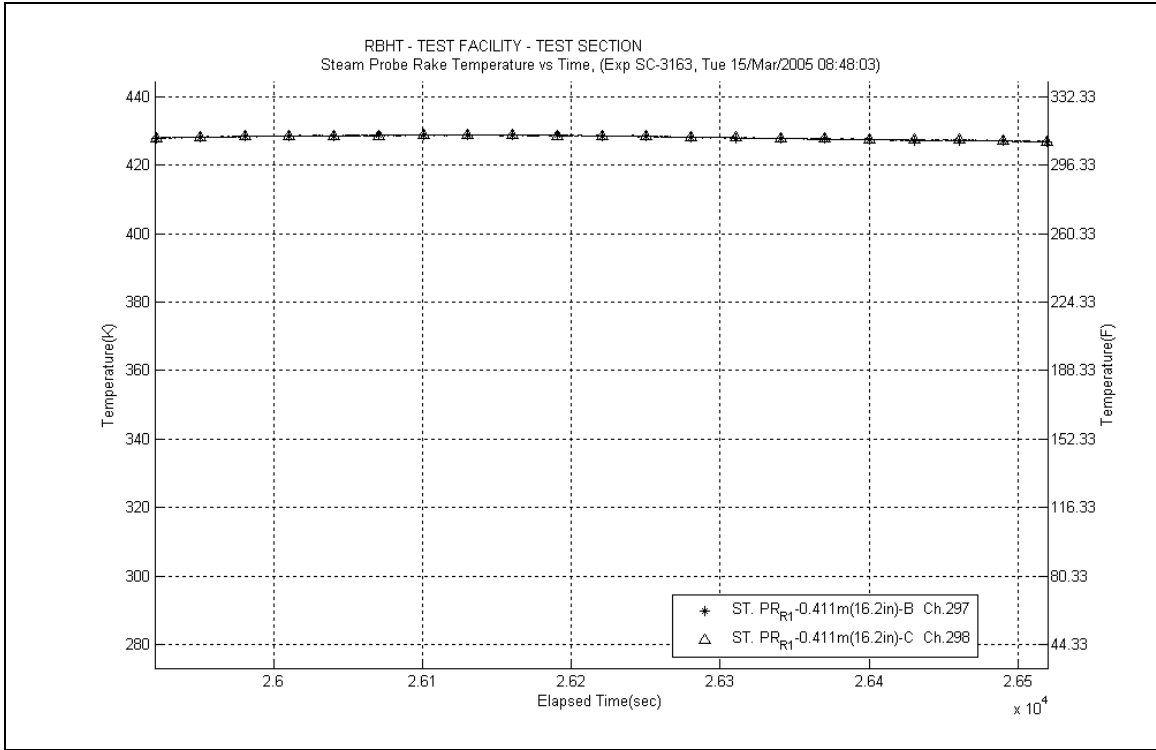
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

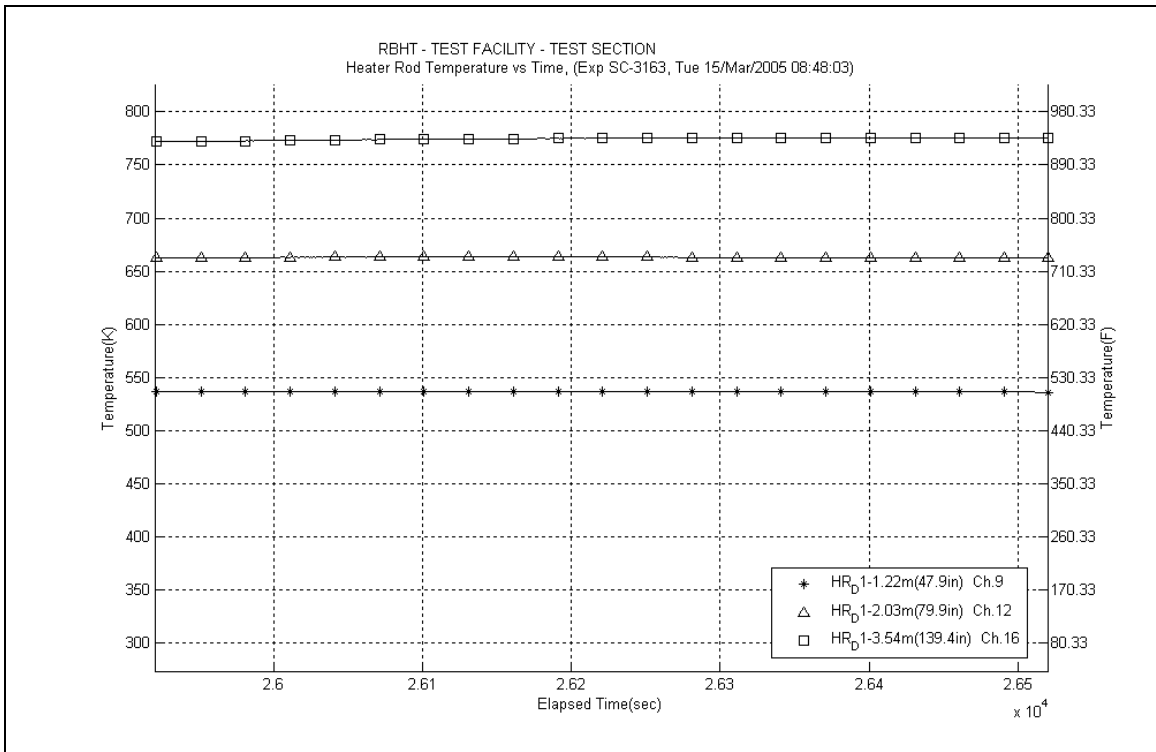
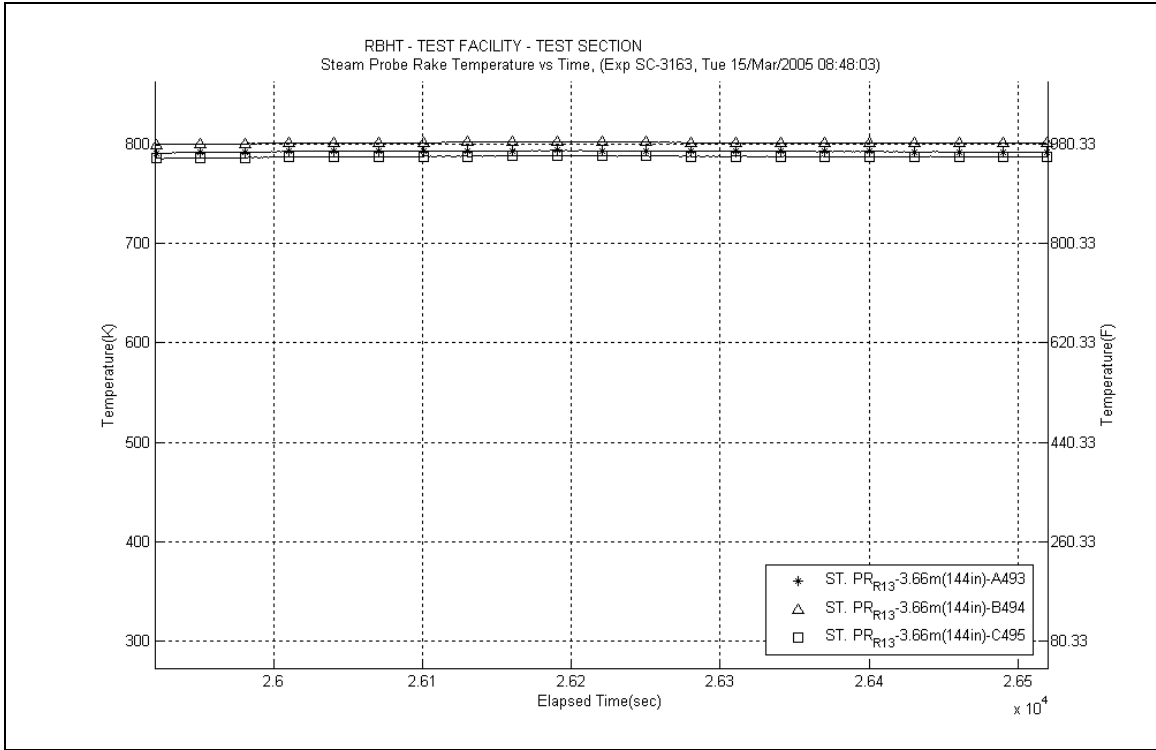
$$T_{cl} = -8.9366x^3 + 58.937x^2 + 6.0702x + 417.72$$

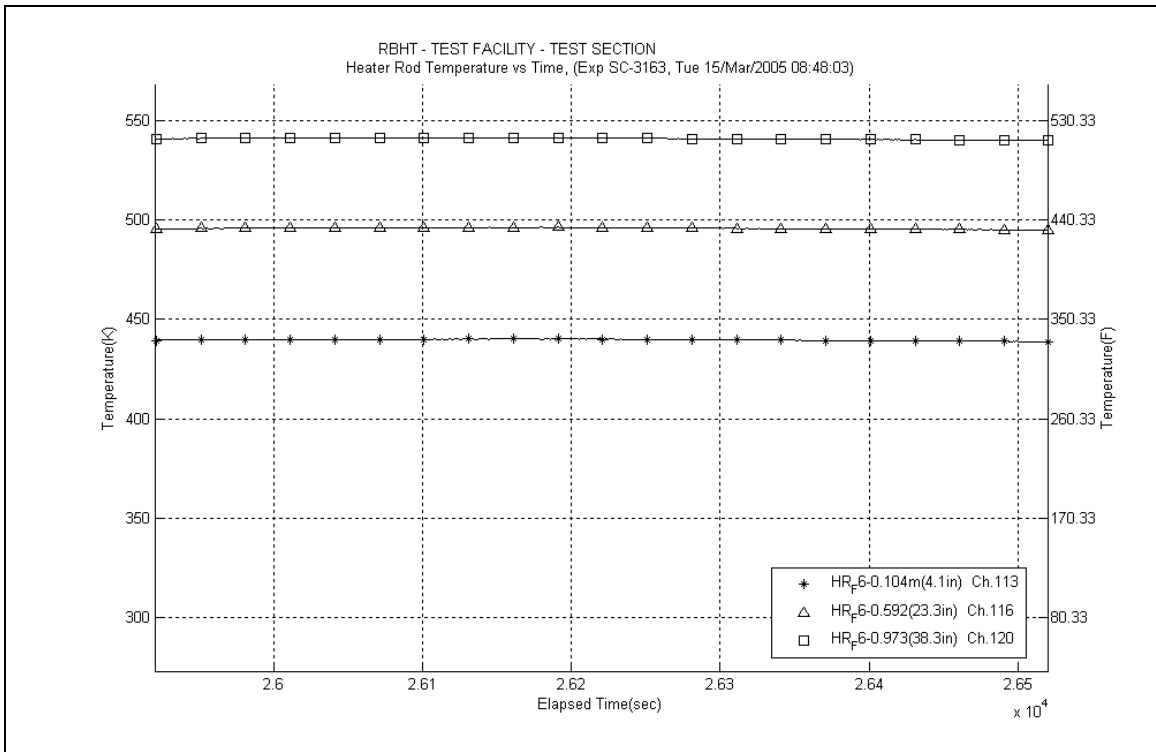
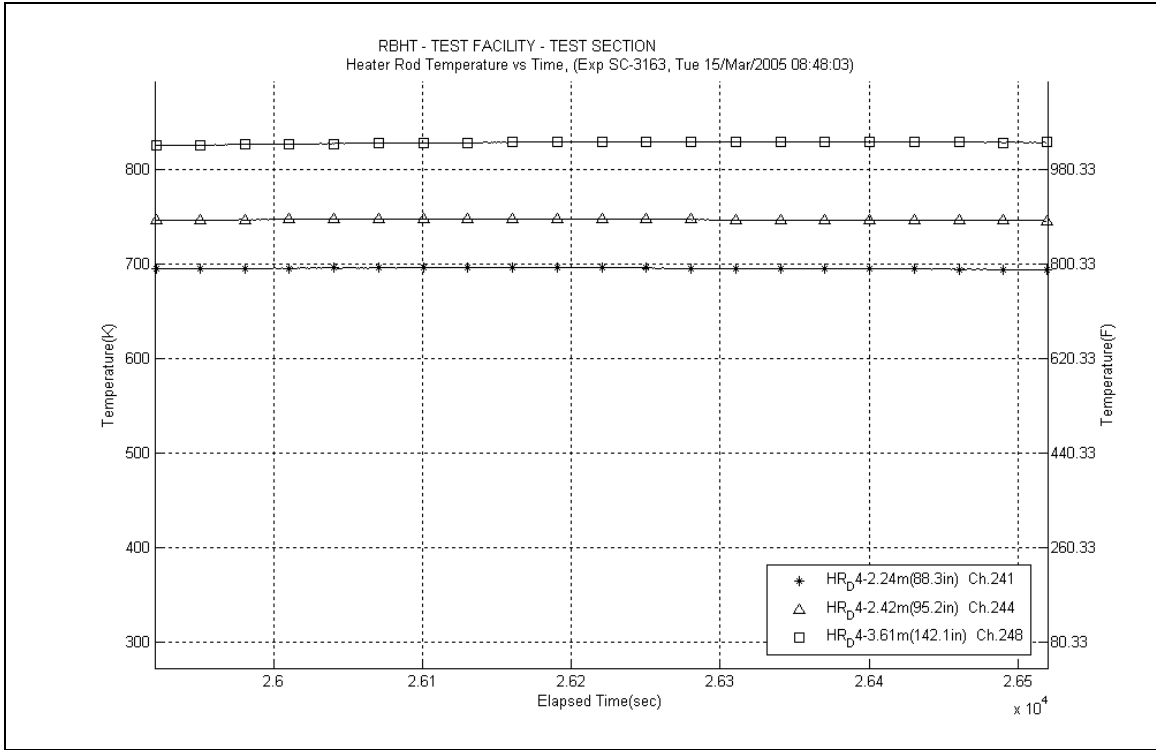
where x is the elevation (m) and T_{cl} is in (K)











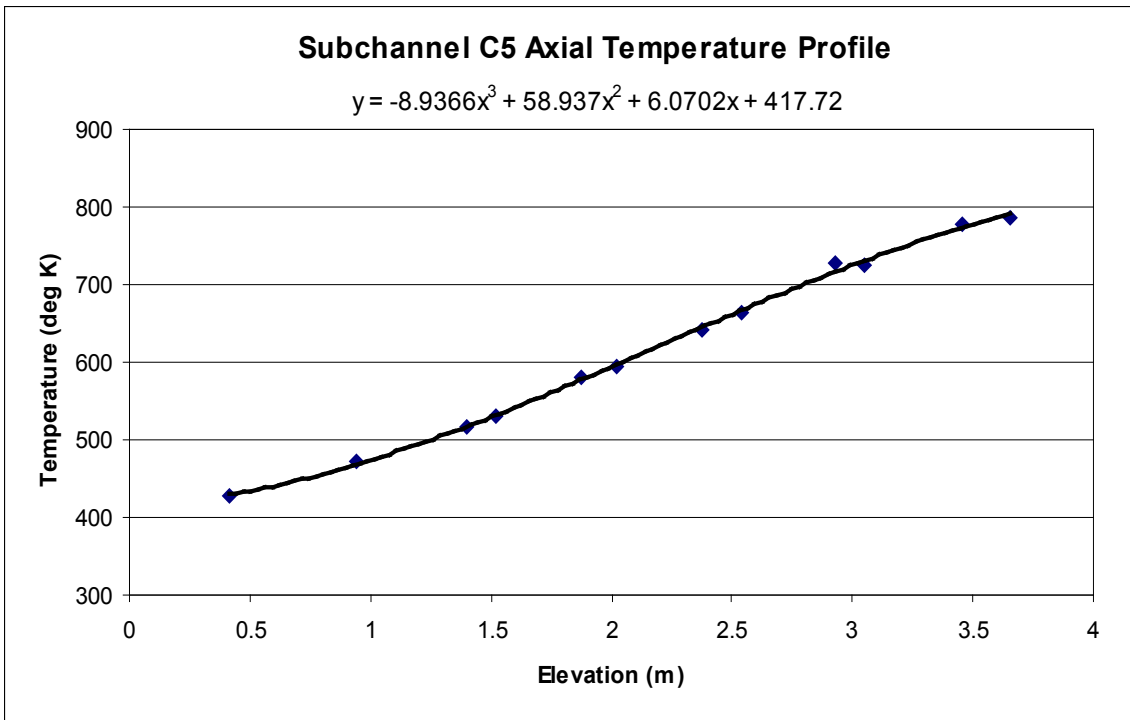
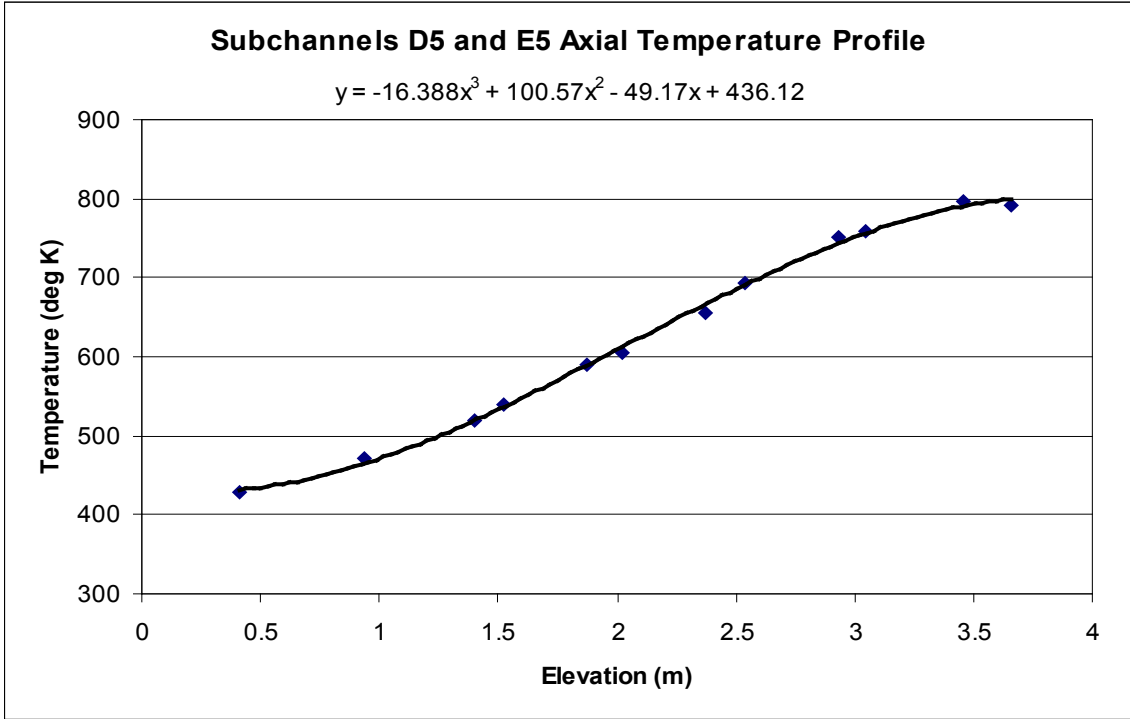


Table SC-3163-A.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h(z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	687.0	8017.7	646.8	1.27	655.4	3554	253.87	19.30	7.60%	56.51
RodD3_91.3	186	2.319	0.071	716.6	8186.1	658.6	1.27	671.0	3459	179.30	12.55	7.00%	38.59
RodD3_93.1	187	2.365	0.117	730.7	8288.9	665.5	1.27	679.5	3410	161.91	11.14	6.88%	34.22
RodD3_95.3	188	2.421	0.173	745.1	8413.7	673.9	1.27	689.2	3355	150.51	10.24	6.80%	31.17
RodD3_100.1	189	2.543	0.295	769.5	8688.1	691.9	1.27	708.5	3251	142.48	9.60	6.74%	28.35
RodD3_106.1	190	2.695	0.447	792.1	9028.0	713.2	1.27	730.1	3143	145.78	9.81	6.73%	27.77
RodD3_110	191	2.794	0.546	785.3	8918.1	726.4	1.27	739.0	3101	192.67	13.37	6.94%	36.07
RodD3_142.1	192	3.609	0.218	817.4	3051.9	798.2	1.27	802.3	2830	202.11	22.06	10.92%	33.59
RodC4_88.4	233	2.245	-0.003	688.9	8112.3	647.2	1.27	656.1	3549	247.99	18.60	7.50%	55.12
RodC4_91.1	234	2.314	0.066	714.1	8268.6	657.8	1.27	669.8	3466	186.96	13.10	7.01%	40.34
RodC4_93.4	235	2.372	0.124	728.5	8400.2	666.7	1.27	679.9	3407	172.98	11.94	6.90%	36.53
RodC4_95.3	236	2.421	0.173	742.2	8510.5	673.9	1.27	688.5	3359	158.73	10.80	6.81%	32.91
RodC4_100.1	237	2.543	0.295	766.6	8787.3	691.9	1.27	707.9	3255	149.67	10.08	6.73%	29.82
RodC4_106.1	238	2.695	0.447	789.5	9131.2	713.2	1.27	729.6	3145	152.38	10.24	6.72%	29.06
RodC4_110	239	2.794	0.546	779.2	8839.6	726.4	1.27	737.7	3107	213.07	15.12	7.10%	39.99
RodC4_142.2	240	3.612	0.221	828.6	3309.5	798.3	1.27	804.8	2821	139.19	11.76	8.45%	23.03
RodD4_88.3	241	2.243	-0.005	695.2	8080.7	646.8	1.27	657.2	3543	212.70	15.38	7.23%	47.17
RodD4_91.3	242	2.319	0.071	721.0	8250.2	658.6	1.27	671.9	3454	168.25	11.61	6.90%	36.14
RodD4_93.2	243	2.367	0.119	734.6	8358.9	665.9	1.27	680.6	3403	154.82	10.54	6.81%	32.64
RodD4_95.2	244	2.418	0.170	746.6	8473.9	673.5	1.27	689.2	3355	147.54	9.97	6.76%	30.55
RodD4_100.1	245	2.543	0.295	770.4	8758.6	691.9	1.27	708.7	3250	141.99	9.52	6.71%	28.24
RodD4_106.1	246	2.695	0.447	789.9	9103.4	713.2	1.27	729.7	3145	151.15	10.16	6.72%	28.82
RodD4_110	247	2.794	0.546	780.9	8793.8	726.4	1.27	738.1	3105	205.13	14.50	7.07%	38.47
RodD4_142.1	248	3.609	0.218	828.4	3200.7	798.2	1.27	804.7	2821	135.06	11.54	8.55%	22.35
RodE4_88.4	201	2.245	-0.003	689.3	7959.9	647.2	1.27	656.2	3549	241.00	18.14	7.53%	53.55
RodE4_91.2	202	2.316	0.069	714.4	8111.6	658.2	1.27	670.2	3464	183.41	12.95	7.06%	39.54
RodE4_95.3	204	2.421	0.173	741.9	8336.7	673.9	1.27	688.5	3359	156.15	10.72	6.87%	32.38
RodE4_100.9	205	2.563	0.315	766.6	8643.2	694.8	1.27	710.2	3243	153.25	10.46	6.82%	30.39
RodE4_142.3	208	3.614	0.224	820.8	3234.4	798.4	1.27	803.2	2827	183.94	18.10	9.84%	30.52
RodE3_63.4	193	1.610	0.417	628.3	6587.6	549.3	1.27	566.2	4217	106.11	7.14	6.73%	29.05
RodE3_113.6	194	2.885	0.022	786.4	8120.8	737.8	1.27	748.2	3058	213.02	15.46	7.26%	39.17
RodE3_115.5	195	2.934	0.070	797.6	8111.5	743.6	1.27	755.2	3026	184.03	13.06	7.10%	33.39
RodE3_118.5	196	3.010	0.146	808.5	7331.2	752.3	1.27	764.4	2986	166.24	11.71	7.04%	29.64
RodE3_122.7	197	3.117	0.253	817.3	6654.8	763.6	1.27	775.1	2940	157.76	11.18	7.09%	27.56
RodE3_126.5	198	3.213	0.349	819.5	6045.2	772.8	1.27	782.8	2908	164.68	12.00	7.29%	28.36
RodE3_131.7	199	3.345	-0.046	805.8	5224.7	783.6	1.27	788.3	2886	298.25	29.11	9.76%	50.85
RodE3_135.6	200	3.444	0.053	810.5	4589.5	790.2	1.27	794.5	2861	287.21	29.58	10.30%	48.41

Table SC-3163-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h(z) (W/m ² -K)	±ohfc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	631.2	6470.1	550.4	1.27	567.7	4204	101.98	6.91	6.77%	27.82
RodC5_113.6	226	2.885	0.022	780.9	7919.8	737.8	1.27	747.1	3063	234.23	17.65	7.54%	43.17
RodC5_115.7	227	2.939	0.075	795.3	7597.2	744.2	1.27	755.2	3026	189.35	13.71	7.24%	34.35
RodC5_122.7	229	3.117	0.253	817.5	6529.5	763.6	1.27	775.1	2940	154.16	11.00	7.13%	26.93
RodC5_126.7	230	3.218	0.354	821.0	5918.6	773.2	1.27	783.5	2905	157.64	11.49	7.29%	27.12
RodC5_131.6	231	3.343	-0.048	810.5	5181.8	783.4	1.27	789.2	2882	243.35	21.47	8.82%	41.42
RodC5_135.7	232	3.447	0.056	817.6	4547.6	790.3	1.27	796.2	2854	212.28	18.62	8.77%	35.67
RodE5_63.6	209	1.615	0.422	626.3	6626.2	550.0	1.27	566.4	4215	110.59	7.45	6.74%	30.27
RodE5_113.6	210	2.885	0.022	774.8	8170.0	737.8	1.27	745.8	3069	281.31	21.95	7.80%	51.97
RodE5_115.4	211	2.931	0.067	785.0	7883.3	743.3	1.27	752.3	3039	240.57	18.08	7.52%	43.89
RodE5_118.7	212	3.015	0.151	795.3	7360.6	752.9	1.27	762.0	2996	220.74	16.49	7.47%	39.53
RodE5_122.6	213	3.114	0.250	803.3	6742.6	763.4	1.27	771.9	2954	214.86	16.30	7.58%	37.76
RodE5_126.6	214	3.216	0.352	808.3	6110.9	773.0	1.27	780.6	2917	220.37	17.36	7.88%	38.11
RodE5_131.6	215	3.343	-0.048	798.9	5332.2	783.4	1.27	786.7	2892	436.41	53.95	12.36%	74.62
RodE5_135.6	216	3.444	0.053	806.7	4691.5	790.2	1.27	793.7	2864	360.85	42.57	11.80%	60.91
RodC3_79.8	177	2.027	0.227	670.9	7502.6	613.2	1.27	625.5	3751	165.33	11.60	7.02%	39.34
RodC3_85.6	178	2.174	0.374	680.3	7825.4	636.2	1.27	645.6	3616	225.71	16.76	7.42%	51.34
RodC3_88.5	179	2.248	0.000	684.6	7987.4	647.6	1.27	655.5	3553	274.99	21.50	7.82%	61.20
RodC3_92.4	180	2.347	0.099	717.2	8205.1	662.8	1.27	674.5	3439	192.11	13.63	7.10%	41.04
RodC3_94.4	181	2.398	0.150	727.7	8316.8	670.5	1.27	682.7	3391	185.02	13.01	7.03%	38.84
RodC3_97.2	182	2.469	0.221	746.7	8475.5	681.1	1.27	695.1	3322	164.52	11.33	6.89%	33.65
RodC3_108.8	183	2.764	0.516	787.9	8931.3	722.4	1.27	736.4	3113	173.57	11.95	6.88%	32.66
RodD5_50	217	1.270	0.076	574.0	5855.8	502.3	1.27	517.7	4691	103.88	7.05	6.78%	32.11
RodD5_54.1	218	1.374	0.180	597.5	6085.5	515.9	1.27	533.4	4527	94.98	6.36	6.70%	28.21
RodD5_56.9	219	1.445	0.251	610.3	6243.3	525.6	1.27	543.8	4424	93.86	6.27	6.68%	27.16
RodD5_60	220	1.524	0.330	622.1	6419.3	536.8	1.27	555.0	4318	95.73	6.39	6.67%	26.94
RodD5_66.1	221	1.679	0.485	636.1	6762.4	559.5	1.27	575.9	4133	112.38	7.57	6.74%	30.05
RodD5_69.9	222	1.775	-0.025	619.6	6978.8	574.1	1.27	583.9	4067	195.10	14.29	7.32%	51.18
RodD5_72.9	223	1.852	0.051	646.6	7142.1	585.8	1.27	598.8	3947	149.66	10.38	6.93%	37.89
RodD5_74.9	224	1.902	0.102	661.0	7252.9	593.7	1.27	608.1	3877	137.20	9.40	6.85%	33.98

Table SC-3163-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h(z) (W/m ² -K)	±ohhc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	553.8	5337.4	477.9	1.20	490.5	5004.0	84.36	4.95	5.87%	27.95
RodB5_52.9	154	1.344	0.150	586.2	6009.9	510.6	1.27	526.8	4594.4	101.11	6.83	6.75%	30.53
RodB5_55	155	1.397	0.203	594.5	6128.8	516.9	1.27	533.5	4525.8	100.44	6.76	6.73%	29.83
RodB5_57.8	156	1.468	0.274	607.0	6288.1	525.4	1.27	542.9	4432.8	98.02	6.57	6.70%	28.43
RodB5_64	157	1.626	0.432	625.5	6640.4	544.9	1.27	562.2	4252.5	104.88	7.03	6.71%	29.00
RodB5_73.9	158	1.877	0.077	646.9	7200.9	577.7	1.27	592.5	3997.1	132.30	9.01	6.81%	34.00
RodB5_75.9	159	1.928	0.128	659.5	7314.2	584.4	1.27	600.5	3934.6	123.97	8.39	6.76%	31.26
RodB5_76.9	160	1.953	0.153	664.6	7370.5	587.8	1.27	604.3	3906.0	122.23	8.25	6.75%	30.55
RodF5_41	105	1.041	0.343	550.9	5290.7	477.9	1.20	490.0	5009.9	86.90	5.15	5.93%	28.82
RodF5_53.1	106	1.349	0.155	582.2	5971.7	511.2	1.27	526.4	4598.5	106.98	7.30	6.82%	32.34
RodF5_55	107	1.397	0.203	591.5	6079.5	516.9	1.27	532.8	4532.3	103.62	7.03	6.78%	30.82
RodF5_57.8	108	1.468	0.274	603.0	6238.1	525.4	1.27	542.0	4441.1	102.22	6.90	6.75%	29.71
RodF5_64	109	1.626	0.432	620.2	6591.3	544.9	1.27	561.1	4262.7	111.40	7.54	6.77%	30.89
RodF5_73.8	110	1.875	0.074	635.8	7147.9	577.3	1.27	589.8	4018.3	155.69	10.89	6.99%	40.26
RodF5_75.8	111	1.925	0.125	648.6	7261.1	584.1	1.27	597.9	3954.8	143.35	9.90	6.91%	36.37
RodF5_76.8	112	1.951	0.150	654.0	7317.9	587.5	1.27	601.7	3925.2	140.06	9.64	6.88%	35.22
RodC2_41	57	1.041	0.343	548.1	5321.0	477.9	1.20	489.6	5015.7	90.92	5.40	5.94%	30.19
RodC2_53.1	58	1.349	0.155	587.5	6004.5	511.2	1.27	527.5	4586.8	100.13	6.76	6.75%	30.18
RodC2_55	59	1.397	0.203	595.7	6112.3	516.9	1.27	533.7	4523.2	98.61	6.64	6.73%	29.26
RodC2_57.8	60	1.468	0.274	607.4	6270.4	525.4	1.27	543.0	4432.0	97.24	6.52	6.71%	28.20
RodC2_63.9	61	1.623	0.429	623.3	6616.5	544.6	1.27	561.5	4259.1	107.03	7.20	6.73%	29.64
RodC2_73.8	62	1.875	0.074	636.5	7179.2	577.3	1.27	590.0	4017.0	154.29	10.75	6.97%	39.88
RodC2_75.8	63	1.925	0.125	647.6	7296.3	584.1	1.27	597.7	3956.3	146.19	10.08	6.89%	37.11
RodC2_76.8	64	1.951	0.150	652.0	7354.2	587.5	1.27	601.3	3928.4	145.03	10.00	6.89%	36.50
RodC6_40.9	137	1.039	0.340	555.4	5298.2	477.6	1.20	490.6	5003.2	81.69	4.79	5.87%	27.06
RodC6_52.8	138	1.341	0.147	588.9	6001.1	510.3	1.27	527.1	4591.0	97.22	6.54	6.73%	29.34
RodC6_54.8	139	1.392	0.198	598.5	6119.7	516.3	1.27	533.9	4521.8	94.64	6.34	6.70%	28.07
RodC6_57.8	140	1.468	0.274	611.6	6296.2	525.4	1.27	543.8	4423.4	92.97	6.20	6.67%	26.90
RodC6_63.8	141	1.621	0.427	629.9	6653.4	544.3	1.27	562.6	4248.6	98.88	6.59	6.66%	27.31
RodC6_73.7	142	1.872	0.072	650.3	7236.1	577.0	1.27	592.7	3995.6	125.62	8.50	6.76%	32.27
RodC6_75.8	143	1.925	0.125	661.1	7358.7	584.1	1.27	600.6	3934.1	121.64	8.18	6.73%	30.67
RodC6_76.8	144	1.951	0.150	667.2	7418.2	587.5	1.27	604.6	3903.8	118.46	7.94	6.70%	29.59

Table SC-3163-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h(z) (W/m ² -K)	±ohfc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	684.0	7958.4	627.3	1.27	639.5	3656.8	178.83	12.61	7.05%	41.24
RodB4_91.3	162	2.319	0.071	711.5	8115.3	637.3	1.27	653.2	3567.9	139.13	9.45	6.80%	31.12
RodB4_93.3	163	2.370	0.122	724.4	8222.6	644.2	1.27	661.3	3517.4	130.46	8.80	6.74%	28.67
RodB4_95.1	164	2.416	0.168	735.1	8320.8	650.3	1.27	668.5	3474.2	124.84	8.38	6.71%	27.01
RodB4_100	165	2.540	0.292	754.1	8588.9	666.9	1.27	685.6	3375.0	125.33	8.39	6.70%	26.15
RodB4_106	166	2.692	0.445	776.5	8915.7	686.9	1.27	706.1	3264.0	126.57	8.46	6.69%	25.31
RodB4_109.9	167	2.791	0.544	767.7	8632.8	699.5	1.27	714.1	3222.3	161.12	11.09	6.88%	31.69
RodB4_142.3	168	3.614	0.224	817.7	3285.8	787.6	1.27	794.1	2862.7	139.09	11.79	8.47%	23.46
RodF4_85.6	98	2.174	0.374	675.8	7848.9	617.7	1.27	630.1	3719.7	171.96	12.05	7.00%	40.50
RodF4_88.4	99	2.245	-0.003	678.2	8006.6	627.3	1.27	638.2	3665.0	200.34	14.38	7.18%	46.33
RodF4_92.4	100	2.347	0.099	712.2	8228.0	641.1	1.27	656.3	3548.4	147.21	10.03	6.81%	32.71
RodF4_94.3	101	2.395	0.147	725.2	8333.9	647.6	1.27	664.2	3499.9	136.58	9.21	6.75%	29.83
RodF4_97.2	102	2.469	0.221	741.7	8495.7	657.5	1.27	675.5	3432.8	128.30	8.59	6.70%	27.35
RodF4_108.8	103	2.764	0.516	774.4	8965.9	696.0	1.27	712.8	3229.2	145.49	9.79	6.73%	28.70
RodF4_111	104	2.819	-0.044	763.4	8602.7	703.0	1.27	716.0	3213.0	181.38	12.61	6.95%	35.55
RodD2_103.2	65	2.621	0.373	759.5	8872.3	677.6	1.27	695.2	3322.2	137.93	9.24	6.70%	28.21
RodD2_106	66	2.692	0.445	769.6	9032.4	686.9	1.27	704.6	3271.8	138.97	9.30	6.69%	27.87
RodD2_112.6	67	2.860	-0.004	761.7	8289.4	708.1	1.27	719.6	3194.8	196.98	14.01	7.11%	38.33
RodD2_114.9	68	2.918	0.055	778.9	7899.0	715.3	1.27	728.9	3148.8	158.11	10.94	6.92%	30.20
RodD2_117.4	69	2.982	0.118	786.4	7474.5	722.9	1.27	736.5	3112.2	149.82	10.37	6.92%	28.18
RodD2_120.8	70	3.068	0.204	795.8	6897.5	733.1	1.27	746.5	3065.7	139.87	9.70	6.94%	25.81
RodD2_124.8	71	3.170	0.306	801.4	6223.7	744.5	1.27	756.7	3019.5	139.24	9.81	7.05%	25.19
RodD2_128.6	72	3.266	0.403	802.2	5583.5	754.9	1.27	765.1	2982.9	150.15	10.98	7.31%	26.73
RodD6_103.1	129	2.619	0.371	762.2	8895.4	677.3	1.27	695.5	3320.5	133.38	8.90	6.67%	27.26
RodD6_106	130	2.692	0.445	769.5	9057.0	686.9	1.27	704.6	3271.8	139.49	9.33	6.69%	27.98
RodD6_112.9	131	2.868	0.004	759.5	8270.5	709.1	1.27	719.8	3193.4	208.78	15.01	7.19%	40.60
RodD6_114.9	132	2.918	0.055	773.5	7923.7	715.3	1.27	727.8	3154.4	173.11	12.12	7.00%	33.14
RodD6_116.8	133	2.967	0.103	784.2	7595.6	721.1	1.27	734.6	3121.2	153.09	10.59	6.92%	28.91
RodD6_120.9	134	3.071	0.207	794.5	6898.0	733.4	1.27	746.4	3065.9	143.58	9.99	6.96%	26.49
RodD6_124.8	135	3.170	0.306	801.7	6232.5	744.5	1.27	756.8	3019.2	138.60	9.75	7.04%	25.07
RodD6_128.7	136	3.269	0.405	804.8	5568.3	755.2	1.27	765.8	2979.6	142.93	10.34	7.24%	25.41

Table SC-3163-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h(z) (W/m ² -K)	±ohhc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	566.2	5866.5	502.5	1.27	516.1	4708.3	117.20	8.07	6.88%	36.37
RodE2_54	74	1.372	0.178	588.2	6090.1	513.9	1.27	529.8	4563.6	104.29	7.04	6.75%	31.26
RodE2_56.9	75	1.445	0.251	600.8	6257.2	522.6	1.27	539.4	4467.2	101.87	6.84	6.72%	29.81
RodE2_59.9	76	1.521	0.328	613.7	6431.7	531.9	1.27	549.4	4370.1	100.11	6.70	6.69%	28.57
RodE2_66	77	1.676	0.483	625.7	6784.2	551.4	1.27	567.3	4207.0	116.23	7.84	6.75%	31.73
RodE2_69.8	78	1.773	-0.027	607.3	7007.0	563.9	1.27	573.2	4155.9	205.51	15.21	7.40%	55.31
RodE2_72.9	79	1.852	0.051	631.0	7181.8	574.3	1.27	586.4	4045.7	161.11	11.27	6.99%	42.00
RodE2_74.9	80	1.902	0.102	642.5	7295.8	581.0	1.27	594.2	3983.7	151.12	10.44	6.91%	38.68
RodB3_50.2	169	1.275	0.081	562.6	5849.6	502.8	1.27	515.6	4714.3	124.45	8.66	6.96%	38.67
RodB3_54.1	170	1.374	0.180	578.3	6071.0	514.2	1.27	527.9	4583.0	120.41	8.29	6.89%	36.26
RodB3_56.9	171	1.445	0.251	588.0	6228.5	522.6	1.27	536.6	4494.3	121.22	8.33	6.87%	35.71
RodB3_60.1	172	1.527	0.333	597.3	6411.5	532.5	1.27	546.4	4398.8	126.05	8.67	6.88%	36.24
RodB3_66.1	173	1.679	0.485	618.3	6750.3	551.8	1.27	566.0	4218.7	129.09	8.84	6.85%	35.36
RodB3_69.9	174	1.775	-0.025	606.3	6969.5	564.3	1.27	573.3	4155.5	210.94	15.77	7.48%	56.77
RodB3_73	175	1.854	0.054	632.2	7141.6	574.6	1.27	587.0	4041.4	157.77	11.03	6.99%	41.08
RodB3_75	176	1.905	0.105	645.1	7254.2	581.4	1.27	595.0	3977.3	145.00	9.99	6.89%	37.04
RodF3_50.1	89	1.273	0.079	569.1	5832.7	502.5	1.27	516.7	4701.6	111.47	7.65	6.86%	34.53
RodF3_54	90	1.372	0.178	590.7	6058.9	513.9	1.27	530.3	4558.0	100.32	6.77	6.75%	30.03
RodF3_57	91	1.448	0.254	603.5	6232.0	522.9	1.27	540.2	4459.1	98.42	6.61	6.71%	28.74
RodF3_60	92	1.524	0.330	615.3	6405.6	532.2	1.27	550.0	4364.4	98.10	6.57	6.69%	27.95
RodF3_66.1	93	1.679	0.485	622.4	6761.7	551.8	1.27	566.9	4211.0	121.79	8.28	6.80%	33.29
RodF3_70	94	1.778	-0.022	608.7	6990.2	564.6	1.27	574.0	4148.9	201.63	14.88	7.38%	54.16
RodF3_73	95	1.854	0.054	633.0	7164.6	574.6	1.27	587.1	4040.2	156.31	10.90	6.97%	40.68
RodF3_75	96	1.905	0.105	647.1	7280.5	581.4	1.27	595.5	3973.9	141.06	9.66	6.85%	36.00
RodE6_50.2	121	1.275	0.081	567.7	5841.3	502.8	1.27	516.7	4702.3	114.49	7.88	6.88%	35.48
RodE6_54.1	122	1.374	0.180	587.5	6059.4	514.2	1.27	529.9	4562.7	105.13	7.13	6.78%	31.50
RodE6_57	123	1.448	0.254	598.6	6221.3	522.9	1.27	539.1	4469.4	104.61	7.07	6.76%	30.62
RodE6_60.2	124	1.529	0.335	610.6	6402.3	532.9	1.27	549.5	4369.2	104.72	7.06	6.74%	29.88
RodE6_66.1	125	1.679	0.485	623.5	6734.8	551.8	1.27	567.1	4209.0	119.51	8.12	6.80%	32.65
RodE6_70	126	1.778	-0.022	608.8	6956.5	564.6	1.27	574.1	4148.7	200.17	14.78	7.39%	53.76
RodE6_73.1	127	1.857	0.056	632.6	7123.7	575.0	1.27	587.3	4038.7	157.39	11.02	7.00%	40.95
RodE6_75	128	1.905	0.105	645.1	7230.8	581.4	1.27	595.0	3977.2	144.49	9.97	6.90%	36.91

RBHT Steam Cooling Test SC-3163-B

Matrix test # 5

Test date – 3/15/2005

Steady state time window: 27300 - 27600 sec

Inlet flow: 1.80 m³/min (63.5 ft³/min)

Inlet steam temperature: 409 K (277 °F)

Upper plenum pressure: 272.3 kPa (39.5 psia)

Bundle power: 39.2 kW

Outlet steam temperature: 805 K (990 °F)

Bundle inlet Reynolds number: 7184

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

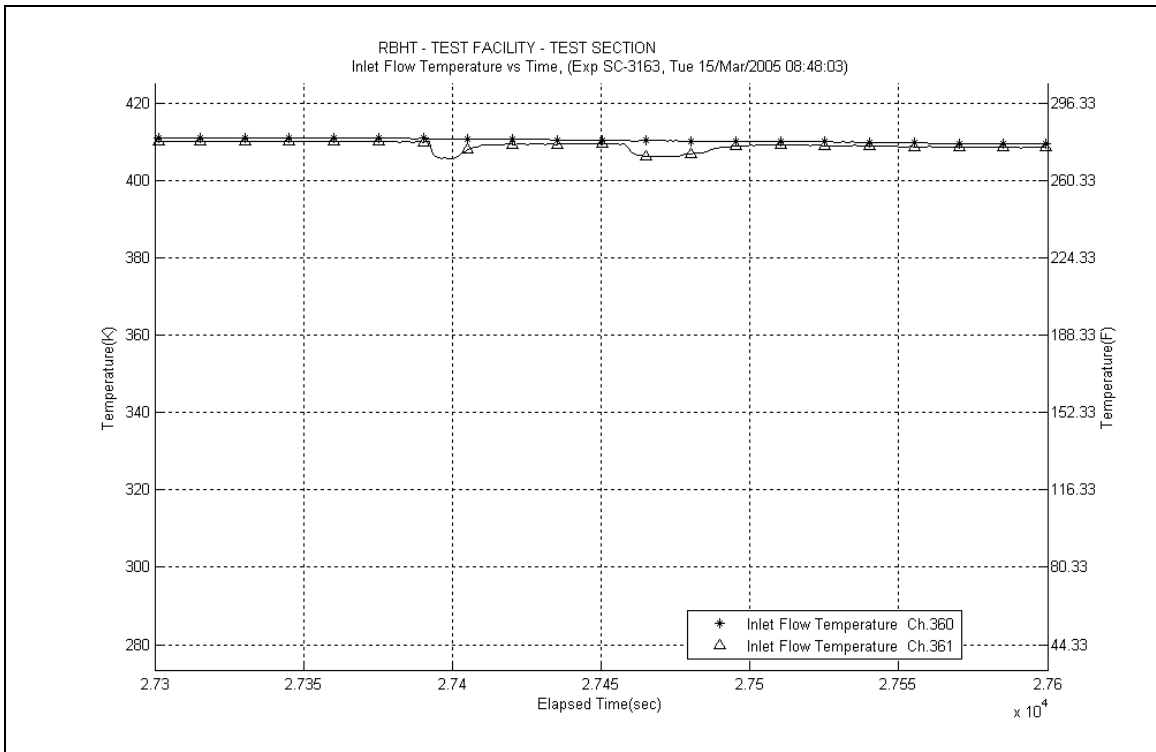
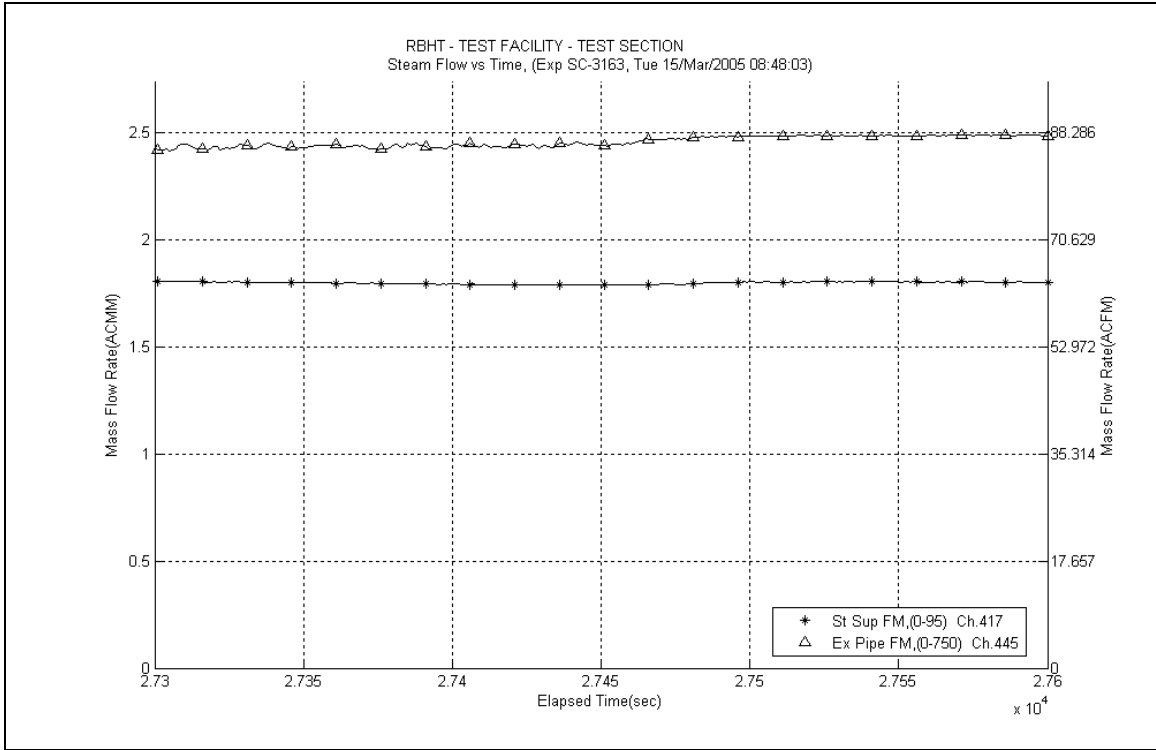
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

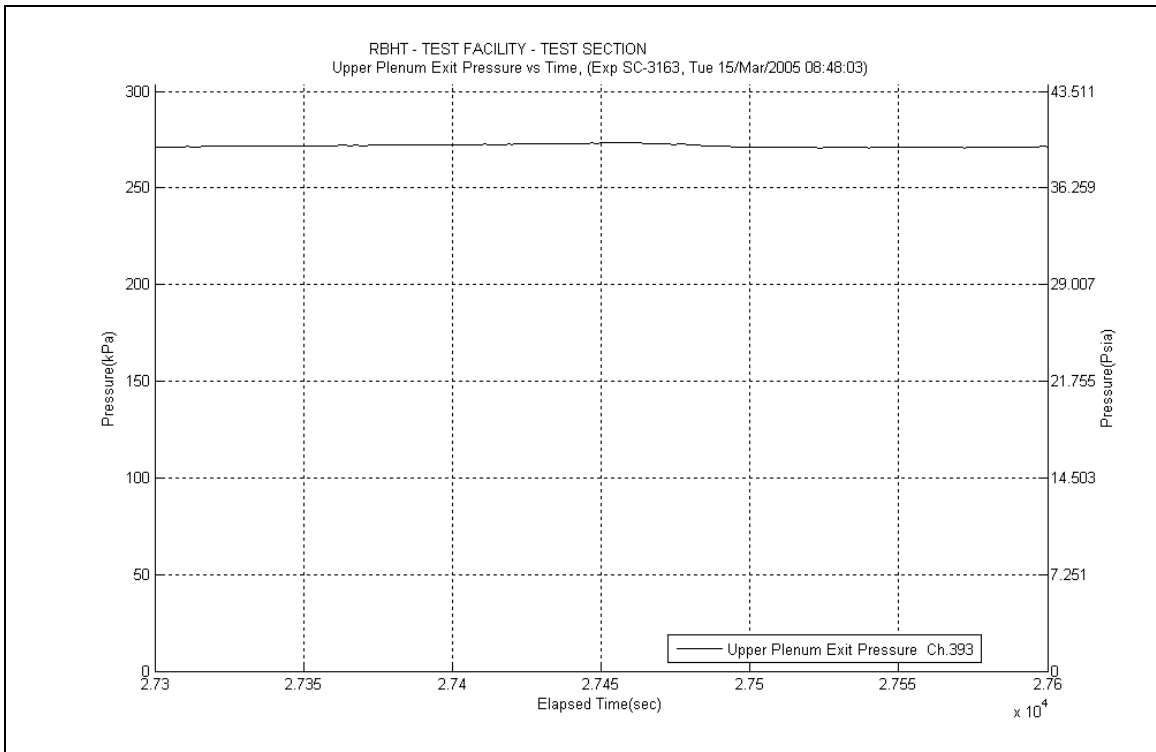
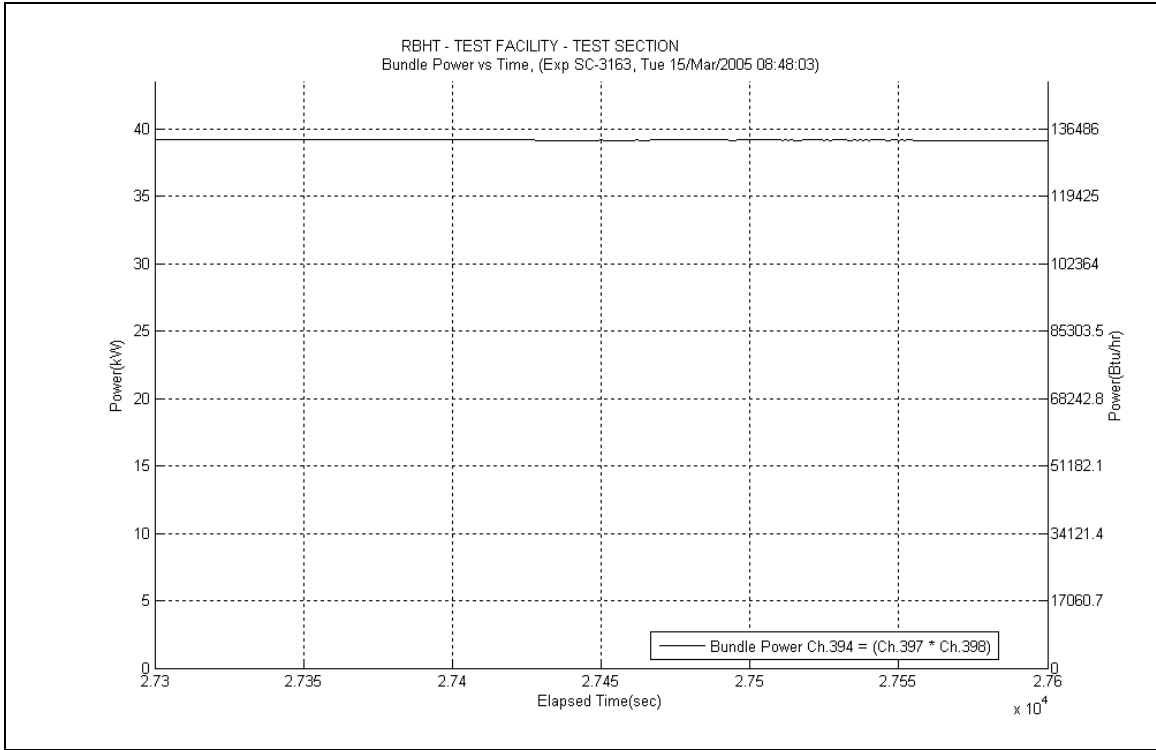
$$T_{cl} = -16.261x^3 + 100.93x^2 - 49.657x + 438.59$$

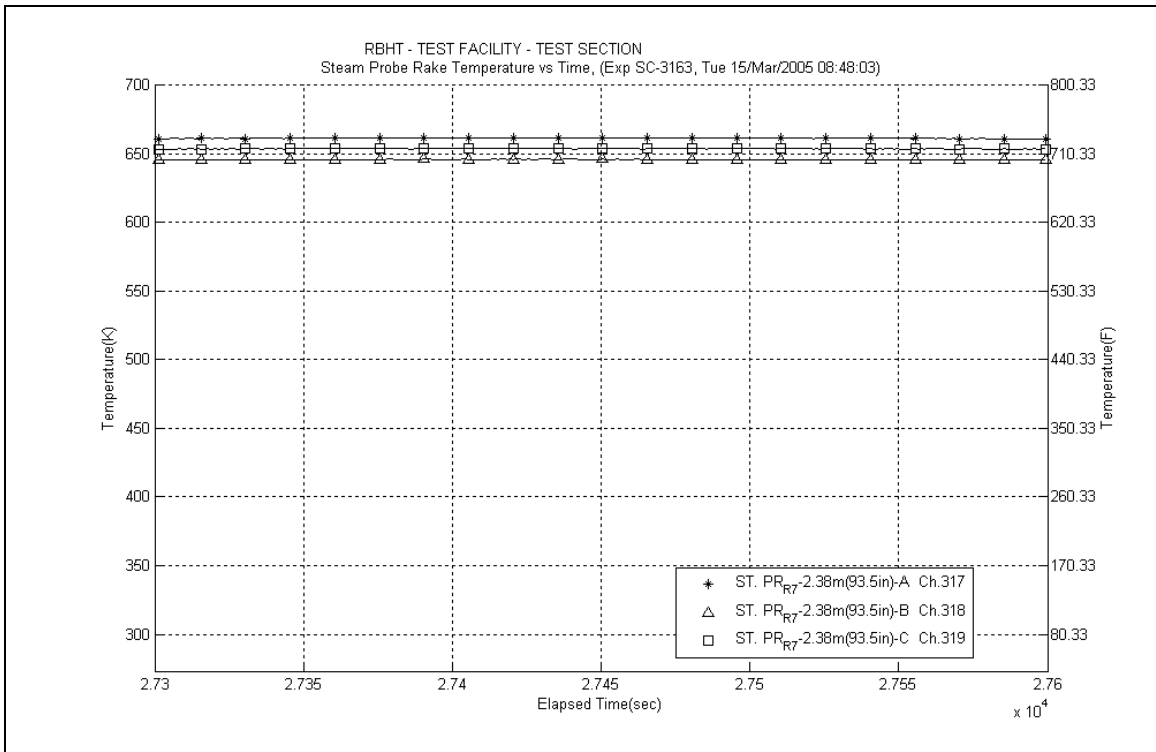
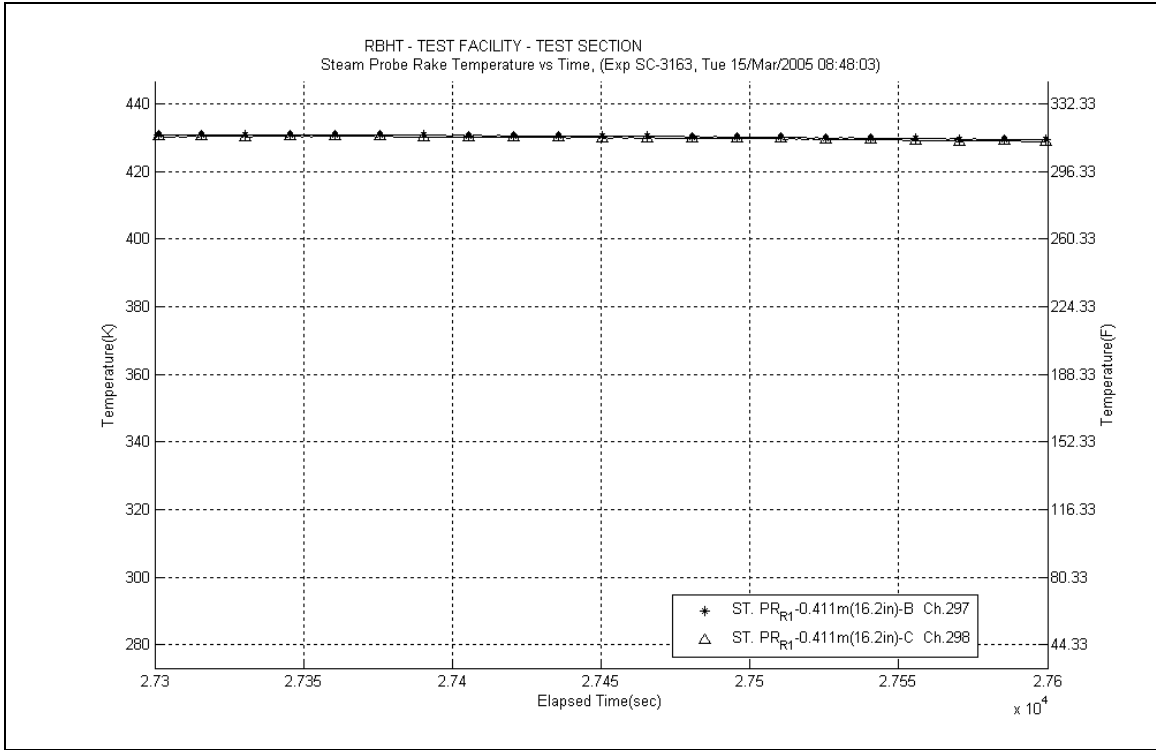
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

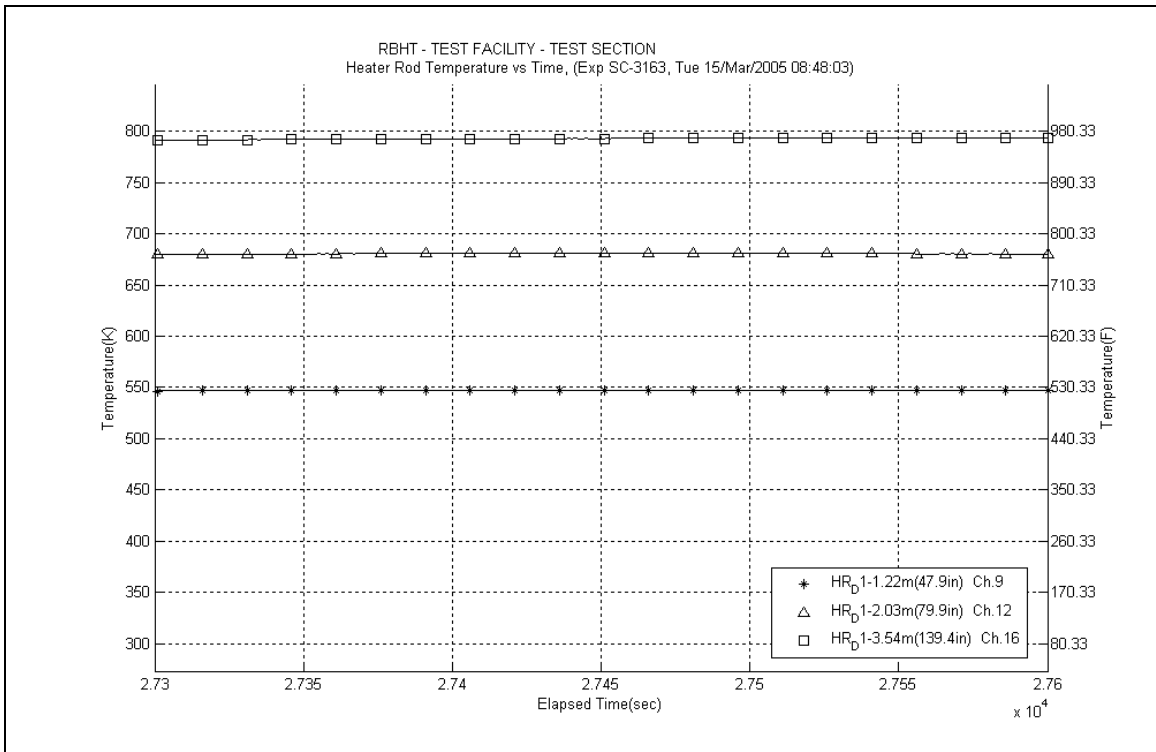
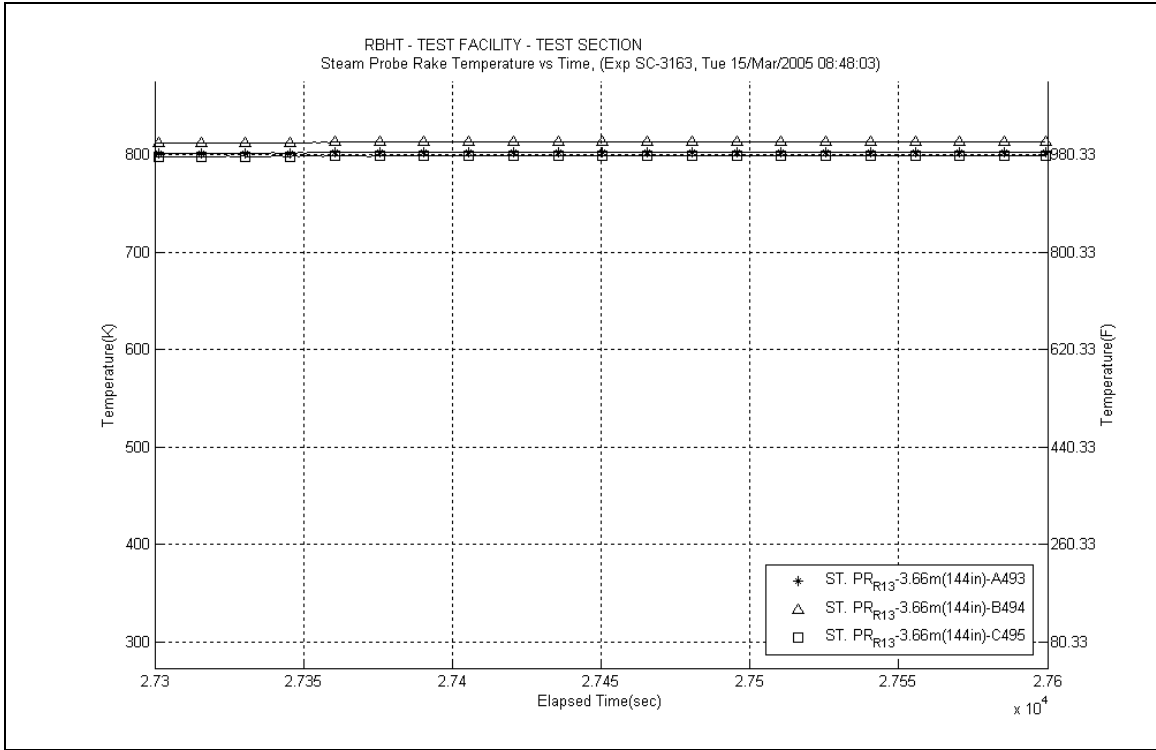
$$T_{cl} = -9.6585x^3 + 64.419x^2 - 2.3145x + 422.76$$

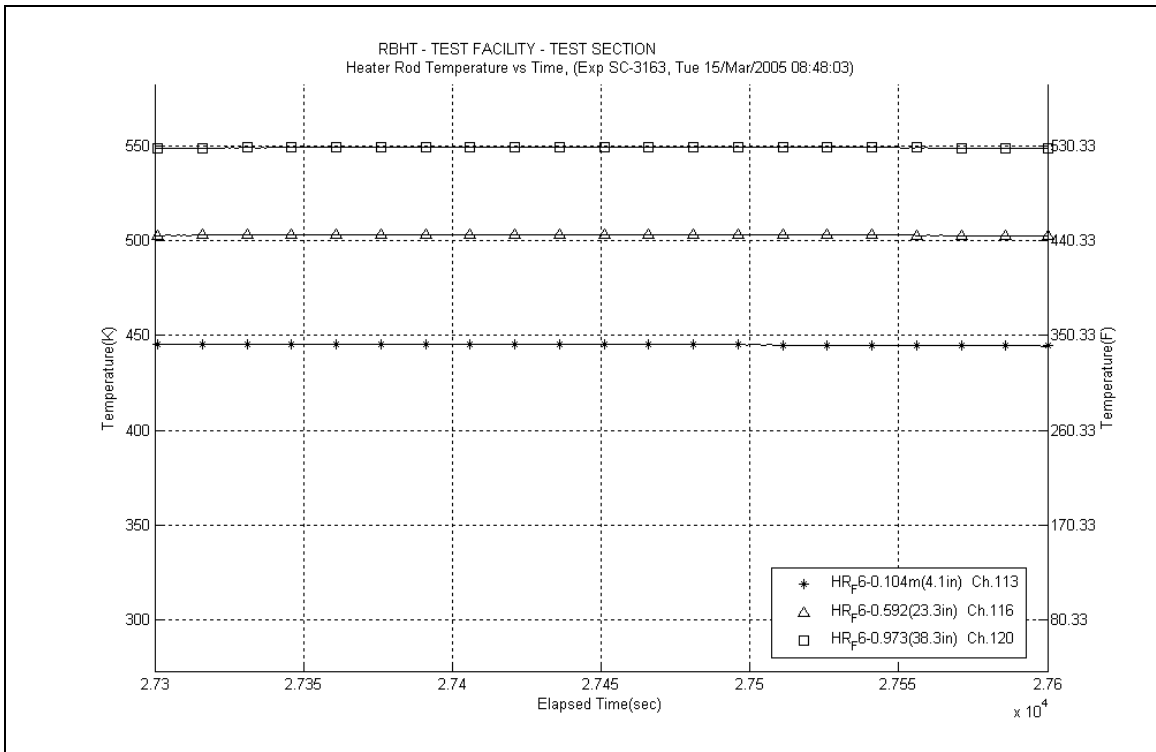
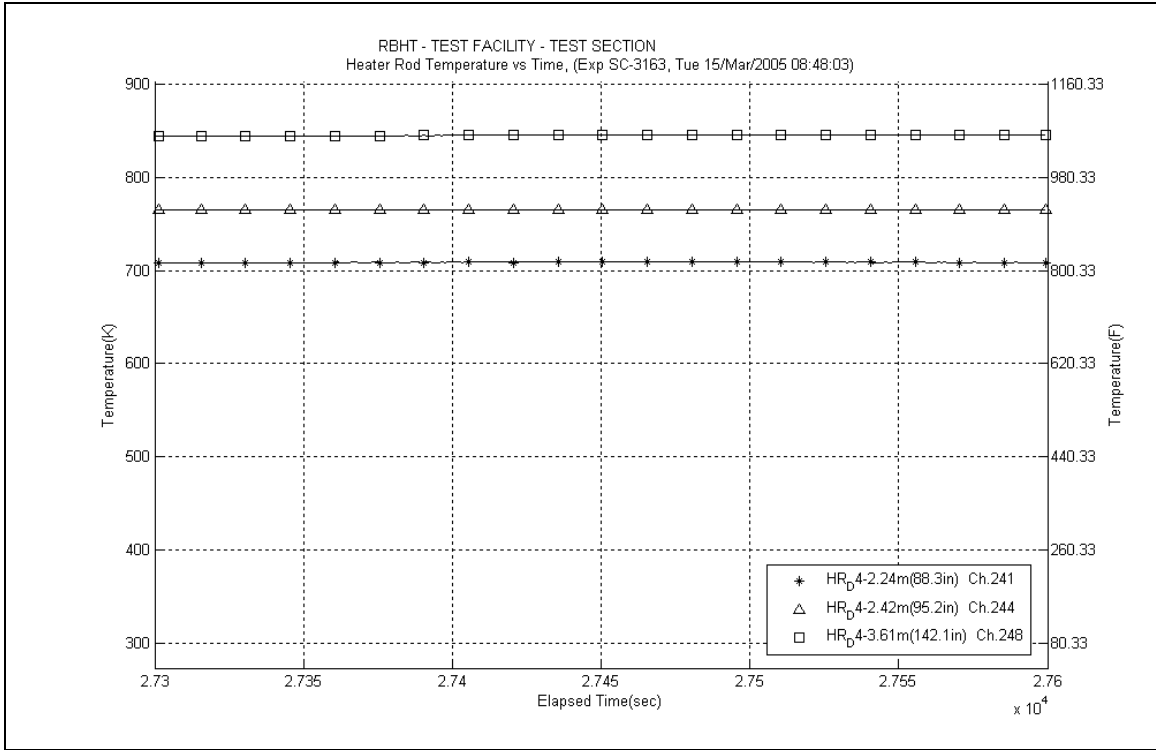
where x is the elevation (m) and T_{cl} is in (K)











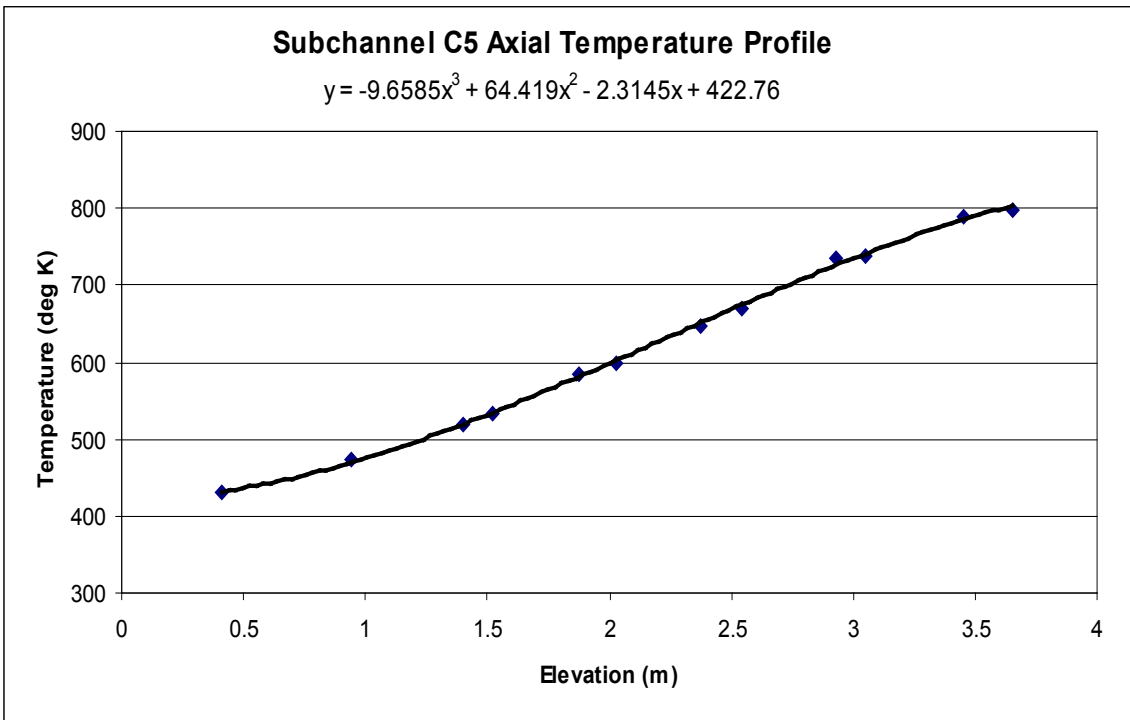
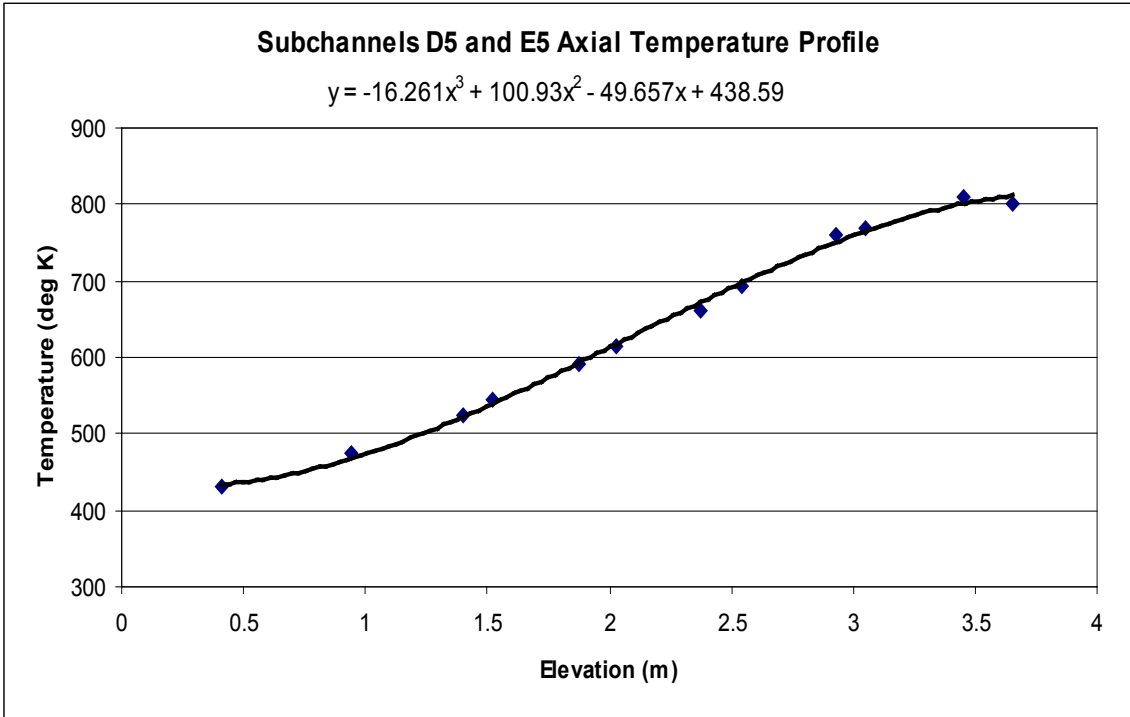


Table SC-3163-B.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htic (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	699.9	10475.2	651.5	1.27	661.9	4679	275.03	18.41	6.69%	60.37
RodD3_91.3	186	2.319	0.071	733.8	10694.5	663.4	1.27	678.5	4548	193.53	12.04	6.22%	40.99
RodD3_93.1	187	2.365	0.117	748.7	10830.9	670.6	1.27	687.3	4482	176.38	10.82	6.13%	36.67
RodD3_95.3	188	2.421	0.173	763.6	10990.7	679.2	1.27	697.2	4409	165.63	10.07	6.08%	33.73
RodD3_100.1	189	2.543	0.295	788.5	11354.7	697.5	1.27	717.0	4271	158.93	9.59	6.04%	31.08
RodD3_106.1	190	2.695	0.447	812.5	11798.7	719.5	1.27	739.5	4126	161.44	9.73	6.02%	30.19
RodD3_110	191	2.794	0.546	801.4	11657.3	733.1	1.27	747.7	4075	217.12	13.50	6.22%	39.96
RodD3_142.1	192	3.609	0.218	833.9	3997.0	809.7	1.27	814.9	3706	209.78	19.01	9.06%	34.09
RodC4_88.4	233	2.245	-0.003	701.6	10594.6	651.9	1.27	662.5	4674	270.91	17.97	6.63%	59.38
RodC4_91.1	234	2.314	0.066	729.8	10793.9	662.6	1.27	677.0	4559	204.48	12.77	6.24%	43.44
RodC4_93.4	235	2.372	0.124	744.2	10968.6	671.7	1.27	687.3	4482	192.53	11.89	6.17%	40.03
RodC4_95.3	236	2.421	0.173	758.8	11114.0	679.2	1.27	696.2	4416	177.64	10.84	6.10%	36.25
RodC4_100.1	237	2.543	0.295	783.8	11479.8	697.5	1.27	716.0	4278	169.43	10.25	6.05%	33.20
RodC4_106.1	238	2.695	0.447	809.0	11934.4	719.5	1.27	738.7	4130	169.77	10.23	6.03%	31.80
RodC4_110	239	2.794	0.546	794.2	11554.4	733.1	1.27	746.2	4084	240.48	15.26	6.35%	44.39
RodC4_142.2	240	3.612	0.221	846.1	4336.6	809.8	1.27	817.5	3692	152.11	11.20	7.36%	24.60
RodD4_88.3	241	2.243	-0.005	708.0	10550.7	651.5	1.27	663.6	4665	237.39	15.30	6.45%	51.91
RodD4_91.3	242	2.319	0.071	737.7	10773.8	663.4	1.27	679.4	4541	184.52	11.37	6.16%	39.01
RodD4_93.2	243	2.367	0.119	752.1	10917.1	670.9	1.27	688.3	4474	171.25	10.44	6.10%	35.53
RodD4_95.2	244	2.418	0.170	764.3	11066.2	678.8	1.27	697.1	4410	164.56	9.97	6.06%	33.52
RodD4_100.1	245	2.543	0.295	787.7	11442.0	697.5	1.27	716.9	4272	161.45	9.73	6.03%	31.59
RodD4_106.1	246	2.695	0.447	808.9	11890.4	719.5	1.27	738.7	4131	169.36	10.22	6.03%	31.72
RodD4_110	247	2.794	0.546	796.2	11488.4	733.1	1.27	746.6	3694	231.53	14.63	6.32%	37.47
RodD4_142.1	248	3.609	0.218	844.8	4194.5	809.7	1.27	817.2	3694	151.90	11.41	7.51%	24.58
RodE4_88.4	201	2.245	-0.003	702.3	10395.1	651.9	1.27	662.7	4673	262.39	17.43	6.64%	57.49
RodE4_91.2	202	2.316	0.069	731.0	10594.2	663.0	1.27	677.6	4555	198.50	12.44	6.27%	42.12
RodE4_95.3	204	2.421	0.173	760.8	10888.5	679.2	1.27	696.6	4413	169.69	10.39	6.12%	34.60
RodE4_100.9	205	2.563	0.315	787.3	11292.5	700.6	1.27	719.1	4257	165.56	10.07	6.08%	32.24
RodE4_142.3	208	3.614	0.224	836.0	4234.2	809.9	1.27	815.5	3702	206.47	17.77	8.60%	33.52
RodE3_63.4	193	1.610	0.417	642.6	8608.1	552.5	1.20	567.5	5600	114.57	5.77	5.04%	31.27
RodE3_113.6	194	2.885	0.022	804.2	10610.6	745.0	1.27	757.7	4015	227.99	14.61	6.41%	41.16
RodE3_115.5	195	2.934	0.070	817.0	10209.7	751.0	1.27	765.1	3971	197.05	12.39	6.29%	35.08
RodE3_118.5	196	3.010	0.146	828.0	9587.1	760.1	1.27	774.7	3917	179.67	11.23	6.25%	31.42
RodE3_122.7	197	3.117	0.253	836.6	8705.3	772.0	1.27	785.8	3856	171.33	10.78	6.29%	29.34
RodE3_126.5	198	3.213	0.349	837.7	7910.7	781.7	1.27	793.7	3814	179.50	11.58	6.45%	30.30
RodE3_131.7	199	3.345	-0.046	818.8	6837.0	793.2	1.27	798.7	3788	340.20	29.37	8.63%	56.91
RodE3_135.6	200	3.444	0.053	826.4	6007.7	800.5	1.27	806.1	3750	295.23	25.29	8.57%	48.74

Table SC-3163-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	642.6	8440.9	553.6	1.20	568.4	5589	113.86	5.80	5.09%	31.00
RodC5_113.6	226	2.885	0.022	798.1	10338.8	745.0	1.27	756.4	4023	247.73	16.35	6.60%	44.84
RodC5_115.7	227	2.939	0.075	814.8	9921.4	751.7	1.27	765.2	3971	199.92	12.74	6.37%	35.59
RodC5_122.7	229	3.117	0.253	837.9	8529.7	772.0	1.27	786.1	3855	164.64	10.39	6.31%	28.18
RodC5_126.7	230	3.218	0.354	840.2	7734.6	782.1	1.27	794.6	3809	169.52	10.91	6.44%	28.57
RodC5_131.6	231	3.343	-0.048	824.3	6770.7	793.0	1.27	799.7	3782	275.90	21.56	7.81%	46.07
RodC5_135.7	232	3.447	0.056	833.9	5948.1	800.7	1.27	807.8	3741	228.18	17.31	7.59%	37.55
RodE5_63.6	209	1.615	0.422	639.3	8654.5	553.2	1.20	567.6	5599	120.69	6.11	5.06%	32.93
RodE5_113.6	210	2.885	0.022	792.9	10669.6	745.0	1.27	755.3	4029	283.53	19.03	6.71%	51.43
RodE5_115.4	211	2.931	0.067	804.0	10296.9	750.7	1.27	762.1	3989	245.74	16.06	6.54%	44.00
RodE5_118.7	212	3.015	0.151	813.0	9616.9	760.7	1.27	771.9	3933	233.96	15.34	6.56%	41.12
RodE5_122.6	213	3.114	0.250	820.8	8815.0	771.7	1.27	782.2	3876	228.35	15.18	6.65%	39.37
RodE5_126.6	214	3.216	0.352	825.3	7989.9	781.9	1.27	791.2	3827	234.15	16.08	6.87%	39.71
RodE5_131.6	215	3.343	-0.048	810.8	6975.7	793.0	1.27	796.8	3797	500.55	54.70	10.93%	84.02
RodE5_135.6	216	3.444	0.053	822.7	6140.4	800.5	1.27	805.3	3754	351.93	32.94	9.36%	58.18
RodC3_79.8	177	2.027	0.227	684.8	9795.8	617.2	1.27	631.7	4939	184.33	11.55	6.27%	43.26
RodC3_85.6	178	2.174	0.374	692.4	10220.4	640.6	1.27	651.7	4763	251.02	16.55	6.59%	56.33
RodC3_88.5	179	2.248	0.000	697.6	10431.5	652.3	1.27	662.0	4678	292.89	20.00	6.83%	64.27
RodC3_92.4	180	2.347	0.099	734.6	10720.0	667.8	1.27	682.1	4521	204.33	12.83	6.28%	42.95
RodC3_94.4	181	2.398	0.150	744.3	10866.3	675.7	1.27	690.4	4459	201.33	12.58	6.25%	41.59
RodC3_97.2	182	2.469	0.221	764.5	11074.1	686.5	1.27	703.2	4366	180.70	11.10	6.15%	36.35
RodC3_108.8	183	2.764	0.516	807.5	11671.5	729.0	1.27	745.8	4086	189.11	11.61	6.14%	34.93
RodD5_50	217	1.270	0.076	586.2	7645.0	505.0	1.20	518.5	6235	113.06	5.77	5.11%	34.86
RodD5_54.1	218	1.374	0.180	611.3	7943.9	518.7	1.20	534.2	6017	103.03	5.17	5.02%	30.54
RodD5_56.9	219	1.445	0.251	625.1	8150.3	528.6	1.20	544.7	5880	101.27	5.05	4.99%	29.24
RodD5_60	220	1.524	0.330	636.6	8377.4	539.8	1.20	555.9	5739	103.82	5.18	4.99%	29.15
RodD5_66.1	221	1.679	0.485	648.7	8824.4	562.8	1.20	577.1	5490	123.25	6.26	5.08%	32.86
RodD5_69.9	222	1.775	-0.025	628.3	9108.5	577.6	1.20	586.0	5392	215.32	12.24	5.69%	56.19
RodD5_72.9	223	1.852	0.051	659.6	9322.6	589.5	1.20	601.2	5233	159.58	8.39	5.26%	40.18
RodD5_74.9	224	1.902	0.102	675.5	9468.9	597.5	1.20	610.5	5139	145.57	7.50	5.15%	35.86

Table SC-3163-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±h _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	562.6	6957.1	479.3	1.20	493.2	6620.1	100.23	5.11	5.09%	32.97
RodB5_52.9	154	1.344	0.150	599.5	7838.7	512.5	1.20	527.0	6114.7	108.10	5.47	5.06%	32.62
RodB5_55	155	1.397	0.203	608.2	7995.1	518.9	1.20	533.8	6022.2	107.42	5.42	5.04%	31.87
RodB5_57.8	156	1.468	0.274	620.9	8203.2	527.6	1.20	543.2	5898.5	105.56	5.29	5.01%	30.59
RodB5_64	157	1.626	0.432	637.2	8662.6	547.7	1.20	562.6	5657.2	116.22	5.86	5.04%	32.10
RodB5_73.9	158	1.877	0.077	661.9	9391.5	581.5	1.20	594.9	5297.2	140.21	7.19	5.13%	35.83
RodB5_75.9	159	1.928	0.128	675.6	9541.5	588.5	1.20	603.0	5213.7	131.53	6.67	5.07%	32.97
RodB5_76.9	160	1.953	0.153	681.1	9617.3	592.0	1.20	606.9	5175.0	129.65	6.55	5.05%	32.21
RodF5_41	105	1.041	0.343	559.5	6914.7	479.3	1.20	492.7	6628.4	103.46	5.31	5.14%	34.08
RodF5_53.1	106	1.349	0.155	595.2	7804.8	513.1	1.20	526.8	6117.8	114.17	5.84	5.12%	34.48
RodF5_55	107	1.397	0.203	604.5	7944.0	518.9	1.20	533.2	6030.7	111.43	5.67	5.09%	33.11
RodF5_57.8	108	1.468	0.274	615.7	8148.6	527.6	1.20	542.3	5909.7	111.03	5.62	5.07%	32.25
RodF5_64	109	1.626	0.432	631.1	8610.0	547.7	1.20	561.6	5669.3	123.93	6.32	5.10%	34.31
RodF5_73.8	110	1.875	0.074	650.2	9334.4	581.2	1.20	592.7	5320.7	162.24	8.58	5.29%	41.67
RodF5_75.8	111	1.925	0.125	664.4	9479.8	588.2	1.20	600.9	5235.7	149.32	7.75	5.19%	37.62
RodF5_76.8	112	1.951	0.150	670.1	9555.0	591.7	1.20	604.8	5196.2	146.13	7.54	5.16%	36.48
RodC2_41	57	1.041	0.343	556.5	6945.7	479.3	1.20	492.2	6636.6	108.01	5.57	5.16%	35.63
RodC2_53.1	58	1.349	0.155	598.8	7843.2	513.1	1.20	527.4	6109.5	109.90	5.58	5.07%	33.14
RodC2_55	59	1.397	0.203	607.0	7983.6	518.9	1.20	533.6	6025.1	108.80	5.50	5.05%	32.30
RodC2_57.8	60	1.468	0.274	618.9	8191.0	527.6	1.20	542.9	5902.8	107.67	5.42	5.03%	31.23
RodC2_63.9	61	1.623	0.429	632.1	8641.9	547.4	1.20	561.5	5670.7	122.46	6.22	5.08%	33.91
RodC2_73.8	62	1.875	0.074	651.0	9377.1	581.2	1.20	592.8	5319.3	161.03	8.48	5.26%	41.35
RodC2_75.8	63	1.925	0.125	663.1	9529.1	588.2	1.20	600.7	5237.8	152.58	7.92	5.19%	38.46
RodC2_76.8	64	1.951	0.150	667.9	9602.2	591.7	1.20	604.4	5200.0	151.20	7.83	5.18%	37.78
RodC6_40.9	137	1.039	0.340	563.8	6913.9	479.1	1.20	493.2	6620.3	97.91	4.99	5.09%	32.21
RodC6_52.8	138	1.341	0.147	601.9	7829.2	512.2	1.20	527.2	6112.8	104.80	5.28	5.04%	31.62
RodC6_54.8	139	1.392	0.198	611.9	7987.2	518.3	1.20	533.9	6021.0	102.42	5.13	5.01%	30.38
RodC6_57.8	140	1.468	0.274	625.4	8219.3	527.6	1.20	543.9	5888.8	100.86	5.03	4.98%	29.17
RodC6_63.8	141	1.621	0.427	642.2	8681.6	547.1	1.20	562.9	5653.8	109.47	5.47	4.99%	30.21
RodC6_73.7	142	1.872	0.072	664.4	9443.0	580.8	1.20	594.7	5298.9	135.54	6.89	5.08%	34.65
RodC6_75.8	143	1.925	0.125	675.4	9604.5	588.2	1.20	602.7	5217.0	132.13	6.67	5.05%	33.15
RodC6_76.8	144	1.951	0.150	681.9	9681.0	591.7	1.20	606.7	5176.6	128.80	6.48	5.03%	32.01

Table SC-3163-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ontc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	697.0	10392.5	633.0	1.27	646.7	4806.0	206.55	13.07	6.33%	46.87
RodB4_91.3	162	2.319	0.071	727.9	10597.0	643.4	1.27	661.5	4682.6	159.61	9.73	6.10%	35.07
RodB4_93.3	163	2.370	0.122	740.4	10740.4	650.5	1.27	669.8	4616.0	151.97	9.21	6.06%	32.79
RodB4_95.1	164	2.416	0.168	752.3	10865.9	656.9	1.27	677.3	4556.9	144.93	8.74	6.03%	30.77
RodB4_100	165	2.540	0.292	773.6	11218.5	674.2	1.27	695.5	4421.4	143.63	8.64	6.01%	29.35
RodB4_106	166	2.692	0.445	797.4	11648.3	695.0	1.27	716.9	4271.9	144.75	8.69	6.00%	28.31
RodB4_109.9	167	2.791	0.544	782.4	11281.5	708.2	1.27	724.1	4224.3	193.37	12.00	6.20%	37.28
RodB4_142.3	168	3.614	0.224	836.9	4305.1	799.9	1.27	807.8	3740.9	148.27	10.85	7.32%	24.40
RodF4_85.6	98	2.174	0.374	688.9	10246.4	623.0	1.27	637.1	4890.1	197.76	12.43	6.29%	45.85
RodF4_88.4	99	2.245	-0.003	692.5	10450.9	633.0	1.27	645.7	4814.4	223.47	14.30	6.40%	50.82
RodF4_92.4	100	2.347	0.099	730.0	10749.8	647.3	1.27	665.0	4653.9	165.36	10.09	6.10%	36.05
RodF4_94.3	101	2.395	0.147	743.9	10887.6	654.1	1.27	673.3	4588.1	154.20	9.33	6.05%	33.02
RodF4_97.2	102	2.469	0.221	761.5	11098.6	664.4	1.27	685.2	4497.5	145.36	8.74	6.01%	30.36
RodF4_108.8	103	2.764	0.516	794.0	11715.6	704.5	1.27	723.7	4227.0	166.53	10.07	6.05%	32.14
RodF4_111	104	2.819	-0.044	776.3	11244.9	711.8	1.27	725.6	4214.1	222.13	14.00	6.30%	42.70
RodD2_103.2	65	2.621	0.373	781.9	11596.2	685.4	1.27	706.0	4346.6	152.91	9.18	6.00%	30.58
RodD2_106	66	2.692	0.445	791.7	11807.0	695.0	1.27	715.7	4280.2	155.44	9.33	6.00%	30.48
RodD2_112.6	67	2.860	-0.004	778.8	10832.8	717.1	1.27	730.3	4183.7	223.60	14.22	6.36%	42.58
RodD2_114.9	68	2.918	0.055	797.9	10324.0	724.6	1.27	740.3	4120.5	179.27	11.10	6.19%	33.47
RodD2_117.4	69	2.982	0.118	806.1	9772.1	732.6	1.27	748.3	4071.1	169.11	10.47	6.19%	31.09
RodD2_120.8	70	3.068	0.204	816.2	9020.6	743.1	1.27	758.8	4008.6	157.11	9.74	6.20%	28.31
RodD2_124.8	71	3.170	0.306	821.1	8143.9	755.1	1.27	769.2	3948.2	157.07	9.88	6.29%	27.75
RodD2_128.6	72	3.266	0.403	820.9	7307.8	765.9	1.27	777.7	3900.6	169.16	11.01	6.51%	29.41
RodD6_103.1	129	2.619	0.371	781.6	11622.4	685.0	1.27	705.7	4348.8	153.06	9.18	6.00%	30.63
RodD6_106	130	2.692	0.445	787.9	11836.6	695.0	1.27	714.9	4285.6	162.09	9.75	6.02%	31.84
RodD6_112.9	131	2.868	0.004	775.4	10800.7	718.1	1.27	730.4	4183.3	239.76	15.45	6.44%	45.65
RodD6_114.9	132	2.918	0.055	791.6	10350.1	724.6	1.27	738.9	4128.9	196.58	12.32	6.27%	36.80
RodD6_116.8	133	2.967	0.103	803.2	9923.7	730.7	1.27	746.2	4084.0	174.15	10.80	6.20%	32.15
RodD6_120.9	134	3.071	0.207	813.6	9015.7	743.4	1.27	758.5	4010.4	163.55	10.19	6.23%	29.49
RodD6_124.8	135	3.170	0.306	820.1	8150.0	755.1	1.27	769.0	3949.3	159.41	10.05	6.31%	28.17
RodD6_128.7	136	3.269	0.405	822.0	7284.0	766.2	1.27	778.1	3898.1	166.13	10.78	6.49%	28.86

Table SC-3163-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±h _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	577.9	7671.5	504.2	1.20	516.5	6263.7	124.95	6.48	5.18%	38.73
RodE2_54	74	1.372	0.178	601.5	7960.8	515.9	1.20	530.1	6072.0	111.55	5.64	5.06%	33.40
RodE2_56.9	75	1.445	0.251	615.1	8178.5	524.8	1.20	539.9	5941.8	108.72	5.46	5.02%	31.77
RodE2_59.9	76	1.521	0.328	628.2	8405.7	534.3	1.20	550.0	5812.1	107.52	5.37	5.00%	30.64
RodE2_66	77	1.676	0.483	639.1	8863.6	554.4	1.20	568.5	5588.1	125.67	6.36	5.06%	34.21
RodE2_69.8	78	1.773	-0.027	616.4	9156.0	567.3	1.20	575.5	5508.2	224.02	12.85	5.74%	59.96
RodE2_72.9	79	1.852	0.051	644.7	9380.6	578.0	1.20	589.1	5358.3	168.96	8.92	5.28%	43.77
RodE2_74.9	80	1.902	0.102	656.9	9531.1	585.0	1.20	597.0	5275.5	158.99	8.30	5.22%	40.42
RodB3_50.2	169	1.275	0.081	574.2	7635.2	504.5	1.20	516.1	6269.2	131.50	6.91	5.25%	40.80
RodB3_54.1	170	1.374	0.180	590.4	7924.9	516.2	1.20	528.5	6093.9	128.11	6.65	5.19%	38.52
RodB3_56.9	171	1.445	0.251	600.5	8129.4	524.8	1.20	537.4	5973.8	128.88	6.66	5.17%	37.89
RodB3_60.1	172	1.527	0.333	608.4	8369.5	535.0	1.20	547.2	5846.9	136.78	7.11	5.20%	39.24
RodB3_66.1	173	1.679	0.485	630.8	8814.2	554.8	1.20	567.4	5600.9	139.10	7.18	5.16%	37.97
RodB3_69.9	174	1.775	-0.025	615.0	9100.1	567.7	1.20	575.5	5507.6	230.80	13.44	5.82%	61.77
RodB3_73	175	1.854	0.054	645.3	9321.5	578.4	1.20	589.5	5354.1	167.15	8.84	5.29%	43.26
RodB3_75	176	1.905	0.105	659.6	9468.0	585.4	1.20	597.7	5267.8	153.00	7.96	5.20%	38.83
RodF3_50.1	89	1.273	0.079	580.7	7626.5	504.2	1.20	517.0	6257.0	119.69	6.18	5.16%	37.06
RodF3_54	90	1.372	0.178	602.9	7917.4	515.9	1.20	530.4	6068.7	109.09	5.52	5.06%	32.65
RodF3_57	91	1.448	0.254	615.4	8146.1	525.1	1.20	540.2	5937.7	108.26	5.45	5.03%	31.61
RodF3_60	92	1.524	0.330	626.0	8373.5	534.7	1.20	549.9	5813.2	109.97	5.53	5.02%	31.34
RodF3_66.1	93	1.679	0.485	631.5	8835.7	554.8	1.20	567.5	5599.5	138.10	7.11	5.15%	37.68
RodF3_70	94	1.778	-0.022	617.9	9135.9	568.0	1.20	576.3	5498.9	219.67	12.55	5.71%	58.68
RodF3_73	95	1.854	0.054	646.5	9358.2	578.4	1.20	589.7	5352.0	164.86	8.68	5.26%	42.65
RodF3_75	96	1.905	0.105	662.3	9509.7	585.4	1.20	598.2	5263.2	148.35	7.65	5.16%	37.61
RodE6_50.2	121	1.275	0.081	579.8	7626.3	504.5	1.20	517.1	6255.5	121.51	6.29	5.18%	37.61
RodE6_54.1	122	1.374	0.180	601.3	7910.7	516.2	1.20	530.4	6069.0	111.48	5.66	5.08%	33.36
RodE6_57	123	1.448	0.254	613.3	8123.3	525.1	1.20	539.8	5942.4	110.61	5.59	5.06%	32.33
RodE6_60.2	124	1.529	0.335	624.7	8359.9	535.3	1.20	550.2	5809.3	112.26	5.66	5.05%	31.97
RodE6_66.1	125	1.679	0.485	636.4	8791.9	554.8	1.20	568.4	5590.0	129.22	6.60	5.11%	35.19
RodE6_70	126	1.778	-0.022	618.2	9083.2	568.0	1.20	576.4	5498.4	217.21	12.41	5.71%	58.01
RodE6_73.1	127	1.857	0.056	646.3	9303.4	578.7	1.20	590.0	5349.2	165.21	8.73	5.29%	42.71
RodE6_75	128	1.905	0.105	660.2	9440.6	585.4	1.20	597.8	5266.9	151.43	7.88	5.20%	38.43

RBHT Steam Cooling Test SC-3166-A

Matrix test # 3

Test date – 3/21/2005

Steady state time window: 15000 - 15600 sec

Inlet flow: 0.91 m³/min (32.2 ft³/min)

Inlet steam temperature: 408 K (275 °F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 21.0 kW

Outlet steam temperature: 780 K (945 °F)

Bundle inlet Reynolds number: 3655

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

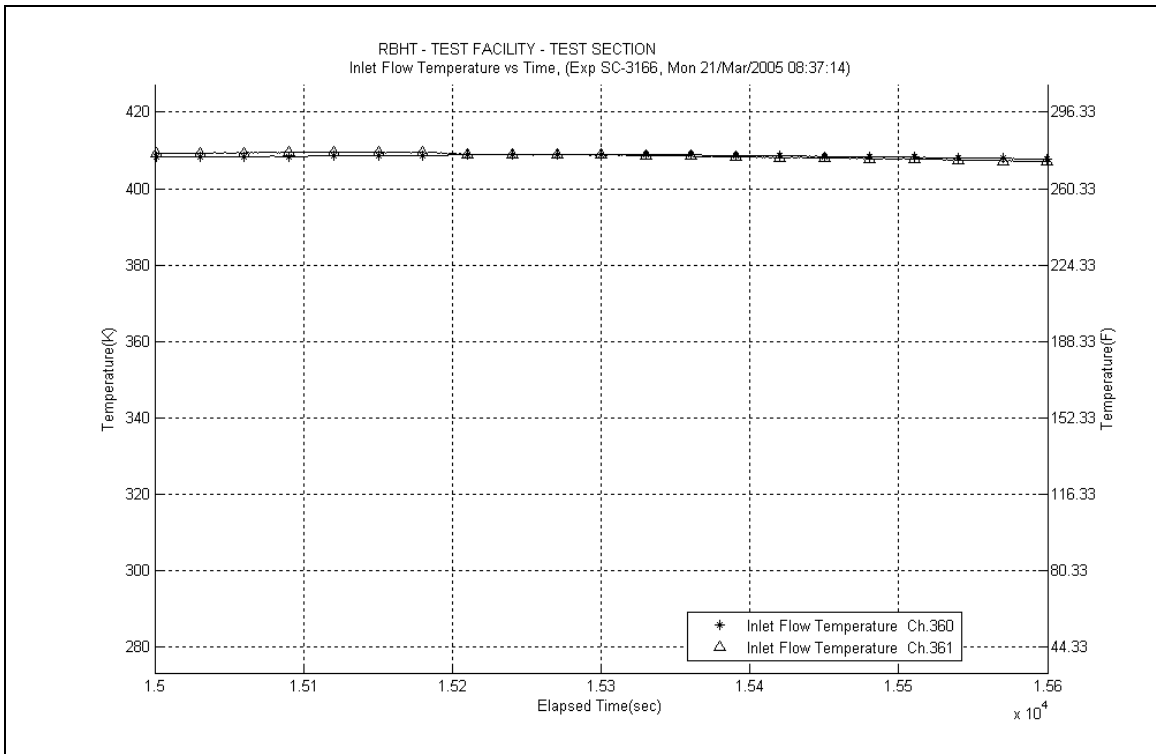
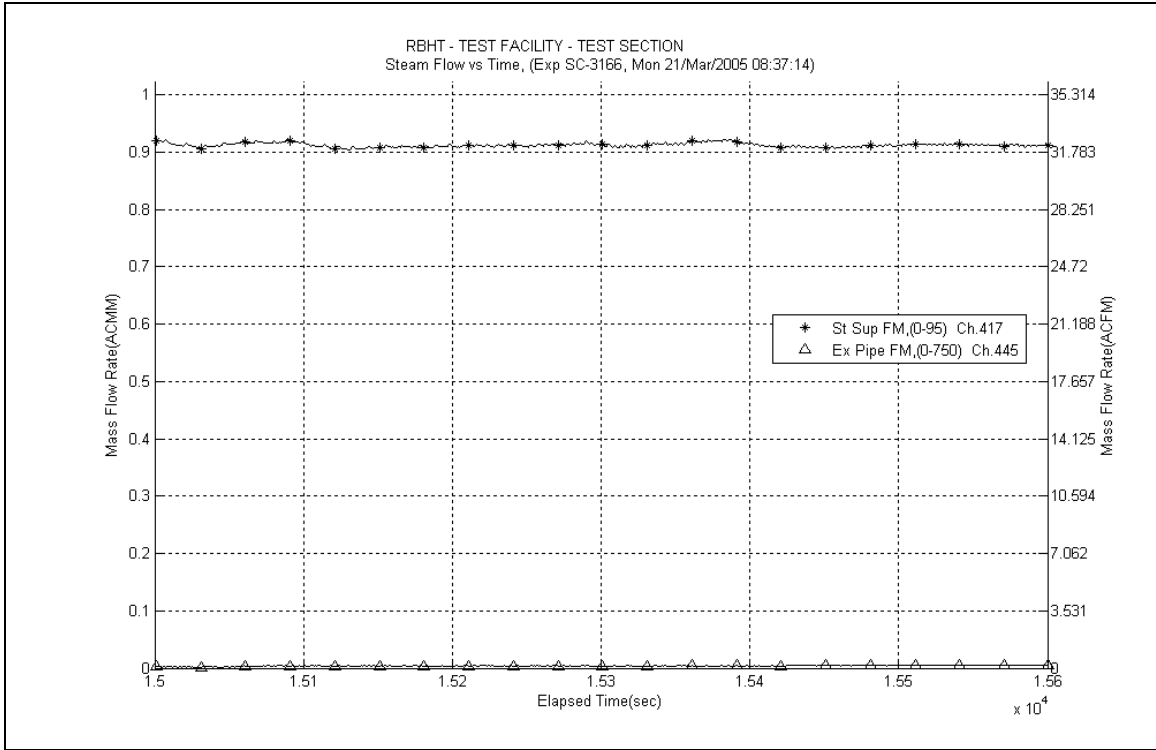
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

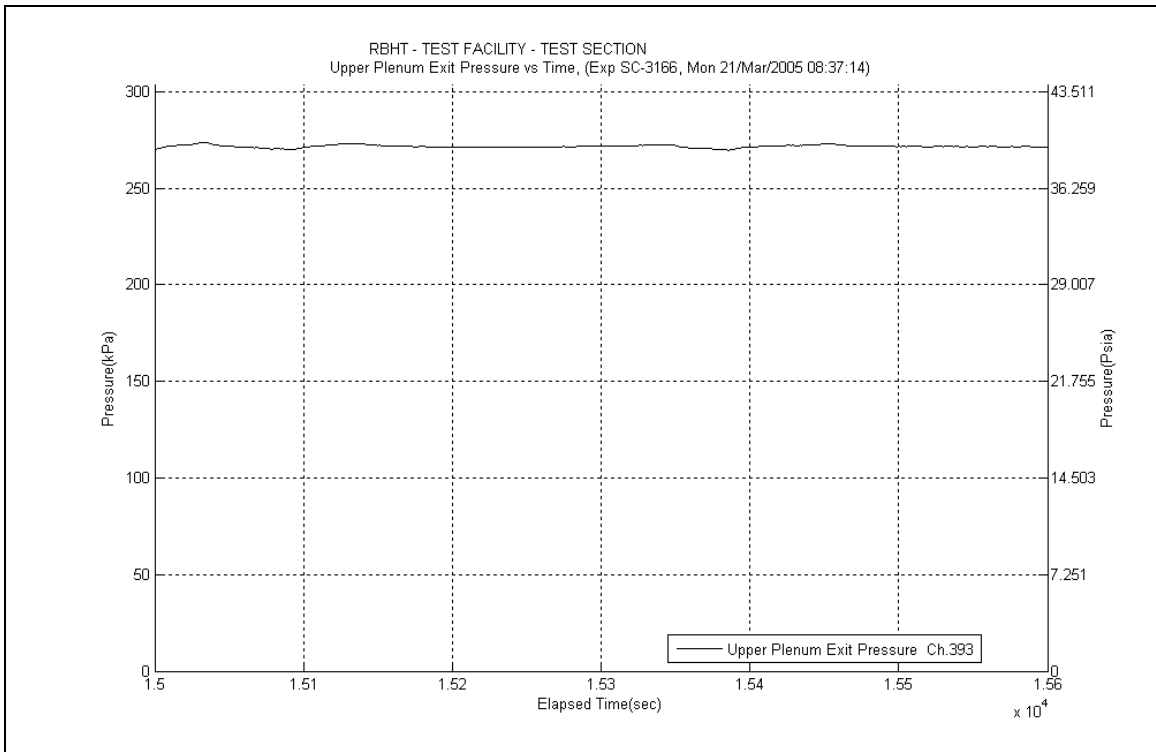
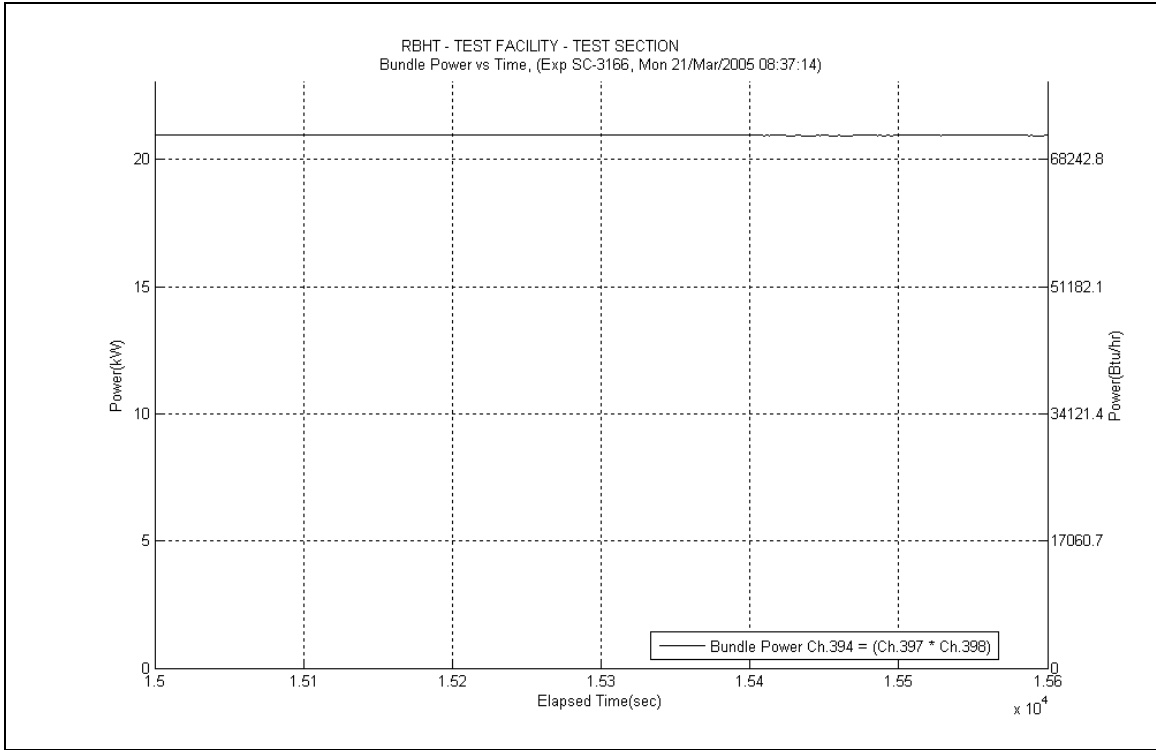
$$T_{cl} = -15.787x^3 + 96.024x^2 - 41.28x + 433.52$$

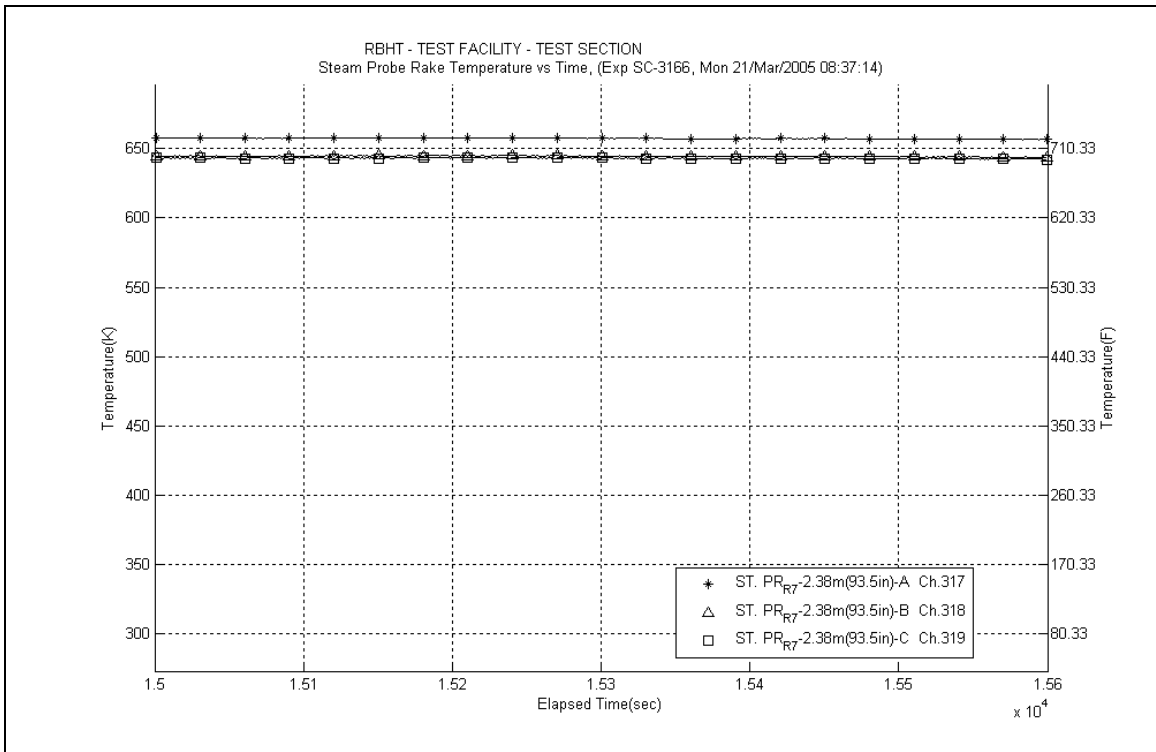
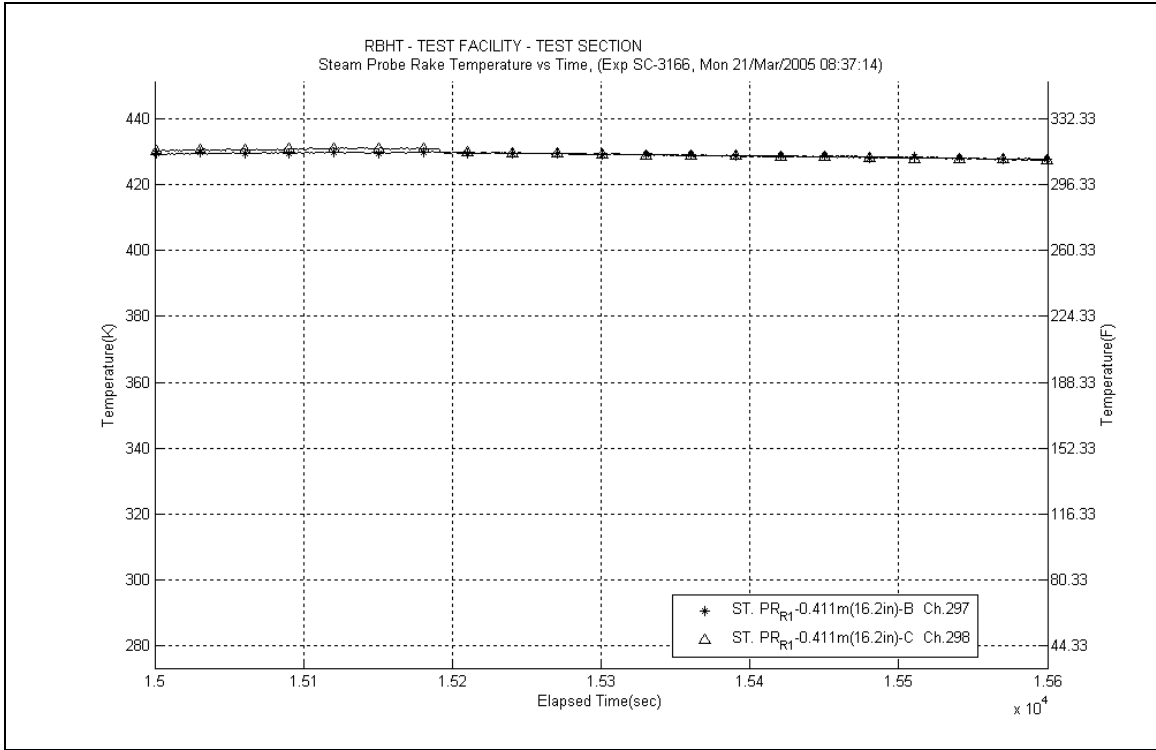
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

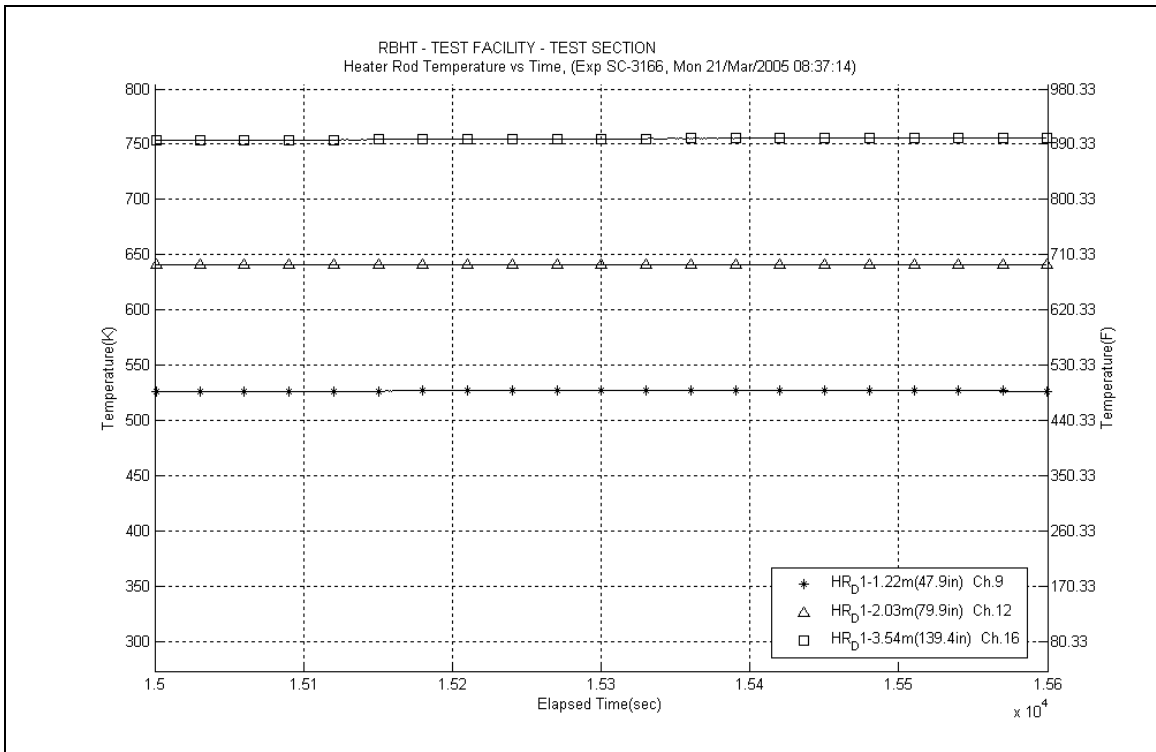
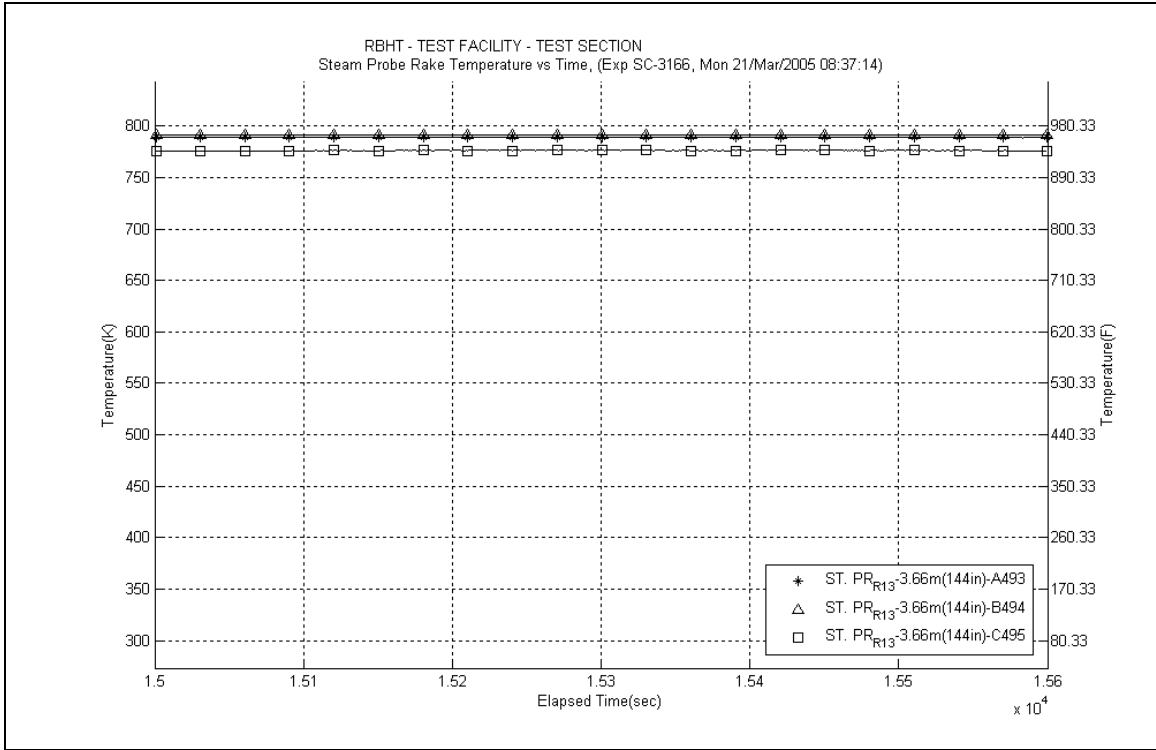
$$T_{cl} = -10.056x^3 + 62.945x^2 + 2.2908x + 419.79$$

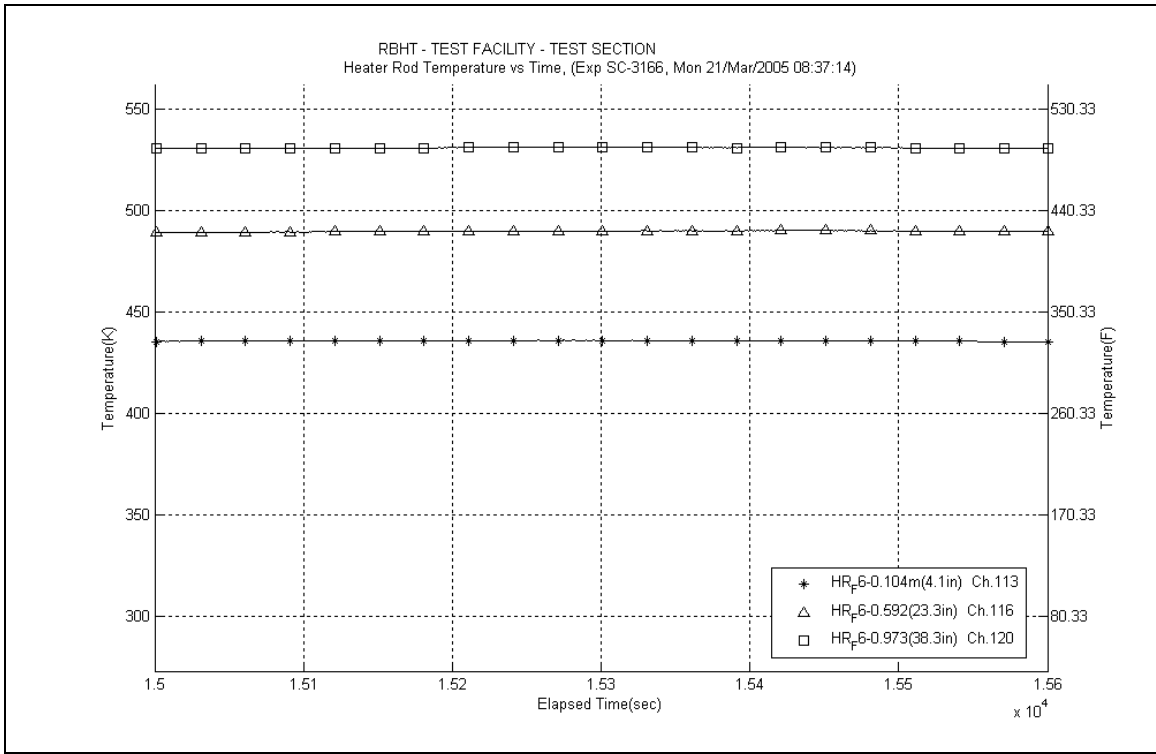
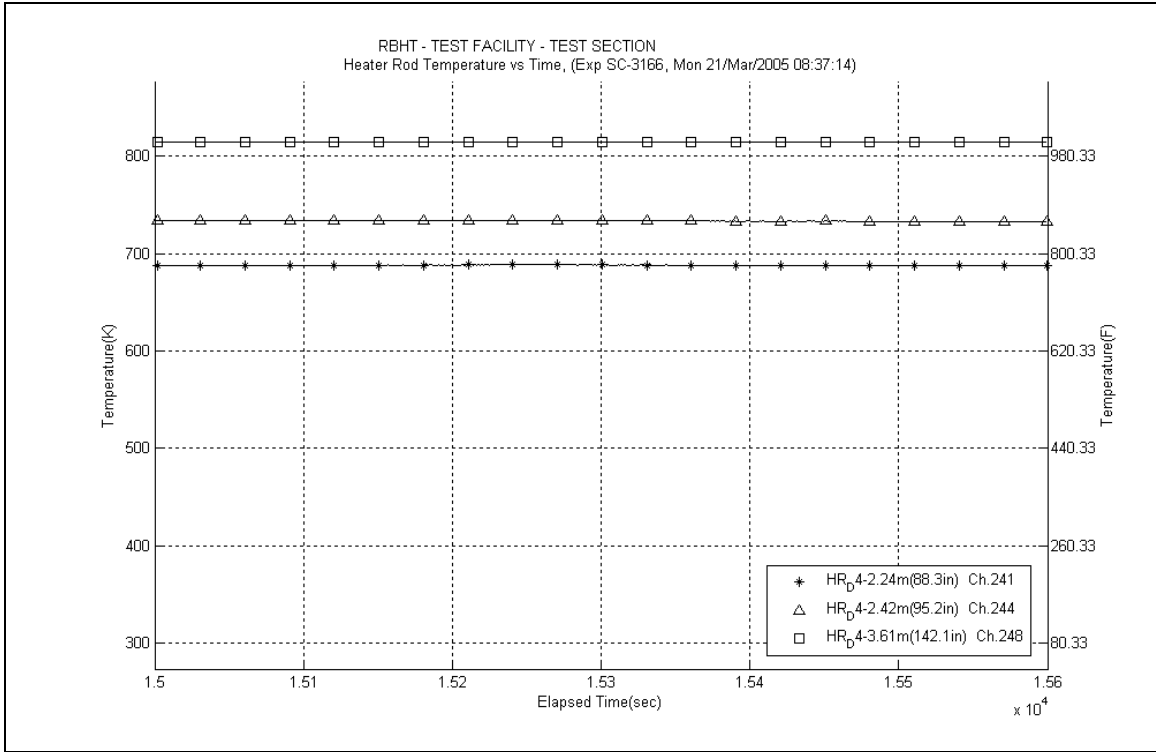
where x is the elevation (m) and T_{cl} is in (K)











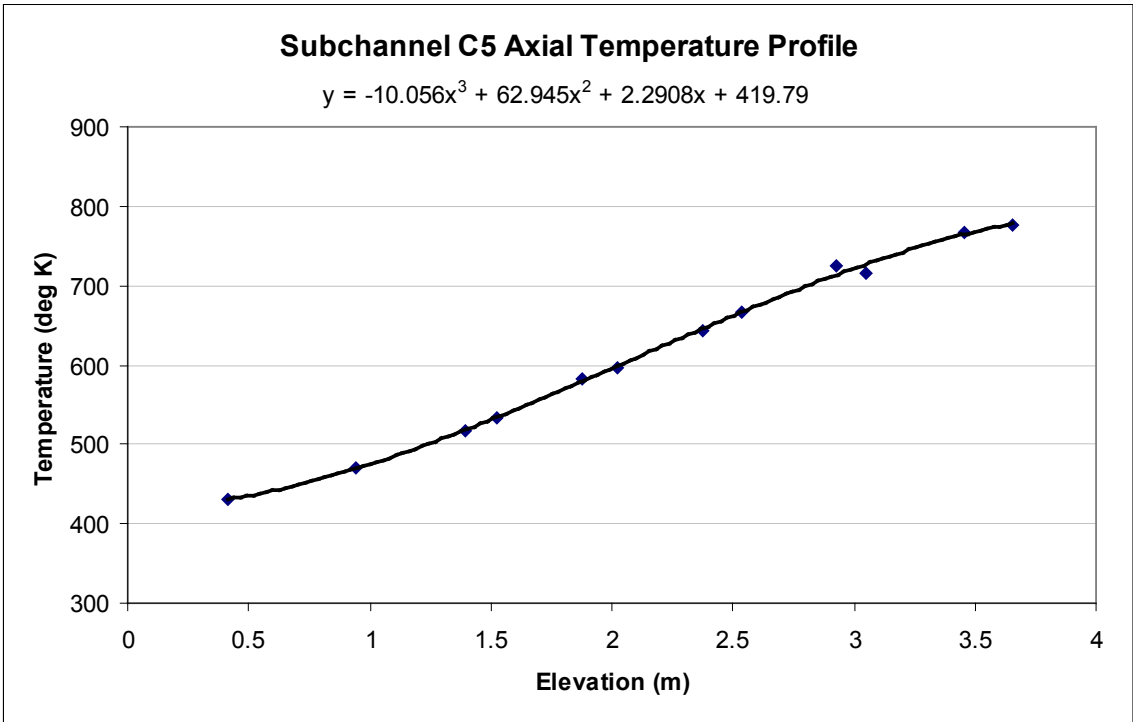
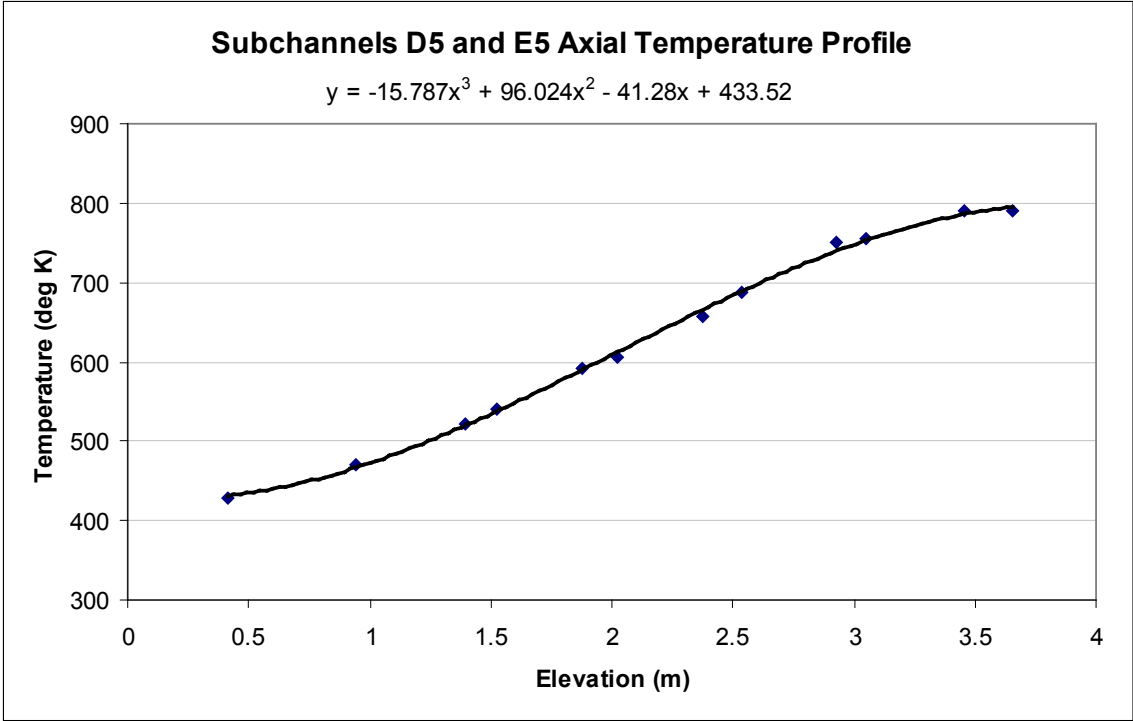


Table SC-3166-A.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±h _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	681.1	5616.5	645.8	1.27	653.4	2411	202.60	18.37	9.07%	45.30
RodD3_91.3	186	2.319	0.071	704.4	5734.5	657.3	1.27	667.4	2353	155.04	13.21	8.52%	33.63
RodD3_93.1	187	2.365	0.117	717.4	5806.5	664.1	1.50	681.9	2296	163.49	15.69	9.60%	34.38
RodD3_95.3	188	2.421	0.173	732.0	5895.4	672.3	1.50	692.2	2257	148.22	14.07	9.49%	30.50
RodD3_100.1	189	2.543	0.295	755.2	6088.2	689.8	1.50	711.6	2187	139.65	13.16	9.42%	27.61
RodD3_106.1	190	2.695	0.447	775.2	6325.3	710.7	1.50	732.2	2118	147.08	13.87	9.43%	27.91
RodD3_110	191	2.794	0.546	772.9	6248.2	723.5	1.50	739.9	2093	189.57	18.21	9.61%	35.42
RodD3_142.1	192	3.609	0.218	804.9	2174.7	793.2	1.50	797.1	1927	278.16	47.24	16.98%	46.67
RodC4_88.4	233	2.245	-0.003	680.3	5683.3	646.2	1.27	653.5	2410	212.21	19.33	9.11%	47.43
RodC4_91.1	234	2.314	0.066	702.3	5791.6	656.5	1.27	666.3	2357	160.96	13.70	8.51%	34.99
RodC4_93.4	235	2.372	0.124	716.7	5885.4	665.2	1.50	682.4	2294	171.52	16.44	9.59%	36.03
RodC4_95.3	236	2.421	0.173	729.3	5962.0	672.3	1.50	691.3	2260	156.90	14.88	9.49%	32.35
RodC4_100.1	237	2.543	0.295	751.9	6158.7	689.8	1.50	710.5	2191	148.93	14.02	9.41%	29.51
RodC4_106.1	238	2.695	0.447	770.3	6402.8	710.7	1.50	730.5	2123	161.05	15.21	9.44%	30.66
RodC4_110	239	2.794	0.546	765.0	6198.8	723.5	1.50	737.3	2101	223.94	22.12	9.88%	42.06
RodC4_142.2	240	3.612	0.221	811.9	2359.3	793.2	1.50	799.5	1921	189.75	24.07	12.68%	31.70
RodD4_88.3	241	2.243	-0.005	687.7	5661.3	645.8	1.27	654.8	2405	171.93	14.91	8.67%	38.32
RodD4_91.3	242	2.319	0.071	708.0	5781.2	657.3	1.27	668.2	2350	145.15	12.17	8.38%	31.43
RodD4_93.2	243	2.367	0.119	721.1	5857.3	664.5	1.50	683.4	2290	155.13	14.75	9.51%	32.52
RodD4_95.2	244	2.418	0.170	733.1	5937.7	672.0	1.50	692.3	2256	145.62	13.75	9.44%	29.96
RodD4_100.1	245	2.543	0.295	756.1	6138.4	689.8	1.50	711.9	2186	138.89	13.03	9.38%	27.44
RodD4_106.1	246	2.695	0.447	773.6	6378.2	710.7	1.50	731.6	2119	152.02	14.31	9.41%	28.87
RodD4_110	247	2.794	0.546	769.6	6381.4	723.5	1.50	738.8	2096	207.22	19.92	9.61%	38.80
RodD4_142.1	248	3.609	0.218	814.3	2283.2	793.2	1.50	800.2	1919	161.75	19.56	12.09%	26.98
RodE4_88.4	201	2.245	-0.003	680.3	5573.6	646.2	1.27	653.5	2410	207.89	19.10	9.19%	46.47
RodE4_91.2	202	2.316	0.069	701.7	5682.1	656.9	1.27	666.5	2356	161.35	13.93	8.63%	35.06
RodE4_95.3	204	2.421	0.173	728.1	5839.8	672.3	1.50	690.9	2261	157.03	15.06	9.59%	32.40
RodE4_100.9	205	2.563	0.315	751.1	6057.8	692.7	1.50	712.2	2185	155.49	14.85	9.55%	30.71
RodE4_142.3	208	3.614	0.224	809.4	2307.3	793.3	1.50	798.7	1923	215.26	29.63	13.76%	36.01
RodE3_63.4	193	1.610	0.417	615.7	4612.3	550.1	1.27	564.2	2863	89.53	7.31	8.17%	24.63
RodE3_113.6	194	2.885	0.022	774.2	5691.1	734.6	1.50	747.8	2068	215.93	21.62	10.01%	39.74
RodE3_115.5	195	2.934	0.070	783.3	5480.9	740.2	1.50	754.6	2047	190.78	18.82	9.87%	34.65
RodE3_118.5	196	3.010	0.146	793.3	5147.2	748.7	1.50	763.6	2021	173.22	16.98	9.80%	30.93
RodE3_122.7	197	3.117	0.253	801.3	4678.3	759.7	1.50	773.5	1992	168.51	16.65	9.88%	29.53
RodE3_126.5	198	3.213	0.349	803.7	4255.2	768.5	1.50	780.3	1973	181.38	18.45	10.17%	31.39
RodE3_131.7	199	3.345	-0.046	797.1	3679.2	779.0	1.50	785.0	1960	304.16	38.92	12.79%	52.17
RodE3_135.6	200	3.444	0.053	799.5	3241.5	785.4	1.50	790.1	1946	345.34	50.98	14.76%	58.68

Table SC-3166-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Td (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohic (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	619.8	4527.2	551.2	1.27	565.9	2852	84.01	6.92	8.24%	23.02
RodC5_113.6	226	2.885	0.022	765.9	5555.5	734.6	1.50	745.0	2077	266.63	28.30	10.61%	49.33
RodC5_115.7	227	2.939	0.075	777.9	5330.9	740.8	1.50	753.2	2052	215.69	22.03	10.21%	39.28
RodC5_122.7	229	3.117	0.253	799.0	4589.5	759.7	1.50	772.8	1994	174.88	17.58	10.05%	30.69
RodC5_126.7	230	3.218	0.354	802.8	4167.3	769.0	1.50	780.2	1973	185.10	19.11	10.32%	32.03
RodC5_131.6	231	3.343	-0.048	798.5	3652.3	778.8	1.50	785.4	1959	278.93	34.42	12.34%	47.81
RodC5_135.7	232	3.447	0.056	803.9	3217.0	785.6	1.50	791.7	1941	262.62	33.34	12.70%	44.50
RodE5_63.6	209	1.615	0.422	613.4	4635.7	550.9	1.27	564.3	2862	94.34	7.73	8.19%	25.95
RodE5_113.6	210	2.885	0.022	762.9	5727.5	734.6	1.50	744.1	2080	303.60	32.76	10.79%	56.28
RodE5_115.4	211	2.931	0.067	772.3	5530.9	740.0	1.50	750.7	2059	256.78	26.72	10.41%	46.99
RodE5_118.7	212	3.015	0.151	783.6	5168.2	749.3	1.50	760.7	2029	225.82	23.13	10.24%	40.54
RodE5_122.6	213	3.114	0.250	791.5	4740.5	759.4	1.50	770.1	2002	221.88	23.03	10.38%	39.13
RodE5_126.6	214	3.216	0.352	796.5	4302.9	768.8	1.50	778.0	1979	232.72	25.06	10.77%	40.44
RodE5_131.6	215	3.343	-0.048	792.8	3757.7	778.8	1.50	783.5	1964	403.23	59.73	14.81%	69.36
RodE5_135.6	216	3.444	0.053	795.9	3317.2	785.4	1.50	788.9	1949	472.78	85.28	18.04%	80.51
RodC3_79.8	177	2.027	0.227	661.5	5250.7	612.9	1.27	623.3	2546	137.33	11.67	8.50%	32.85
RodC3_85.6	178	2.174	0.374	671.8	5477.4	635.4	1.27	643.2	2455	191.41	17.26	9.02%	43.77
RodC3_88.5	179	2.248	0.000	675.7	5593.2	646.6	1.27	652.8	2413	245.05	23.64	9.65%	54.86
RodC3_92.4	180	2.347	0.099	703.2	5746.1	661.5	1.27	670.4	2341	175.04	15.29	8.74%	37.72
RodC3_94.4	181	2.398	0.150	714.6	5825.7	669.0	1.50	684.2	2287	191.68	18.78	9.80%	40.11
RodC3_97.2	182	2.469	0.221	731.5	5936.0	679.3	1.50	696.7	2240	170.56	16.44	9.64%	34.77
RodC3_108.8	183	2.764	0.516	769.4	6256.9	719.6	1.50	736.2	2105	188.49	18.25	9.68%	35.48
RodD5_50	217	1.270	0.076	565.2	4096.5	503.6	1.27	516.8	3177	84.66	6.95	8.21%	26.22
RodD5_54.1	218	1.374	0.180	586.5	4256.1	517.1	1.27	532.0	3069	78.07	6.34	8.12%	23.27
RodD5_56.9	219	1.445	0.251	597.6	4367.8	526.8	1.27	541.9	3002	78.43	6.35	8.10%	22.80
RodD5_60	220	1.524	0.330	608.9	4489.9	537.7	1.27	553.0	2931	80.33	6.51	8.10%	22.72
RodD5_66.1	221	1.679	0.485	625.0	4731.1	560.2	1.27	574.0	2804	92.88	7.58	8.16%	24.95
RodD5_69.9	222	1.775	-0.025	615.0	4881.5	574.6	1.27	583.2	2753	153.68	13.44	8.75%	40.38
RodD5_72.9	223	1.852	0.051	635.8	4997.9	586.1	1.27	596.7	2679	127.90	10.78	8.43%	32.54
RodD5_74.9	224	1.902	0.102	648.8	5077.9	593.8	1.27	605.6	2633	117.44	9.78	8.33%	29.26

Table SC-3166-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Td (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±h _{thc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	544.2	3730.9	479.1	1.27	493.0	3362.0	72.93	5.96	8.17%	24.01
RodB5_52.9	154	1.344	0.150	575.4	4201.0	512.1	1.27	525.7	3113.6	84.42	6.92	8.19%	25.57
RodB5_55	155	1.397	0.203	583.0	4286.2	518.4	1.27	532.3	3067.7	84.40	6.90	8.17%	25.14
RodB5_57.8	156	1.468	0.274	594.5	4397.7	527.0	1.27	541.4	3005.8	82.95	6.75	8.14%	24.15
RodB5_64	157	1.626	0.432	613.6	4643.8	546.7	1.27	561.0	2881.8	88.23	7.19	8.14%	24.47
RodB5_73.9	158	1.877	0.077	634.6	5037.4	579.4	1.27	591.2	2709.0	116.14	9.65	8.31%	29.94
RodB5_75.9	159	1.928	0.128	646.0	5116.8	586.1	1.27	598.9	2667.9	108.61	8.94	8.23%	27.49
RodB5_76.9	160	1.953	0.153	650.6	5156.9	589.5	1.27	602.6	2649.0	107.40	8.84	8.23%	26.95
RodF5_41	105	1.041	0.343	539.4	3690.2	479.1	1.27	492.0	3370.3	77.80	6.45	8.29%	25.67
RodF5_53.1	106	1.349	0.155	569.4	4179.6	512.7	1.27	524.8	3119.4	93.85	7.81	8.33%	28.48
RodF5_55	107	1.397	0.203	578.1	4256.4	518.4	1.27	531.2	3075.0	90.72	7.51	8.27%	27.09
RodF5_57.8	108	1.468	0.274	588.7	4369.3	527.0	1.27	540.2	3013.9	90.09	7.42	8.24%	26.30
RodF5_64	109	1.626	0.432	606.4	4616.2	546.7	1.27	559.5	2891.2	98.27	8.12	8.26%	27.35
RodF5_73.8	110	1.875	0.074	623.0	5004.5	579.0	1.27	588.5	2723.8	144.67	12.48	8.63%	37.54
RodF5_75.8	111	1.925	0.125	634.4	5084.8	585.8	1.27	596.2	2682.4	133.14	11.30	8.48%	33.92
RodF5_76.8	112	1.951	0.150	639.2	5124.5	589.1	1.27	599.9	2663.0	130.23	11.00	8.45%	32.89
RodC2_41	57	1.041	0.343	541.0	3720.3	479.1	1.27	492.3	3367.5	76.45	6.29	8.23%	25.21
RodC2_53.1	58	1.349	0.155	575.9	4197.3	512.7	1.27	526.2	3109.5	84.50	6.94	8.21%	25.55
RodC2_55	59	1.397	0.203	583.8	4274.0	518.4	1.27	532.4	3066.6	83.17	6.80	8.18%	24.76
RodC2_57.8	60	1.468	0.274	594.6	4385.4	527.0	1.27	541.5	3005.6	82.58	6.73	8.15%	24.04
RodC2_63.9	61	1.623	0.429	611.2	4629.1	546.3	1.27	560.2	2886.6	90.85	7.43	8.18%	25.24
RodC2_73.8	62	1.875	0.074	623.4	5021.8	579.0	1.27	588.5	2723.3	144.00	12.39	8.60%	37.36
RodC2_75.8	63	1.925	0.125	632.9	5101.1	585.8	1.27	595.9	2684.1	137.73	11.72	8.51%	35.11
RodC2_76.8	64	1.951	0.150	636.7	5140.8	589.1	1.27	599.3	2665.8	137.55	11.69	8.50%	34.78
RodC6_40.9	137	1.039	0.340	545.4	3703.6	478.8	1.27	493.1	3361.5	70.82	5.80	8.19%	23.31
RodC6_52.8	138	1.341	0.147	577.7	4194.2	511.8	1.27	525.9	3111.9	81.06	6.62	8.17%	24.54
RodC6_54.8	139	1.392	0.198	586.7	4278.9	517.8	1.27	532.6	3065.6	79.04	6.42	8.13%	23.53
RodC6_57.8	140	1.468	0.274	598.1	4403.3	527.0	1.27	542.2	3000.6	78.77	6.38	8.10%	22.88
RodC6_63.8	141	1.621	0.427	616.6	4652.8	546.0	1.27	561.1	2881.0	83.86	6.78	8.09%	23.25
RodC6_73.7	142	1.872	0.072	638.4	5065.3	578.7	1.27	591.5	2707.4	107.89	8.85	8.20%	27.79
RodC6_75.8	143	1.925	0.125	648.8	5151.7	585.8	1.27	599.3	2666.2	104.01	8.49	8.17%	26.31
RodC6_76.8	144	1.951	0.150	654.4	5193.9	589.1	1.27	603.1	2646.2	101.31	8.24	8.14%	25.39

Table SC-3I66-A.1: Reduced Heat Transfer Coefficient Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Td (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	673.7	5573.8	628.4	1.27	638.1	2477.7	156.59	13.49	8.61%	36.22
RodB4_91.3	162	2.319	0.071	696.2	5683.9	638.2	1.27	650.6	2422.7	124.60	10.35	8.31%	28.03
RodB4_93.3	163	2.370	0.122	709.1	5759.7	644.9	1.27	658.6	2388.9	114.21	9.39	8.22%	25.25
RodB4_95.1	164	2.416	0.168	719.4	5828.8	650.9	1.27	665.5	2360.4	108.31	8.85	8.17%	23.59
RodB4_100	165	2.540	0.292	738.0	6018.2	666.9	1.50	690.6	2262.5	126.96	11.95	9.41%	26.21
RodB4_106	166	2.692	0.445	756.5	6247.5	686.0	1.50	709.5	2194.3	132.87	12.52	9.42%	26.38
RodB4_109.9	167	2.791	0.544	753.5	6050.0	697.9	1.50	716.5	2170.2	163.34	15.72	9.62%	31.98
RodB4_142.3	168	3.614	0.224	798.3	2332.6	775.6	1.50	783.1	1964.8	153.82	17.91	11.64%	26.47
RodF4_85.6	98	2.174	0.374	665.7	5496.3	619.0	1.27	629.0	2519.6	149.68	12.78	8.54%	35.34
RodF4_88.4	99	2.245	-0.003	667.4	5604.4	628.4	1.27	636.8	2483.8	183.03	16.21	8.86%	42.46
RodF4_92.4	100	2.347	0.099	697.5	5762.7	641.9	1.27	653.8	2409.2	131.86	10.97	8.32%	29.46
RodF4_94.3	101	2.395	0.147	709.4	5837.7	648.2	1.27	661.3	2377.7	121.34	9.99	8.23%	26.66
RodF4_97.2	102	2.469	0.221	724.6	5950.6	657.8	1.27	672.1	2333.9	113.26	9.24	8.16%	24.32
RodF4_108.8	103	2.764	0.516	758.8	6286.8	694.6	1.50	716.0	2171.7	146.83	13.85	9.43%	28.77
RodF4_111	104	2.819	-0.044	755.2	6033.3	701.2	1.50	719.2	2160.8	167.78	16.07	9.58%	32.67
RodD2_103.2	65	2.621	0.373	739.2	6215.5	677.2	1.50	697.9	2235.8	150.30	14.21	9.46%	30.57
RodD2_106	66	2.692	0.445	748.5	6325.6	686.0	1.50	706.8	2203.6	151.77	14.34	9.45%	30.30
RodD2_112.6	67	2.860	-0.004	751.0	5807.1	706.0	1.50	721.0	2154.8	193.28	18.96	9.81%	37.50
RodD2_114.9	68	2.918	0.055	764.1	5535.4	712.6	1.50	729.8	2125.5	161.28	15.56	9.65%	30.74
RodD2_117.4	69	2.982	0.118	778.9	4841.6	719.7	1.50	739.4	2094.4	122.61	12.09	9.86%	22.93
RodD2_120.8	70	3.068	0.204	778.9	4841.6	728.9	1.50	745.6	2075.0	145.28	14.07	9.69%	26.85
RodD2_124.8	71	3.170	0.306	784.3	4373.0	739.2	1.50	754.3	2048.4	145.45	14.28	9.81%	26.43
RodD2_128.6	72	3.266	0.403	786.1	3926.8	748.4	1.50	761.0	2028.3	156.32	15.80	10.11%	28.05
RodD6_103.1	129	2.619	0.371	744.4	6229.6	676.9	1.50	699.4	2230.3	138.29	12.98	9.38%	28.04
RodD6_106	130	2.692	0.445	751.0	6344.5	686.0	1.50	707.6	2200.7	146.45	13.78	9.41%	29.19
RodD6_112.9	131	2.868	0.004	748.3	5789.7	706.9	1.50	720.7	2155.9	209.57	20.80	9.92%	40.69
RodD6_114.9	132	2.918	0.055	759.0	5553.1	712.6	1.50	728.1	2131.1	179.57	17.53	9.76%	34.35
RodD6_116.8	133	2.967	0.103	768.8	5327.9	718.0	1.50	734.9	2108.8	157.52	15.21	9.66%	29.72
RodD6_120.9	134	3.071	0.207	778.6	4841.1	729.2	1.50	745.7	2074.8	147.00	14.24	9.69%	27.16
RodD6_124.8	135	3.170	0.306	786.8	4379.2	739.2	1.50	755.1	2046.0	138.28	13.47	9.74%	25.09
RodD6_128.7	136	3.269	0.405	790.8	3917.6	748.6	1.50	762.7	2023.2	139.28	13.80	9.91%	24.91

Table SC-3166-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Td (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	555.9	4100.4	503.9	1.27	515.0	3190.5	100.34	8.40	8.37%	31.22
RodE2_54	74	1.372	0.178	575.9	4259.3	515.4	1.27	528.4	3094.7	89.61	7.36	8.22%	26.96
RodE2_56.9	75	1.445	0.251	587.4	4377.6	524.2	1.27	537.8	3030.4	88.15	7.21	8.17%	25.90
RodE2_59.9	76	1.521	0.328	599.6	4499.4	533.6	1.27	547.7	2965.0	86.74	7.06	8.14%	24.86
RodE2_66	77	1.676	0.483	613.7	4746.3	553.1	1.27	566.1	2851.0	99.73	8.18	8.20%	27.31
RodE2_69.8	78	1.773	-0.027	602.7	4899.1	565.7	1.27	573.6	2807.1	168.15	14.97	8.90%	45.21
RodE2_72.9	79	1.852	0.051	620.8	5021.9	576.0	1.27	585.6	2739.4	142.59	12.20	8.55%	37.25
RodE2_74.9	80	1.902	0.102	631.5	5102.7	582.7	1.27	593.2	2698.3	133.15	11.23	8.43%	34.16
RodB3_50.2	169	1.275	0.081	552.2	4088.5	504.2	1.27	514.5	3194.7	108.46	9.21	8.49%	33.79
RodB3_54.1	170	1.374	0.180	566.6	4243.7	515.7	1.27	526.6	3107.1	106.14	8.93	8.42%	32.07
RodB3_56.9	171	1.445	0.251	576.3	4354.7	524.2	1.27	535.4	3046.4	106.37	8.92	8.39%	31.44
RodB3_60.1	172	1.527	0.333	587.2	4483.7	534.2	1.27	545.5	2979.0	107.73	9.01	8.37%	31.04
RodB3_66.1	173	1.679	0.485	607.2	4722.4	553.5	1.27	565.0	2857.8	111.92	9.34	8.35%	30.73
RodB3_69.9	174	1.775	-0.025	600.3	4873.8	566.0	1.27	573.3	2808.6	180.74	16.46	9.11%	48.63
RodB3_73	175	1.854	0.054	621.2	4996.8	576.3	1.27	585.9	2737.5	141.73	12.16	8.58%	36.99
RodB3_75	176	1.905	0.105	633.4	5076.9	583.1	1.27	593.8	2694.7	128.27	10.80	8.42%	32.86
RodF3_50.1	89	1.273	0.079	558.7	4077.5	503.9	1.27	515.6	3186.1	94.74	7.90	8.34%	29.43
RodF3_54	90	1.372	0.178	578.1	4237.8	515.4	1.27	528.8	3091.4	85.97	7.06	8.21%	25.83
RodF3_57	91	1.448	0.254	589.8	4360.9	524.5	1.27	538.5	3025.3	84.97	6.94	8.17%	24.91
RodF3_60	92	1.524	0.330	600.9	4484.1	533.9	1.27	548.2	2961.6	85.15	6.94	8.15%	24.37
RodF3_66.1	93	1.679	0.485	611.6	4732.9	553.5	1.27	565.9	2852.1	103.54	8.55	8.26%	28.37
RodF3_70	94	1.778	-0.022	602.8	4889.8	566.3	1.27	574.1	2804.0	170.54	15.27	8.95%	45.80
RodF3_73	95	1.854	0.054	622.4	5013.7	576.3	1.27	586.2	2736.1	138.49	11.81	8.52%	36.13
RodF3_75	96	1.905	0.105	635.2	5095.4	583.1	1.27	594.2	2692.6	124.25	10.39	8.36%	31.80
RodE6_50.2	121	1.275	0.081	557.1	4081.8	504.2	1.27	515.5	3186.9	98.16	8.23	8.38%	30.50
RodE6_54.1	122	1.374	0.180	574.9	4236.7	515.7	1.27	528.4	3094.6	91.12	7.53	8.26%	27.41
RodE6_57	123	1.448	0.254	585.0	4352.0	524.5	1.27	537.5	3032.2	91.61	7.55	8.24%	26.93
RodE6_60.2	124	1.529	0.335	596.9	4478.7	534.5	1.27	547.9	2963.9	91.37	7.51	8.22%	26.17
RodE6_66.1	125	1.679	0.485	611.3	4711.4	553.5	1.27	565.9	2852.5	103.69	8.59	8.28%	28.41
RodE6_70	126	1.778	-0.022	602.1	4864.3	566.3	1.27	574.0	2804.8	172.85	15.59	9.02%	46.44
RodE6_73.1	127	1.857	0.056	621.1	4985.4	576.7	1.27	586.2	2736.2	142.85	12.30	8.61%	37.27
RodE6_75	128	1.905	0.105	632.4	5060.3	583.1	1.27	593.6	2695.8	130.39	11.03	8.46%	33.42

RBHT Steam Cooling Test SC-3166-B

Matrix test # 2

Test date – 3/21/2005

Steady state time window: 18660 – 19260 sec

Inlet flow: 0.48 m³/min (17.1 ft³/min)

Inlet steam temperature: 406 K (272 °F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 14.0 kW

Outlet steam temperature: 825 K (1026 °F)

Bundle inlet Reynolds number: 1965

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

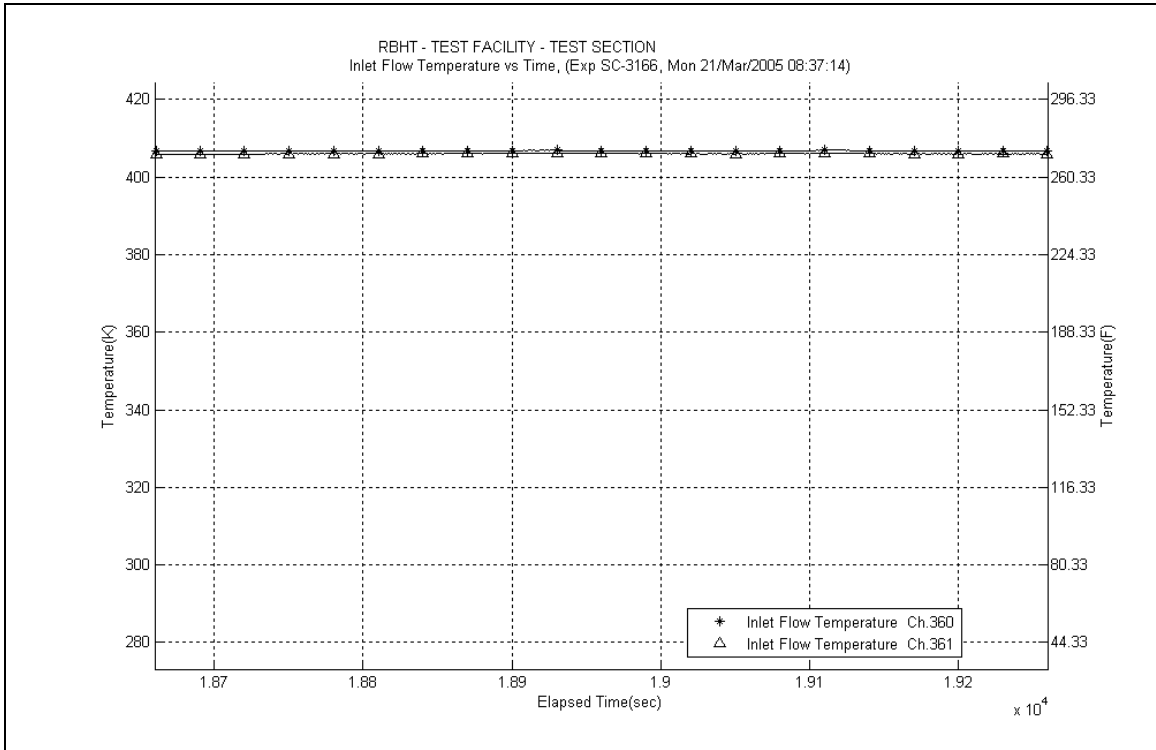
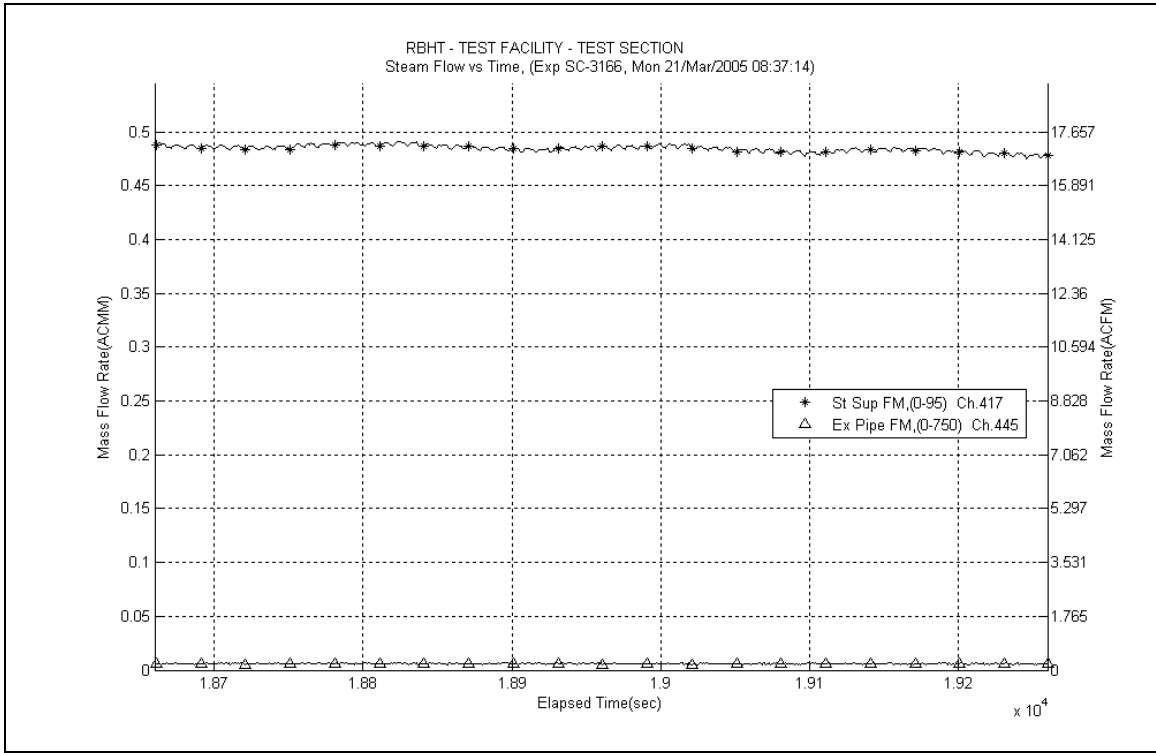
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

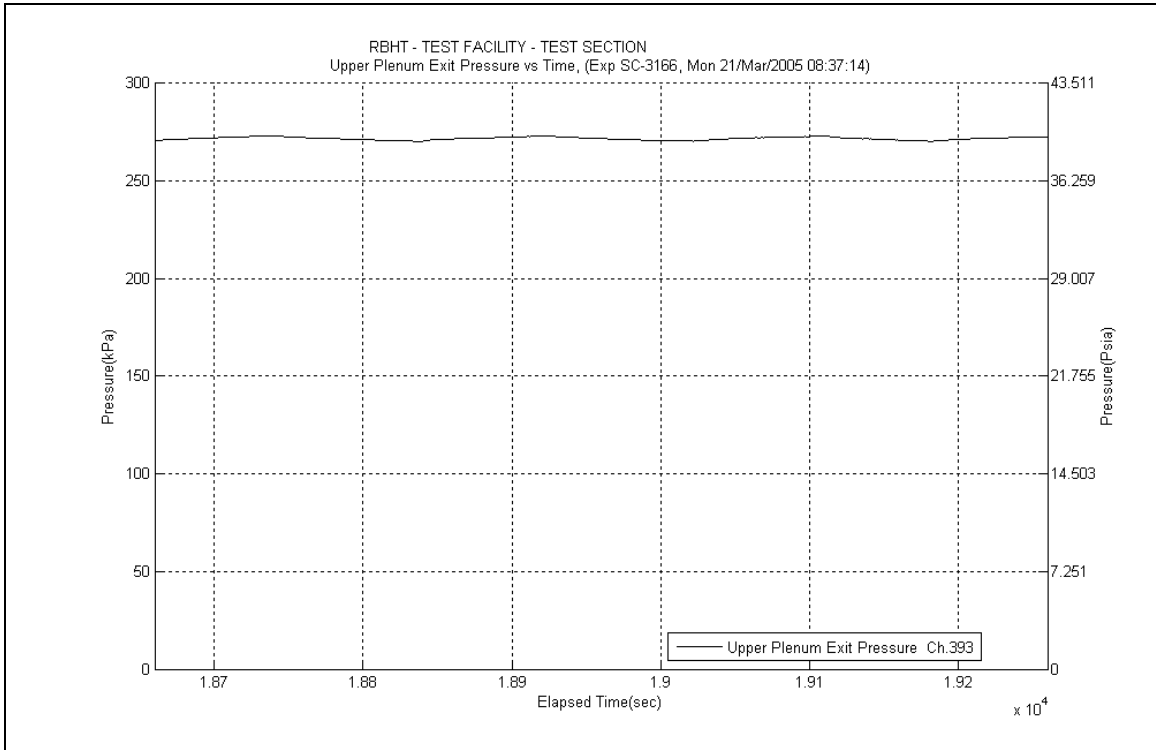
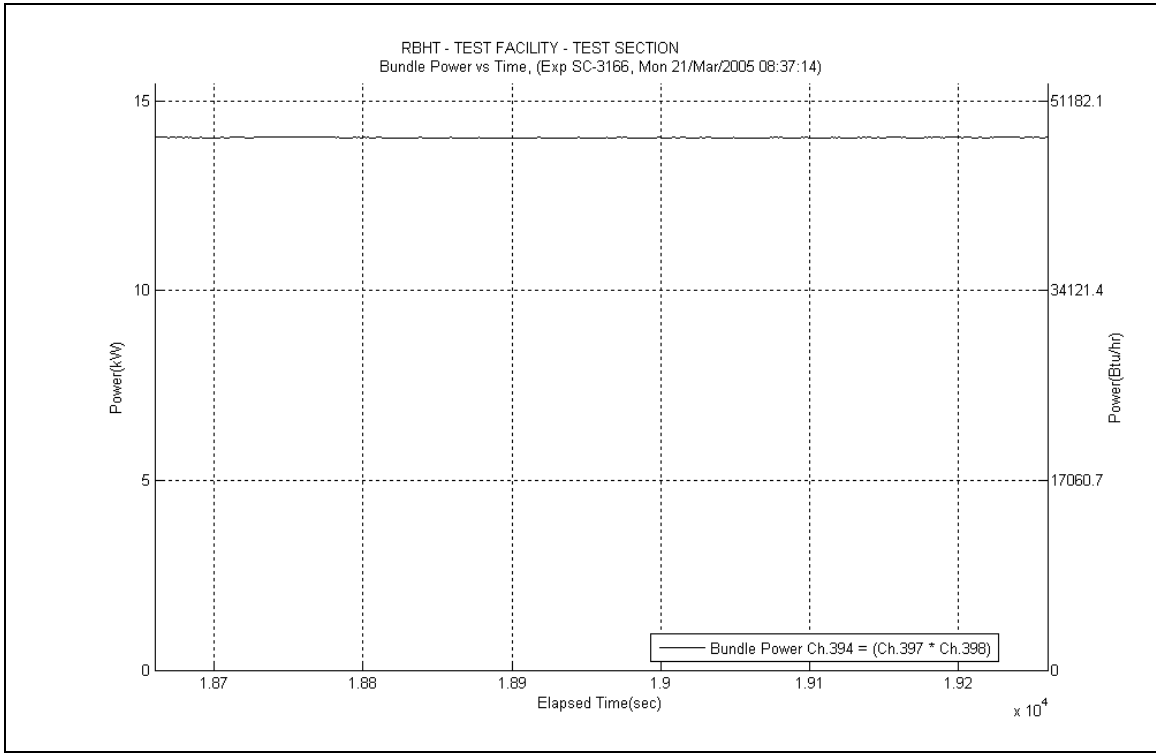
$$T_{cl} = -18.477x^3 + 106.36x^2 - 31.321x + 429.69$$

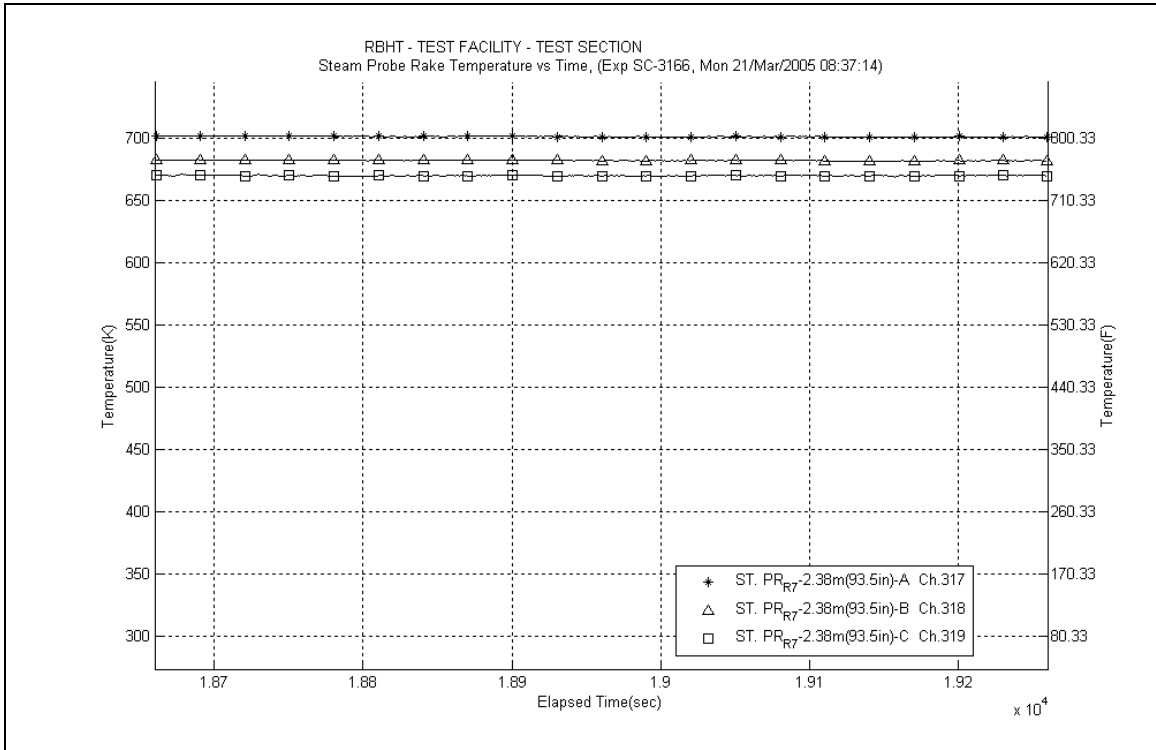
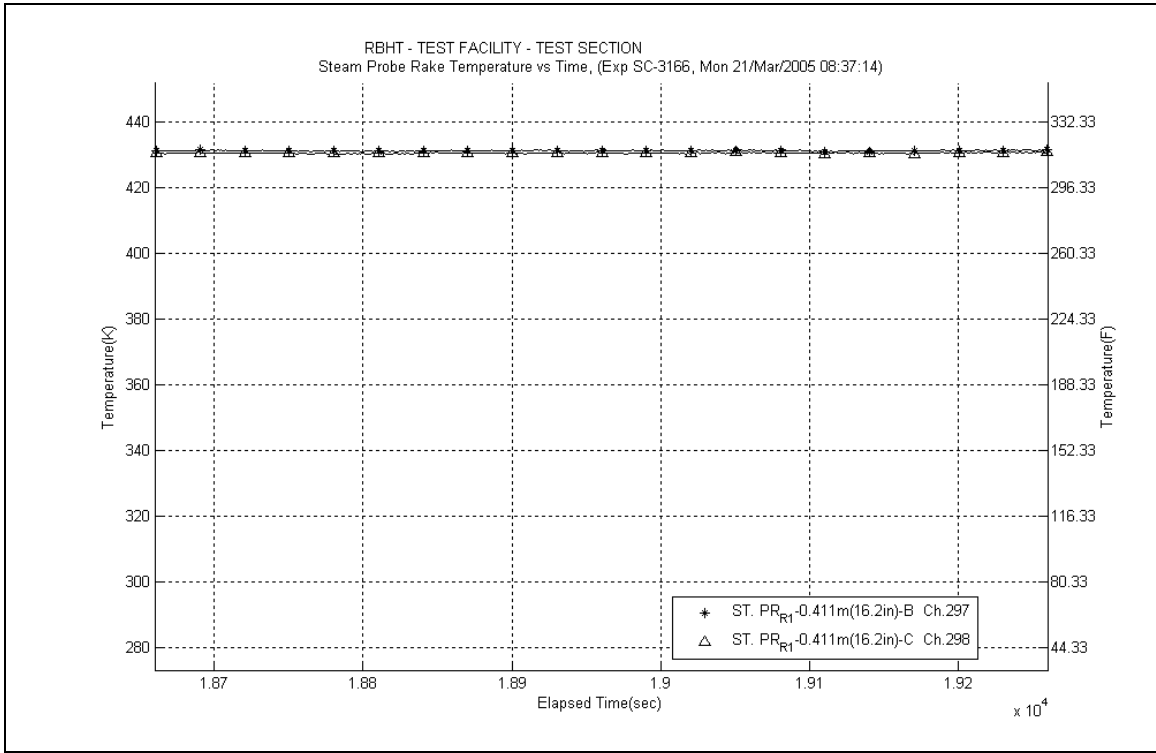
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

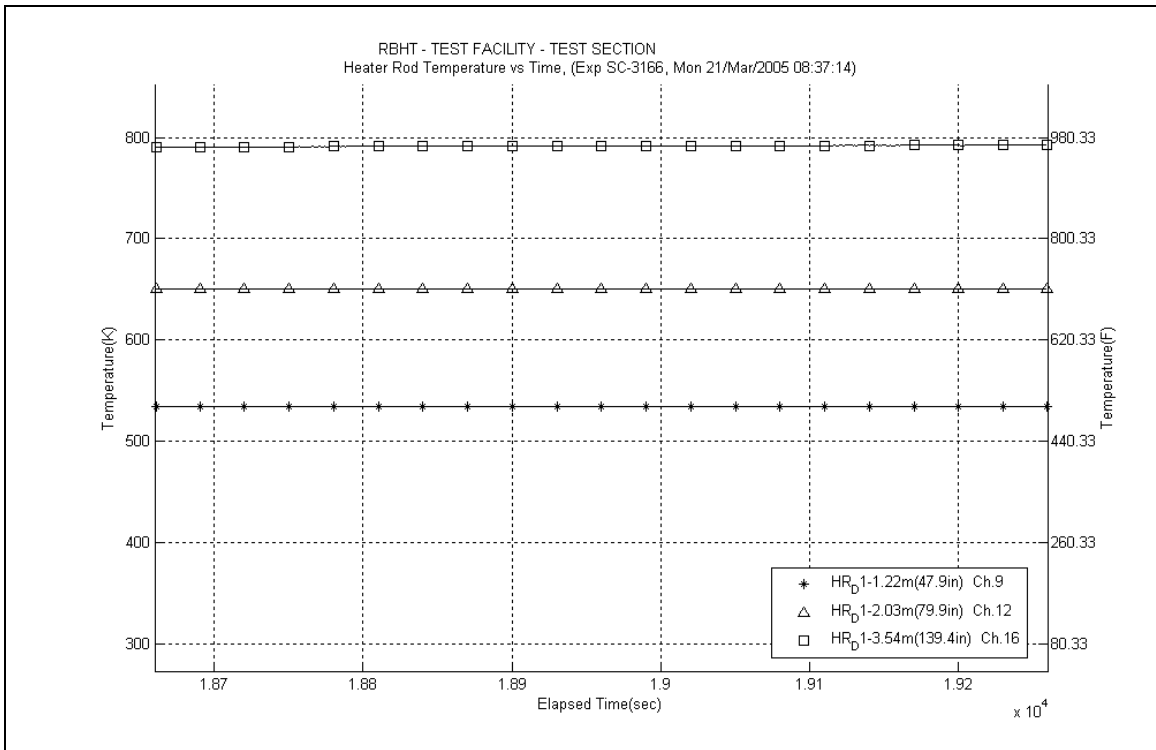
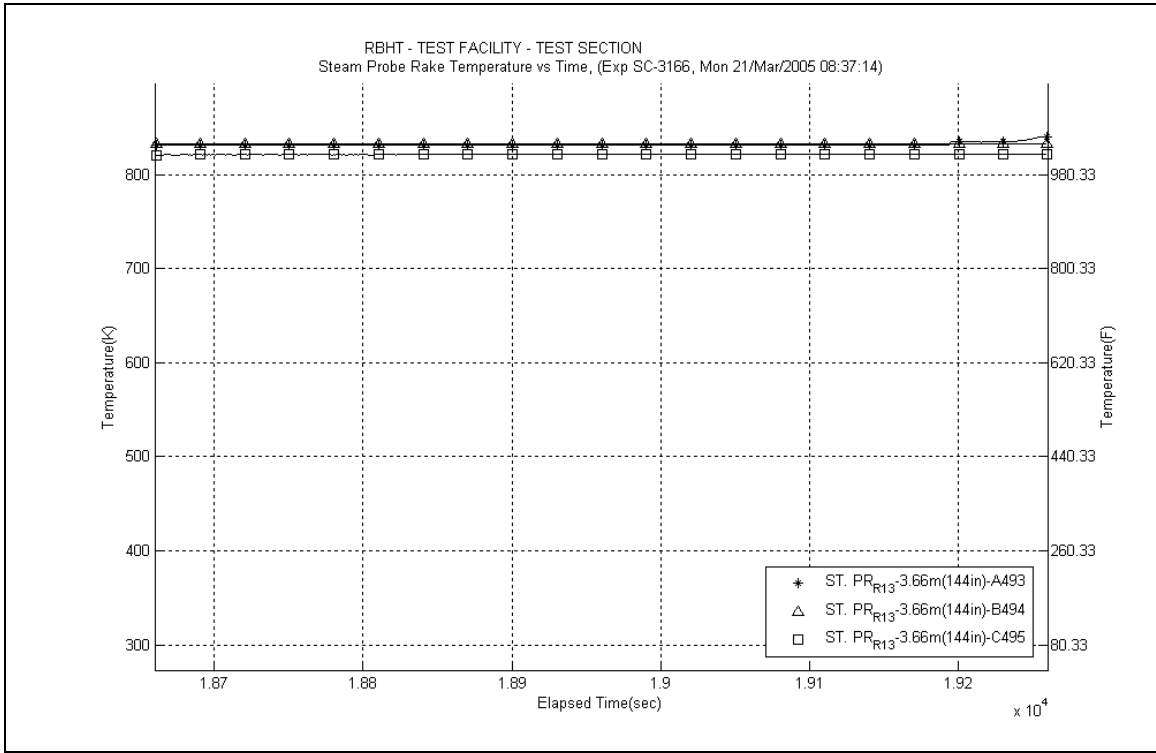
$$T_{cl} = -10.78x^3 + 62.962x^2 + 26.651x + 409.87$$

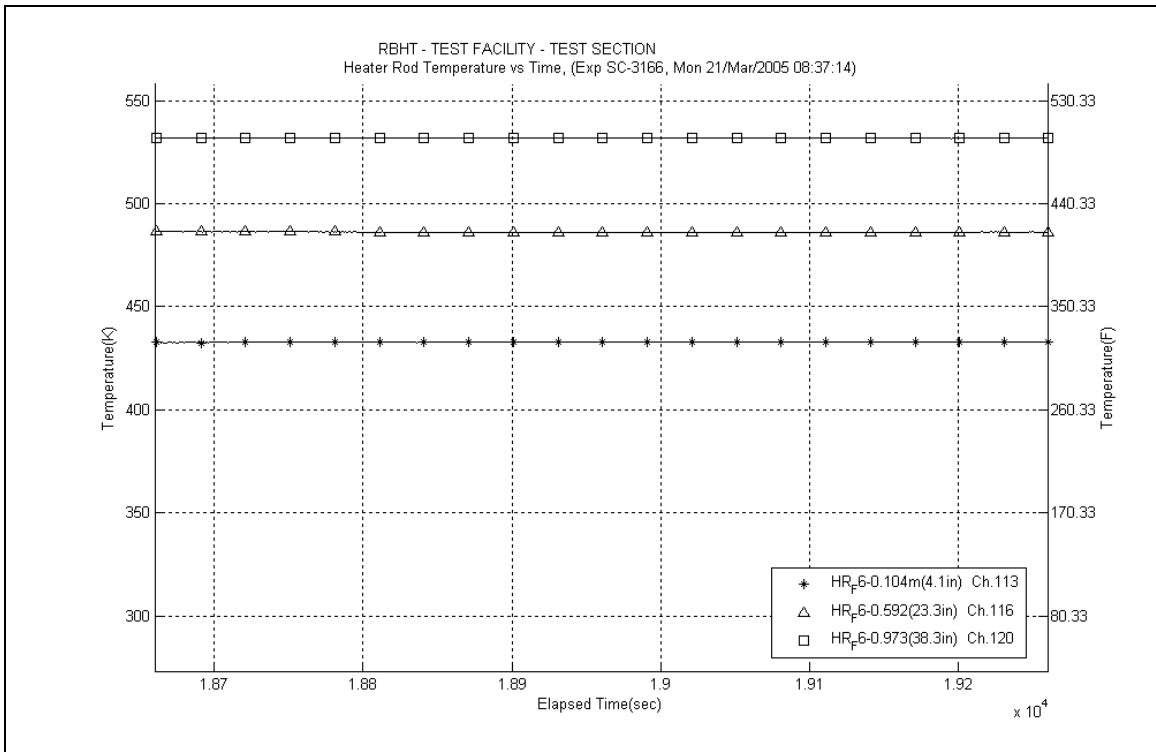
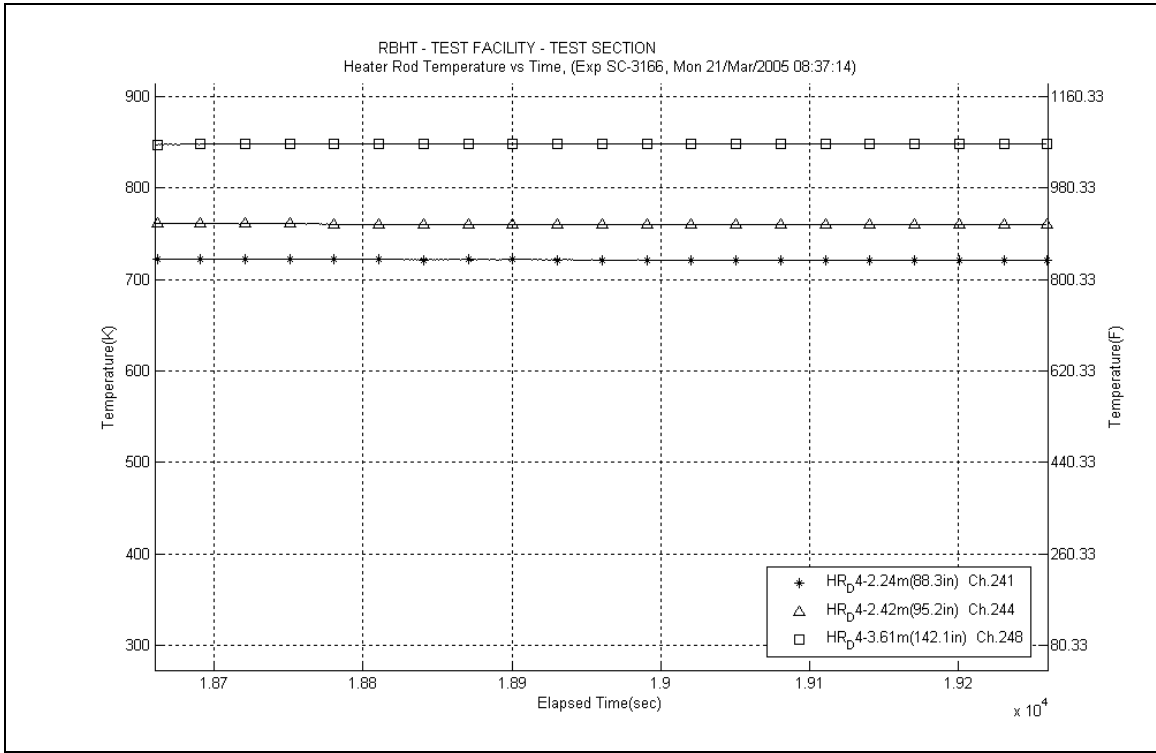
where x is the elevation (m) and T_{cl} is in (K)











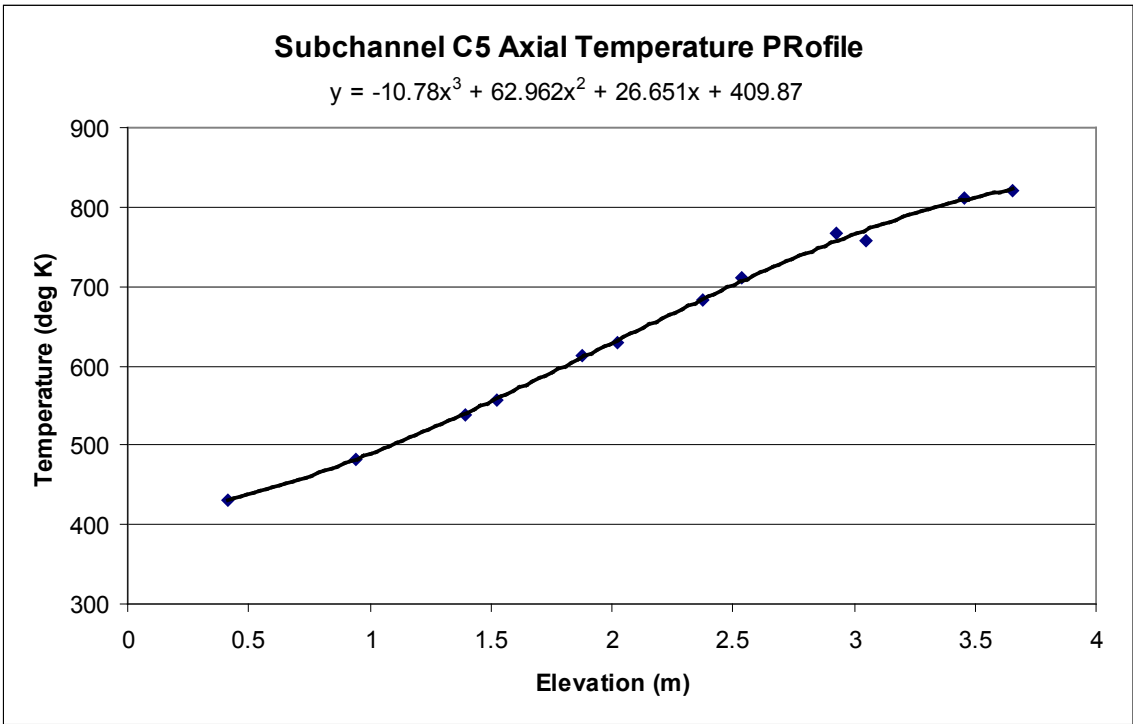
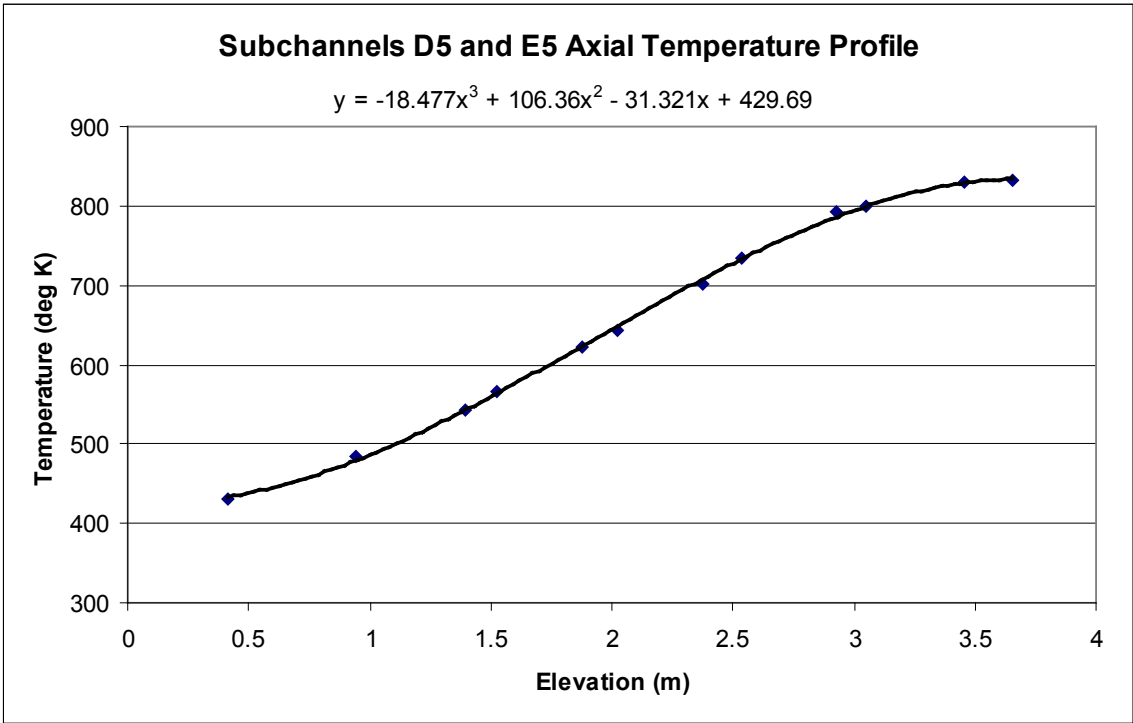


Table SC-3166-B.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	sohtc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	712.8	3762.5	686.0	1.50	694.9	1200	211.12	27.31	12.94%	43.20
RodD3_91.3	186	2.319	0.071	729.8	3841.4	698.6	1.50	709.0	1173	185.05	23.21	12.54%	36.78
RodD3_93.1	187	2.365	0.117	742.4	3887.0	706.1	1.50	718.2	1156	160.66	19.67	12.25%	31.35
RodD3_95.3	188	2.421	0.173	757.2	3944.9	715.0	1.50	729.1	1137	140.27	16.87	12.02%	26.78
RodD3_100.1	189	2.543	0.295	780.1	4072.3	734.0	1.50	749.3	1102	132.40	15.78	11.92%	24.29
RodD3_106.1	190	2.695	0.447	798.0	4231.0	756.1	1.50	770.1	1069	151.62	18.25	12.03%	26.74
RodD3_110	191	2.794	0.546	803.1	4178.4	769.5	1.50	780.7	1053	186.63	22.91	12.28%	32.27
RodD3_142.1	192	3.609	0.218	840.7	1443.2	833.5	1.50	835.9	977	299.04	77.34	25.86%	46.84
RodC4_88.4	233	2.245	-0.003	712.6	3802.9	686.4	1.50	695.2	1200	218.16	28.23	12.94%	44.62
RodC4_91.1	234	2.314	0.066	730.1	3877.1	697.8	1.50	708.6	1174	179.89	22.29	12.39%	35.79
RodC4_93.4	235	2.372	0.124	743.4	3938.5	707.3	1.50	719.3	1154	163.81	19.95	12.18%	31.89
RodC4_95.3	236	2.421	0.173	755.2	3990.2	715.0	1.50	728.4	1138	149.07	17.90	12.01%	28.49
RodC4_100.1	237	2.543	0.295	779.1	4119.7	734.0	1.50	749.0	1103	136.86	16.23	11.86%	25.13
RodC4_106.1	238	2.695	0.447	793.6	4280.1	756.1	1.50	768.6	1072	171.16	20.73	12.11%	30.27
RodC4_110	239	2.794	0.546	796.0	4141.9	769.5	1.50	778.3	1057	234.34	30.27	12.92%	40.70
RodC4_142.2	240	3.612	0.221	844.4	1565.9	833.5	1.50	837.1	976	217.26	41.47	19.09%	33.95
RodD4_88.3	241	2.243	-0.005	721.5	3791.3	686.0	1.50	697.9	1194	160.25	19.60	12.23%	32.59
RodD4_91.3	242	2.319	0.071	736.4	3871.9	698.6	1.50	711.2	1169	153.77	18.64	12.12%	30.43
RodD4_93.2	243	2.367	0.119	748.4	3921.3	706.5	1.50	720.5	1152	140.19	16.79	11.97%	27.23
RodD4_95.2	244	2.418	0.170	760.4	3974.4	714.6	1.50	729.9	1135	130.39	15.48	11.87%	24.85
RodD4_100.1	245	2.543	0.295	783.5	4105.5	734.0	1.50	750.5	1100	124.31	14.65	11.79%	22.76
RodD4_106.1	246	2.695	0.447	798.8	4266.0	756.1	1.50	770.4	1069	150.00	17.93	11.95%	26.44
RodD4_110	247	2.794	0.546	802.2	4121.2	769.5	1.50	780.4	1054	188.79	23.45	12.42%	32.66
RodD4_142.1	248	3.609	0.218	848.1	1515.8	833.5	1.50	838.4	974	155.97	25.42	16.30%	24.32
RodE4_88.4	201	2.245	-0.003	715.5	3733.2	686.4	1.50	696.1	1198	193.09	24.66	12.77%	39.41
RodE4_91.2	202	2.316	0.069	730.1	3806.3	698.2	1.50	708.8	1173	179.24	22.50	12.55%	35.64
RodE4_95.3	204	2.421	0.173	753.8	3910.5	715.0	1.50	728.0	1139	151.27	18.46	12.20%	28.94
RodE4_100.9	205	2.563	0.315	776.6	4052.7	737.0	1.50	750.2	1139	153.74	18.73	12.18%	29.41
RodE4_142.3	208	3.614	0.224	844.2	1530.7	833.6	1.50	837.1	1101	216.05	41.87	19.38%	39.57
RodE3_63.4	193	1.610	0.417	628.0	3093.6	577.9	1.50	594.6	1437	92.73	10.98	11.84%	23.71
RodE3_113.6	194	2.885	0.022	809.0	3804.1	781.0	1.50	790.3	1039	203.88	26.20	12.85%	34.63
RodE3_115.5	195	2.934	0.070	815.3	3663.5	786.7	1.50	796.2	1031	192.36	24.58	12.78%	32.32
RodE3_118.5	196	3.010	0.146	822.5	3438.6	795.2	1.50	804.3	1019	189.23	24.39	12.89%	31.34
RodE3_122.7	197	3.117	0.253	828.9	3124.8	805.9	1.50	813.6	1007	203.49	27.30	13.42%	33.15
RodE3_126.5	198	3.213	0.349	832.2	2840.1	814.2	1.50	820.2	998	237.86	34.70	14.59%	38.29
RodE3_131.7	199	3.345	-0.046	834.5	2452.5	823.5	1.50	827.2	989	335.12	62.95	18.79%	53.29
RodE3_135.6	200	3.444	0.053	836.3	2158.0	828.7	1.50	831.2	983	426.35	104.36	24.48%	67.32

Table SC-3166-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohfc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	627.8	3033.0	579.2	1.50	595.4	1435	93.56	11.26	12.03%	23.88
RodC5_113.6	226	2.885	0.022	800.9	3710.6	781.0	1.50	787.6	1043	279.22	39.83	14.26%	47.66
RodC5_115.7	227	2.939	0.075	809.2	3561.8	787.3	1.50	794.6	1033	243.75	33.68	13.82%	41.08
RodC5_122.7	229	3.117	0.253	826.7	3062.9	805.9	1.50	812.8	1008	220.32	30.75	13.96%	35.93
RodC5_126.7	230	3.218	0.354	832.0	2778.9	814.7	1.50	820.4	997	240.32	35.74	14.87%	38.67
RodC5_131.6	231	3.343	-0.048	835.4	2431.9	823.4	1.50	827.4	988	303.74	54.12	17.82%	48.29
RodC5_135.7	232	3.447	0.056	840.4	2138.9	828.8	1.50	832.7	982	275.02	49.67	18.06%	43.32
RodE5_63.6	209	1.615	0.422	628.1	3107.0	578.8	1.50	595.2	1436	94.54	11.19	11.84%	24.14
RodE5_113.6	210	2.885	0.022	802.0	3825.7	781.0	1.50	788.0	1043	273.71	37.88	13.84%	46.69
RodE5_115.4	211	2.931	0.067	808.5	3694.4	786.4	1.50	793.8	1034	251.09	34.15	13.60%	42.38
RodE5_118.7	212	3.015	0.151	818.4	3451.0	795.7	1.50	803.3	1021	228.91	30.84	13.47%	37.98
RodE5_122.6	213	3.114	0.250	826.4	3163.5	805.6	1.50	812.5	1008	229.06	31.62	13.80%	37.38
RodE5_126.6	214	3.216	0.352	831.2	2870.1	814.4	1.50	820.0	998	256.53	38.26	14.92%	41.31
RodE5_131.6	215	3.343	-0.048	835.7	2503.6	823.4	1.50	827.5	988	304.42	52.98	17.40%	48.38
RodE5_135.6	216	3.444	0.053	838.5	2207.0	828.7	1.50	831.9	982	336.21	67.50	20.08%	53.02
RodC3_79.8	177	2.027	0.227	681.7	3516.9	649.3	1.50	660.1	1273	162.81	20.35	12.50%	35.87
RodC3_85.6	178	2.174	0.374	696.0	3669.5	674.5	1.50	681.7	1227	255.87	35.20	13.76%	53.83
RodC3_88.5	179	2.248	0.000	707.5	3748.8	686.9	1.50	693.7	1202	273.02	38.07	13.95%	56.00
RodC3_92.4	180	2.347	0.099	729.7	3850.9	703.2	1.50	712.0	1167	217.85	28.31	13.00%	43.04
RodC3_94.4	181	2.398	0.150	742.0	3903.4	711.4	1.50	721.6	1150	191.55	24.18	12.62%	37.12
RodC3_97.2	182	2.469	0.221	757.7	3975.2	722.6	1.50	734.3	1128	170.09	20.99	12.34%	32.14
RodC3_108.8	183	2.764	0.516	795.4	4186.7	765.5	1.50	775.4	1061	210.23	26.64	12.67%	36.71
RodD5_50	217	1.270	0.076	574.2	2745.8	523.6	1.50	540.5	1609	81.38	9.62	11.82%	23.74
RodD5_54.1	218	1.374	0.180	594.8	2854.3	539.5	1.50	558.0	1549	77.44	9.10	11.75%	21.63
RodD5_56.9	219	1.445	0.251	607.0	2928.6	550.8	1.50	569.5	1512	78.18	9.17	11.73%	21.23
RodD5_60	220	1.524	0.330	619.1	3009.8	563.6	1.50	582.1	1474	81.29	9.55	11.74%	21.42
RodD5_66.1	221	1.679	0.485	638.3	3169.6	589.5	1.50	605.8	1406	97.34	11.54	11.85%	24.25
RodD5_69.9	222	1.775	-0.025	641.4	3268.4	606.0	1.50	617.8	1374	138.32	16.97	12.27%	33.51
RodD5_72.9	223	1.852	0.051	658.0	3349.3	619.1	1.50	632.0	1338	129.12	15.68	12.14%	30.28
RodD5_74.9	224	1.902	0.102	669.6	3402.0	627.8	1.50	641.8	1315	122.25	14.73	12.05%	28.05

Table SC-3166-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohic (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	546.2	2494.6	493.7	1.50	511.2	1719.7	71.33	8.43	11.83%	22.41
RodB5_52.9	154	1.344	0.150	583.1	2813.1	533.2	1.50	549.8	1576.6	84.57	10.02	11.85%	24.11
RodB5_55	155	1.397	0.203	590.2	2868.4	540.6	1.50	557.1	1552.1	86.65	10.27	11.86%	24.26
RodB5_57.8	156	1.468	0.274	601.3	2942.5	550.6	1.50	567.5	1518.7	87.11	10.31	11.84%	23.78
RodB5_64	157	1.626	0.432	620.1	3107.4	573.3	1.50	588.9	1453.8	99.49	11.85	11.91%	25.79
RodB5_73.9	158	1.877	0.077	637.9	2611.7	610.4	1.50	619.6	1369.8	142.88	21.27	14.88%	34.47
RodB5_75.9	159	1.928	0.128	659.0	3424.1	618.0	1.50	631.7	1339.4	125.39	15.15	12.08%	29.43
RodB5_76.9	160	1.953	0.153	663.6	3450.8	621.8	1.50	635.7	1329.4	123.80	14.92	12.05%	28.79
RodF5_41	105	1.041	0.343	543.9	2478.7	493.7	1.50	510.5	1722.8	74.12	8.83	11.91%	23.33
RodF5_53.1	106	1.349	0.155	579.1	2801.3	533.9	1.50	549.0	1579.6	92.90	11.14	11.99%	26.54
RodF5_55	107	1.397	0.203	588.0	2852.1	540.6	1.50	556.4	1554.7	90.32	10.79	11.94%	25.33
RodF5_57.8	108	1.468	0.274	598.9	2926.8	550.6	1.50	566.7	1521.2	90.94	10.84	11.92%	24.87
RodF5_64	109	1.626	0.432	617.7	3093.1	573.3	1.50	588.1	1456.2	104.48	12.54	12.00%	27.13
RodF5_73.8	110	1.875	0.074	645.0	3354.0	610.1	1.50	621.7	1364.4	144.13	17.77	12.33%	34.60
RodF5_75.8	111	1.925	0.125	655.6	3406.9	617.6	1.50	630.3	1342.8	134.78	16.47	12.22%	31.73
RodF5_76.8	112	1.951	0.150	660.2	3433.4	621.4	1.50	634.4	1332.8	132.78	16.18	12.19%	30.97
RodC2_41	57	1.041	0.343	542.5	2491.8	493.7	1.50	510.0	1724.7	76.69	9.12	11.90%	24.17
RodC2_53.1	58	1.349	0.155	579.6	2817.0	533.9	1.50	549.1	1579.0	92.50	11.05	11.94%	26.41
RodC2_55	59	1.397	0.203	586.8	2867.6	540.6	1.50	556.0	1555.9	92.99	11.09	11.93%	26.10
RodC2_57.8	60	1.468	0.274	597.2	2941.8	550.6	1.50	566.1	1523.0	94.68	11.28	11.92%	25.93
RodC2_63.9	61	1.623	0.429	614.7	3104.3	572.9	1.50	586.8	1459.8	111.41	13.41	12.04%	29.02
RodC2_73.8	62	1.875	0.074	638.1	3366.9	610.1	1.50	619.4	1370.3	180.12	23.02	12.78%	43.47
RodC2_75.8	63	1.925	0.125	646.9	3419.2	617.6	1.50	627.4	1349.9	175.00	22.17	12.67%	41.47
RodC2_76.8	64	1.951	0.150	651.0	3446.4	621.4	1.50	631.3	1340.3	175.01	22.21	12.69%	41.11
RodC6_40.9	137	1.039	0.340	546.6	2479.1	493.4	1.50	511.1	1720.0	69.95	8.29	11.85%	21.98
RodC6_52.8	138	1.341	0.147	584.3	2810.1	532.9	1.50	550.0	1576.1	81.97	9.69	11.83%	23.36
RodC6_54.8	139	1.392	0.198	593.1	2865.4	539.9	1.50	557.6	1550.5	80.76	9.52	11.79%	22.58
RodC6_57.8	140	1.468	0.274	603.7	2947.9	550.6	1.50	568.3	1516.1	83.26	9.81	11.79%	22.68
RodC6_63.8	141	1.621	0.427	623.1	3114.4	572.5	1.50	589.4	1452.3	92.33	10.90	11.81%	23.90
RodC6_73.7	142	1.872	0.072	654.1	3390.2	609.7	1.50	624.5	1357.3	114.47	13.65	11.93%	27.31
RodC6_75.8	143	1.925	0.125	663.2	3448.2	617.6	1.50	632.8	1336.5	113.50	13.50	11.89%	26.57
RodC6_76.8	144	1.951	0.150	668.2	3475.6	621.4	1.50	637.0	1326.3	111.58	13.24	11.87%	25.87

Table SC-3166-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohfc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	700.5	3727.6	665.1	1.50	676.9	1236.7	158.12	19.54	12.36%	33.60
RodB4_91.3	162	2.319	0.071	718.0	3803.1	675.8	1.50	689.9	1210.1	135.34	16.37	12.09%	27.99
RodB4_93.3	163	2.370	0.122	729.2	3853.8	683.2	1.50	698.5	1193.1	125.61	15.06	11.99%	25.51
RodB4_95.1	164	2.416	0.168	737.9	3898.9	689.7	1.50	705.8	1179.2	121.19	14.48	11.95%	24.25
RodB4_100	165	2.540	0.292	756.4	4022.1	707.1	1.50	723.6	1146.5	122.35	14.60	11.94%	23.62
RodB4_106	166	2.692	0.445	776.0	4174.7	727.7	1.50	743.8	1111.6	129.61	15.51	11.96%	24.04
RodB4_109.9	167	2.791	0.544	780.6	4040.7	740.4	1.50	753.8	1095.0	150.66	18.41	12.22%	27.41
RodB4_142.3	168	3.614	1.367	828.2	1549.4	819.7	2.50	824.8	991.6	456.05	100.14	21.96%	72.82
RodF4_85.6	98	2.174	0.374	691.4	3680.3	654.7	1.50	666.9	1258.0	150.28	18.40	12.24%	32.63
RodF4_88.4	99	2.245	0.445	698.7	3753.2	665.1	1.50	676.3	1237.9	167.63	20.80	12.41%	35.67
RodF4_92.4	100	2.347	0.547	724.5	3858.9	679.9	1.50	694.7	1200.5	129.83	15.55	11.97%	26.58
RodF4_94.3	101	2.395	0.595	735.7	3908.6	686.8	1.50	703.1	1184.3	119.96	14.25	11.88%	24.13
RodF4_97.2	102	2.469	0.669	750.7	3983.0	697.2	1.50	715.1	1161.9	111.69	13.18	11.80%	21.93
RodF4_108.8	103	2.764	0.963	787.0	4203.5	736.9	1.50	753.6	1095.4	125.67	14.87	11.84%	22.87
RodF4_111	104	2.819	-0.044	791.5	4031.2	743.9	1.50	759.8	1085.5	126.99	15.09	11.89%	22.84
RodD2_103.2	65	2.621	0.373	761.8	4157.2	718.2	1.50	732.7	1130.4	143.14	17.15	11.98%	27.13
RodD2_106	66	2.692	0.445	772.1	4232.6	727.7	1.50	742.5	1113.7	142.85	17.07	11.95%	26.56
RodD2_112.6	67	2.860	-0.004	789.3	3883.1	748.9	1.50	762.4	1081.3	144.14	17.47	12.12%	25.79
RodD2_114.9	68	2.918	0.055	797.3	3701.1	756.0	1.50	769.7	1069.9	134.45	16.26	12.10%	23.73
RodD2_117.4	69	2.982	0.118	810.3	3234.8	763.4	1.50	779.0	1055.8	103.33	12.97	12.55%	17.92
RodD2_120.8	70	3.068	0.204	810.3	3234.8	773.0	1.50	785.5	1046.2	130.03	15.93	12.25%	22.28
RodD2_124.8	71	3.170	0.306	816.2	2919.8	783.7	1.50	794.5	1033.1	134.75	16.86	12.51%	22.71
RodD2_128.6	72	3.266	0.403	819.4	2619.8	793.0	1.50	801.8	1022.8	148.96	19.43	13.05%	24.78
RodD6_103.1	129	2.619	0.371	763.7	4164.9	717.9	1.50	733.1	1129.6	136.17	16.21	11.90%	25.79
RodD6_106	130	2.692	0.445	769.5	4240.6	727.7	1.50	741.6	1115.2	151.93	18.25	12.01%	28.30
RodD6_112.9	131	2.868	0.004	783.8	3867.6	749.9	1.50	761.2	1083.3	171.10	21.21	12.39%	30.69
RodD6_114.9	132	2.918	0.055	790.1	3710.1	756.0	1.50	767.4	1073.6	162.89	20.17	12.38%	28.88
RodD6_116.8	133	2.967	0.103	797.5	3559.1	761.6	1.50	773.6	1064.0	148.86	18.30	12.30%	26.08
RodD6_120.9	134	3.071	0.207	808.5	3231.4	773.3	1.50	785.0	1046.8	137.61	16.98	12.34%	23.60
RodD6_124.8	135	3.170	0.306	817.3	2920.6	783.7	1.50	794.9	1032.6	130.29	16.21	12.44%	21.95
RodD6_128.7	136	3.269	0.405	822.3	2610.9	793.3	1.50	802.9	1021.2	134.74	17.22	12.78%	22.37

Table SC-3166-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	sohtc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	564.6	2754.7	523.5	1.50	537.2	1620.7	100.50	12.08	12.02%	29.56
RodE2_54	74	1.372	0.178	584.6	2860.3	537.1	1.50	552.9	1566.2	90.20	10.69	11.85%	25.51
RodE2_56.9	75	1.445	0.251	595.8	2938.1	547.4	1.50	563.5	1531.3	90.92	10.76	11.83%	25.06
RodE2_59.9	76	1.521	0.328	607.5	3018.8	558.2	1.50	574.6	1496.4	91.84	10.85	11.81%	24.63
RodE2_66	77	1.676	0.483	623.4	3183.3	580.7	1.50	595.0	1436.4	111.71	13.36	11.96%	28.54
RodE2_69.8	78	1.773	-0.027	625.9	3284.4	595.0	1.50	605.3	1407.7	159.05	19.87	12.49%	39.66
RodE2_72.9	79	1.852	0.051	639.0	3366.7	606.7	1.50	617.5	1375.3	155.96	19.34	12.40%	37.81
RodE2_74.9	80	1.902	0.102	648.5	3421.1	614.2	1.50	625.6	1354.4	149.93	18.47	12.32%	35.67
RodB3_50.2	169	1.275	0.081	558.9	2737.4	523.9	1.50	535.5	1626.8	117.35	14.46	12.32%	34.67
RodB3_54.1	170	1.374	0.180	574.3	2841.5	537.4	1.50	549.7	1577.1	115.54	14.13	12.23%	32.95
RodB3_56.9	171	1.445	0.251	586.1	2915.9	547.4	1.50	560.3	1541.9	113.00	13.73	12.15%	31.39
RodB3_60.1	172	1.527	0.333	598.4	3001.3	558.9	1.50	572.1	1504.3	114.16	13.84	12.12%	30.81
RodB3_66.1	173	1.679	0.485	617.8	3160.0	581.1	1.50	593.3	1441.0	128.91	15.76	12.23%	33.06
RodB3_69.9	174	1.775	-0.025	621.8	3261.7	595.3	1.50	604.2	1410.8	184.75	23.91	12.94%	46.19
RodB3_73	175	1.854	0.054	636.9	3344.4	607.0	1.50	617.0	1376.6	168.24	21.25	12.63%	40.83
RodB3_75	176	1.905	0.105	647.2	3397.7	614.6	1.50	625.5	1354.8	156.28	19.43	12.43%	37.19
RodF3_50.1	89	1.273	0.079	568.4	2738.0	523.5	1.50	538.5	1616.3	91.58	10.95	11.96%	26.85
RodF3_54	90	1.372	0.178	587.0	2843.6	537.1	1.50	553.7	1563.6	85.44	10.12	11.85%	24.12
RodF3_57	91	1.448	0.254	597.9	2925.5	547.7	1.50	564.4	1528.4	87.46	10.35	11.84%	24.05
RodF3_60	92	1.524	0.330	608.2	3007.7	558.6	1.50	575.1	1494.9	90.94	10.77	11.84%	24.37
RodF3_66.1	93	1.679	0.485	623.6	3173.4	581.1	1.50	595.3	1435.5	111.92	13.42	11.99%	28.57
RodF3_70	94	1.778	-0.022	627.2	3278.6	595.7	1.50	606.2	1405.2	156.39	19.52	12.48%	38.92
RodF3_73	95	1.854	0.054	642.6	3360.7	607.0	1.50	618.9	1371.6	141.88	17.37	12.24%	34.28
RodF3_75	96	1.905	0.105	654.5	3415.0	614.6	1.50	627.9	1348.7	128.33	15.51	12.09%	30.37
RodE6_50.2	121	1.275	0.081	567.8	2736.6	523.9	1.50	538.5	1616.2	93.51	11.22	12.00%	27.42
RodE6_54.1	122	1.374	0.180	585.6	2839.9	537.4	1.50	553.5	1564.4	88.45	10.52	11.90%	24.99
RodE6_57	123	1.448	0.254	596.1	2915.9	547.7	1.50	563.9	1530.2	90.33	10.74	11.89%	24.87
RodE6_60.2	124	1.529	0.335	608.5	2999.9	559.3	1.50	575.7	1493.1	91.36	10.85	11.88%	24.44

RBHT Steam Cooling Test SC-3166-C

Matrix test # 1

Test date – 3/21/2005

Steady state time window: 25050 - 25550 sec

Inlet flow: 0.33 m³/min (11.5 ft³/min)

Inlet steam temperature: 406 K (272 °F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 10.3 kW

Outlet steam temperature: 810 K (999 °F)

Bundle inlet Reynolds number: 1320

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

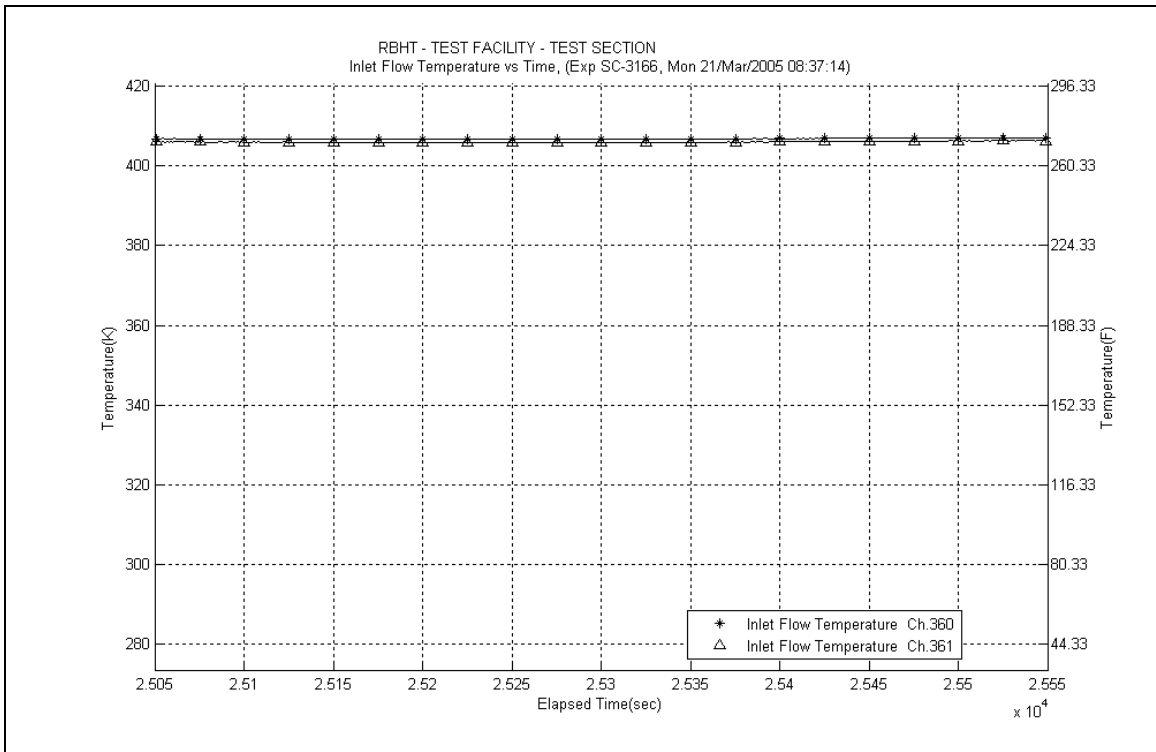
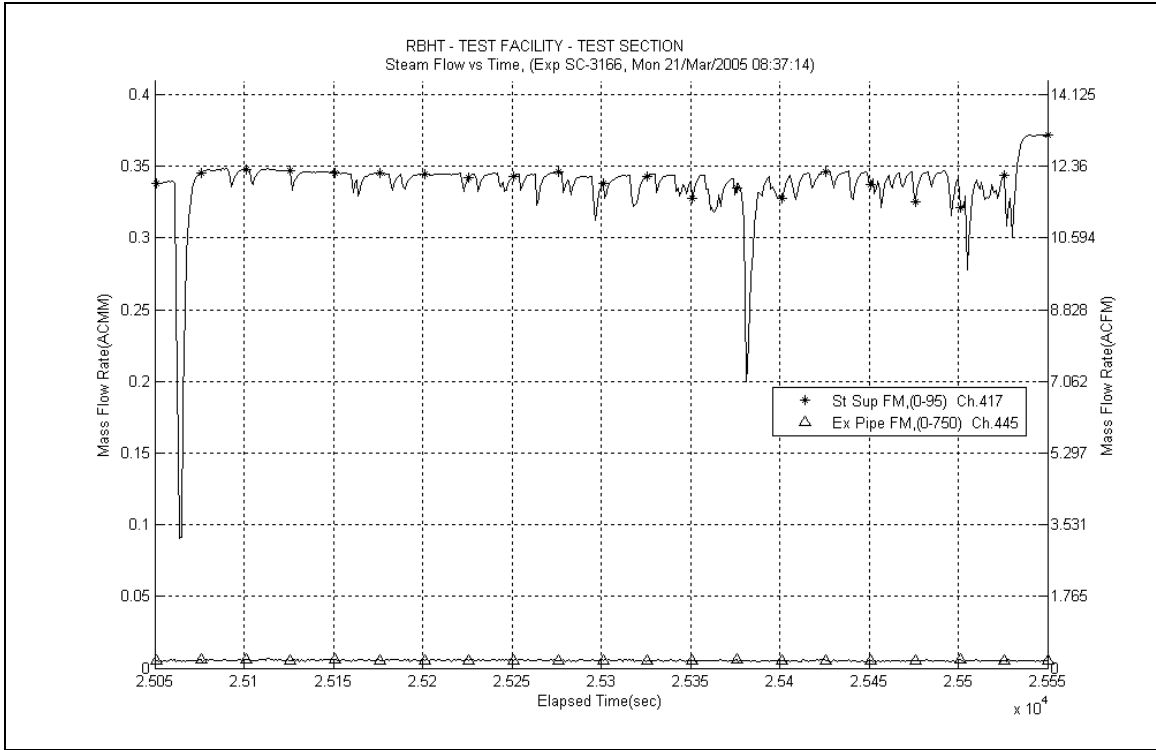
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

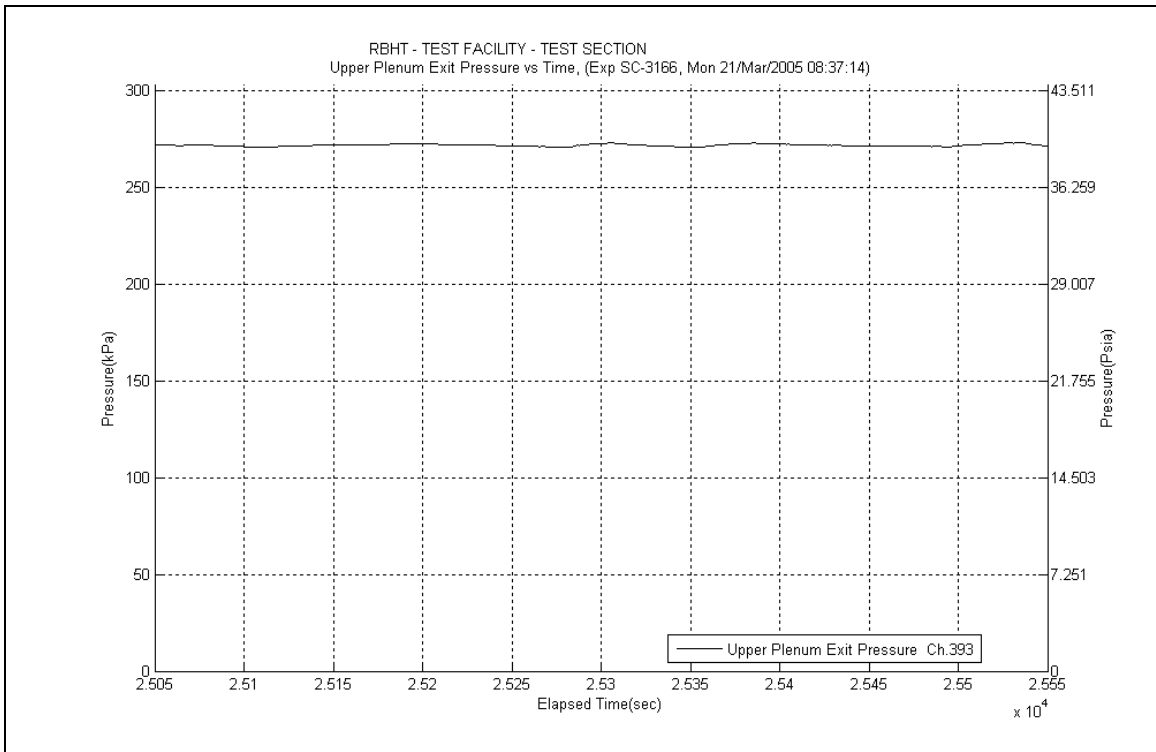
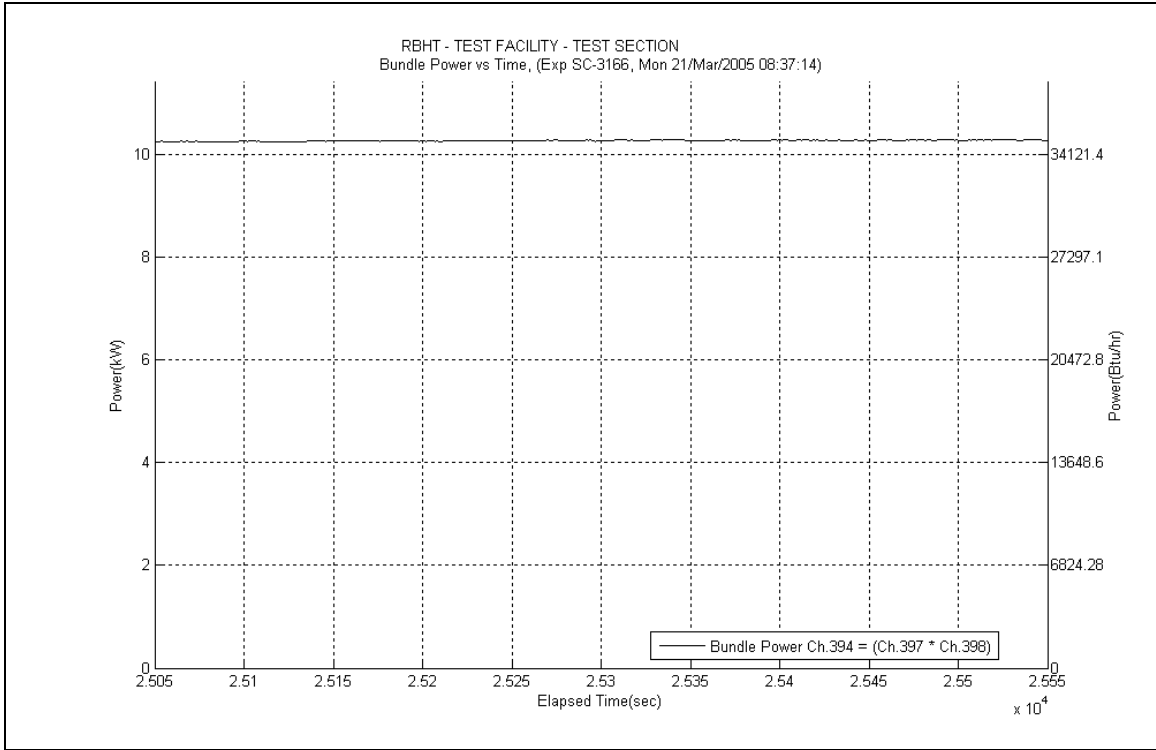
$$T_{cl} = -15.802x^3 + 89.248x^2 - 6.8734x + 421.94$$

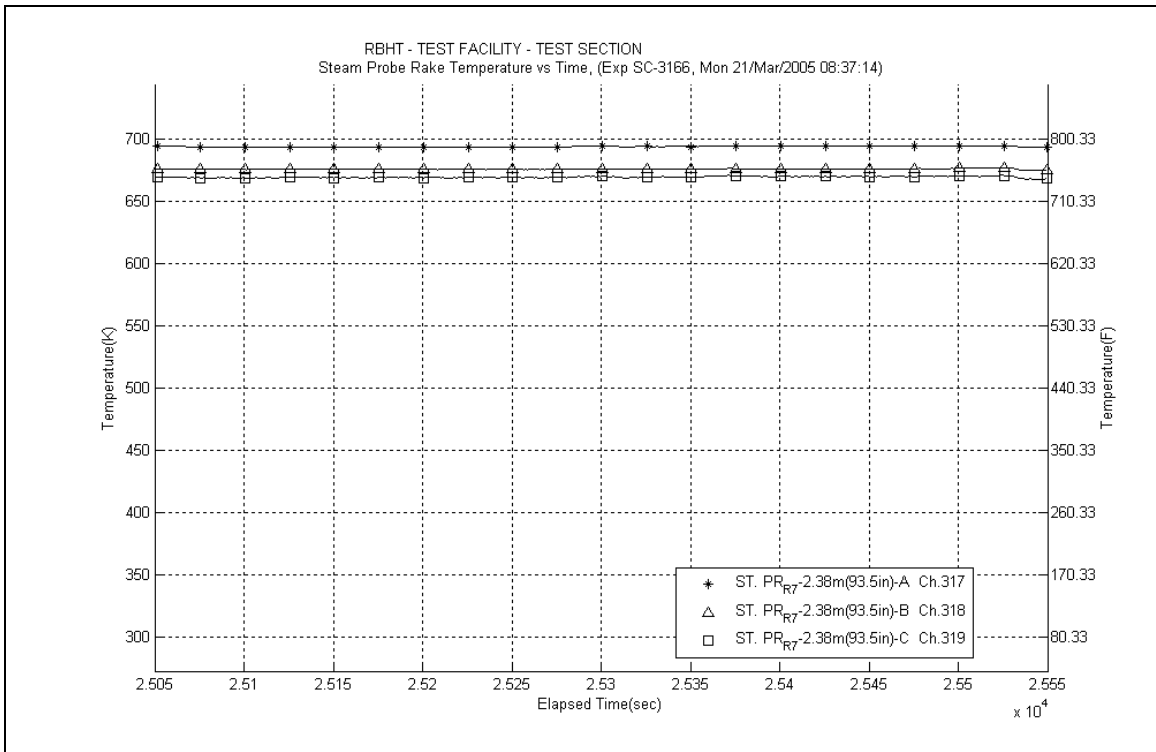
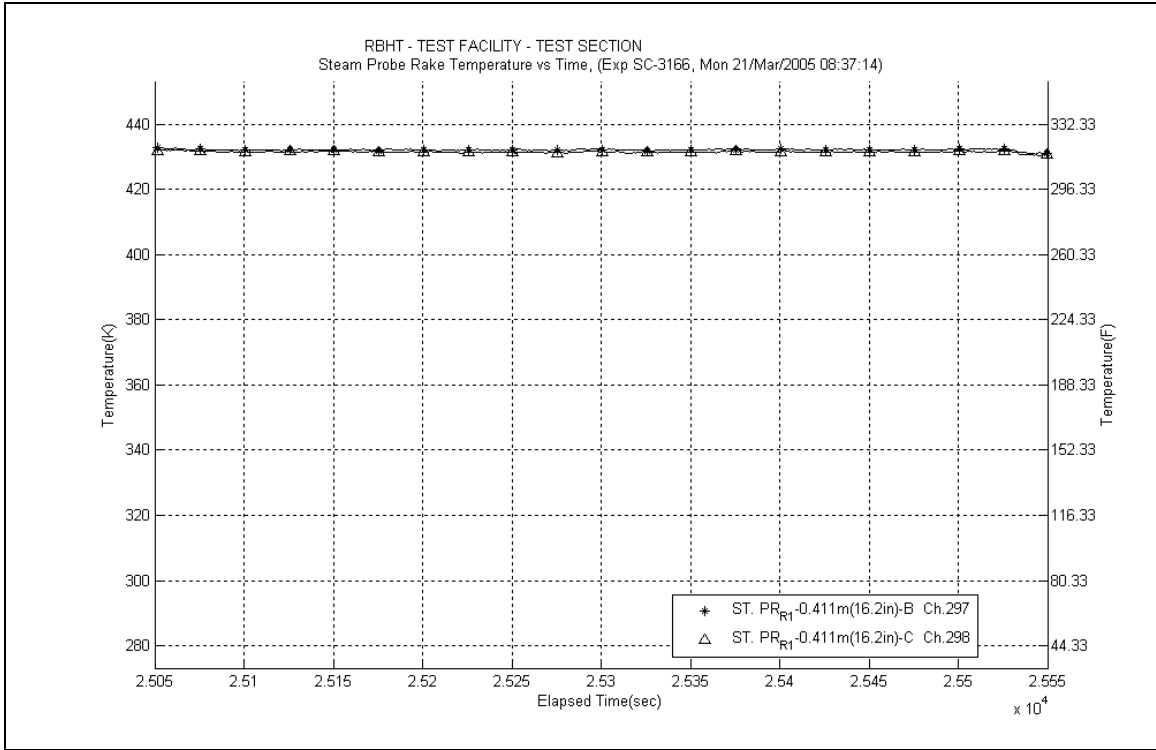
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

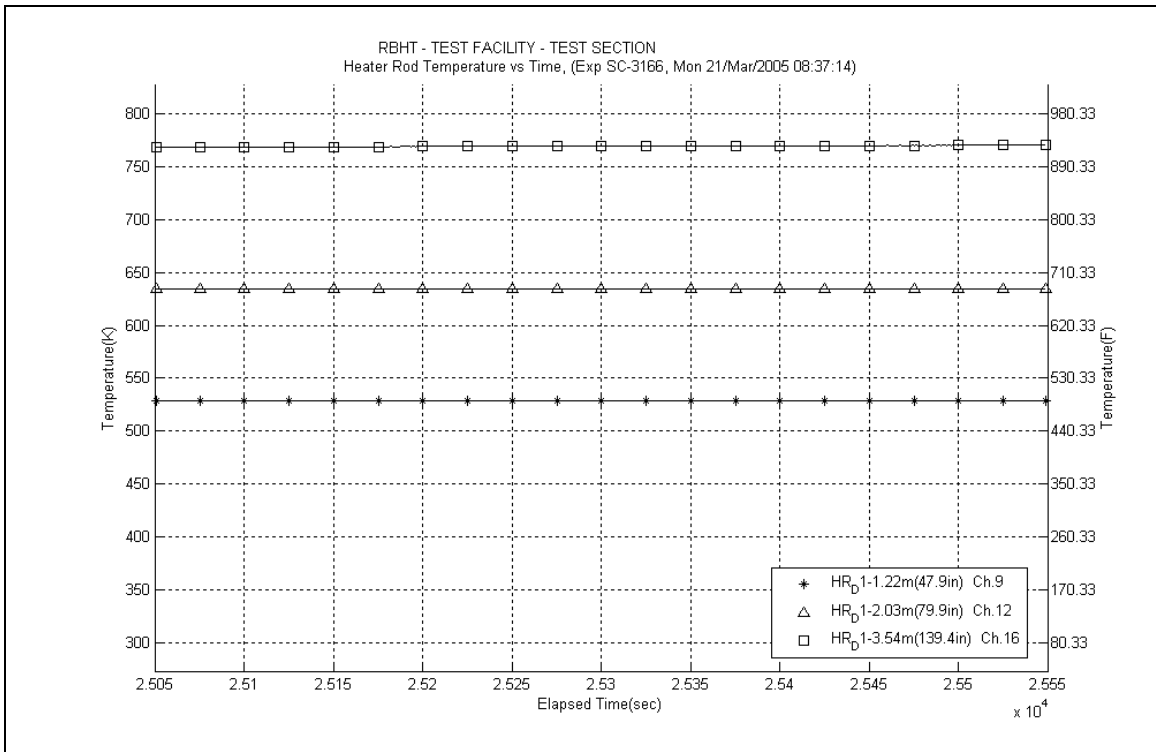
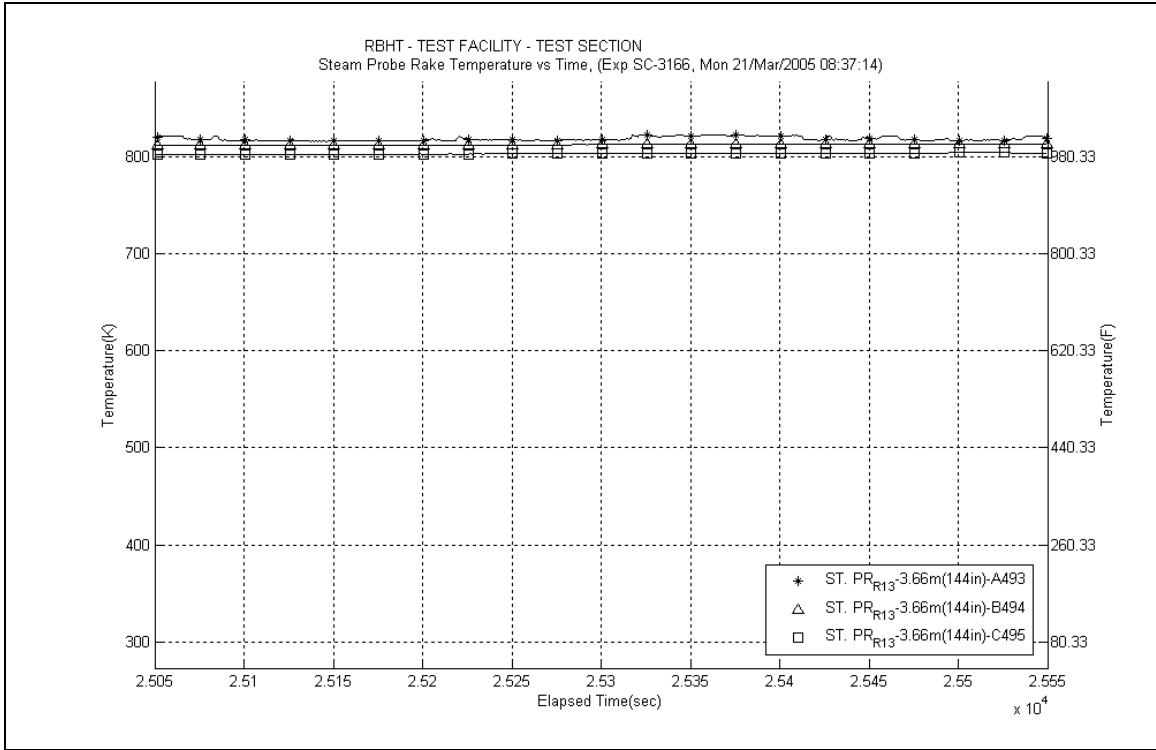
$$T_{cl} = -10.723x^3 + 60.253x^2 + 30.582x + 409.62$$

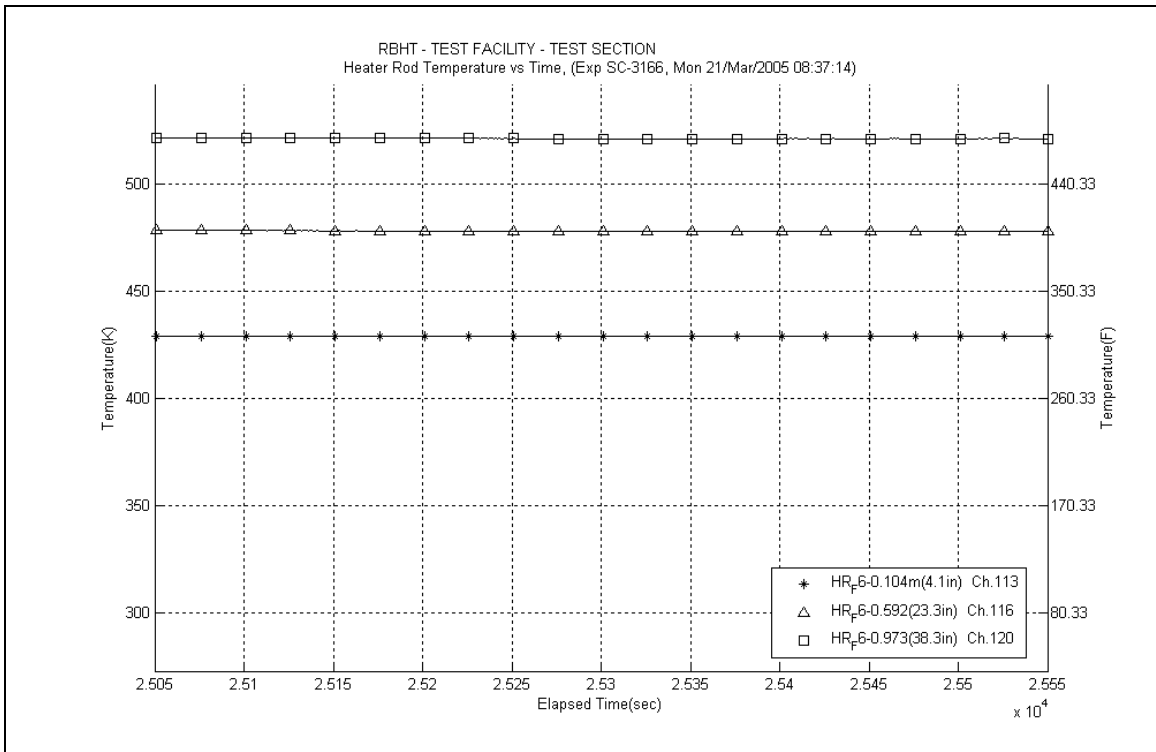
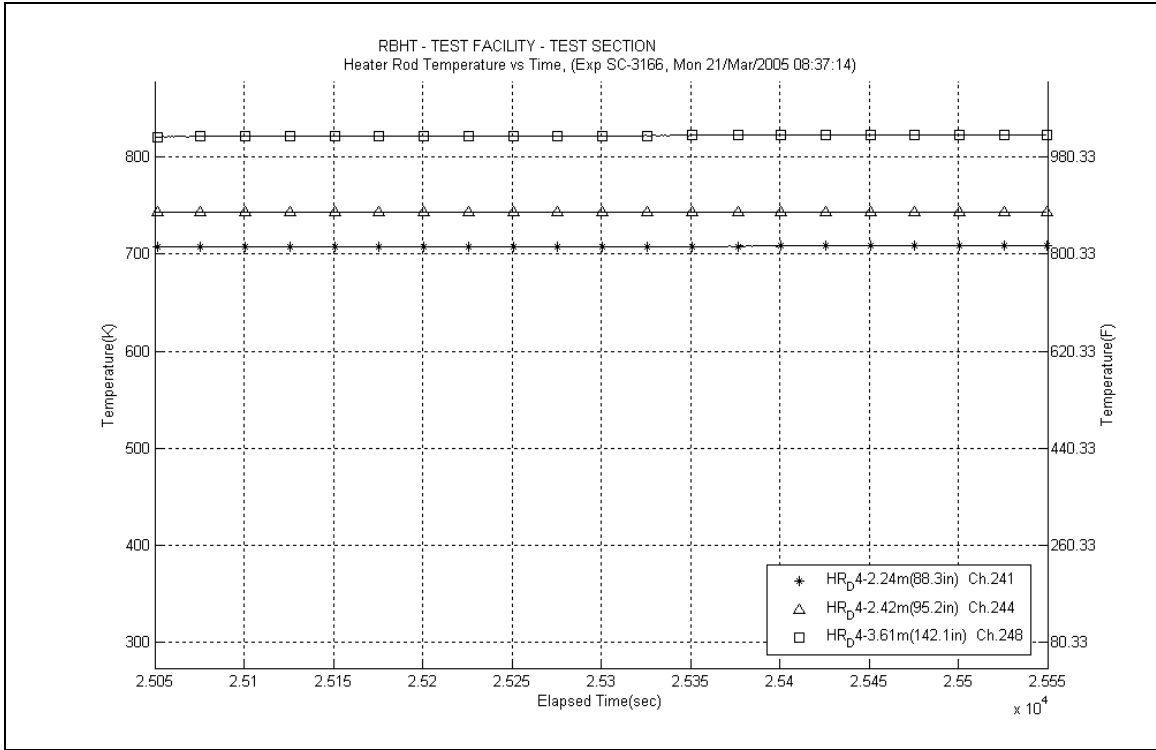
where x is the elevation (m) and T_{cl} is in (K)











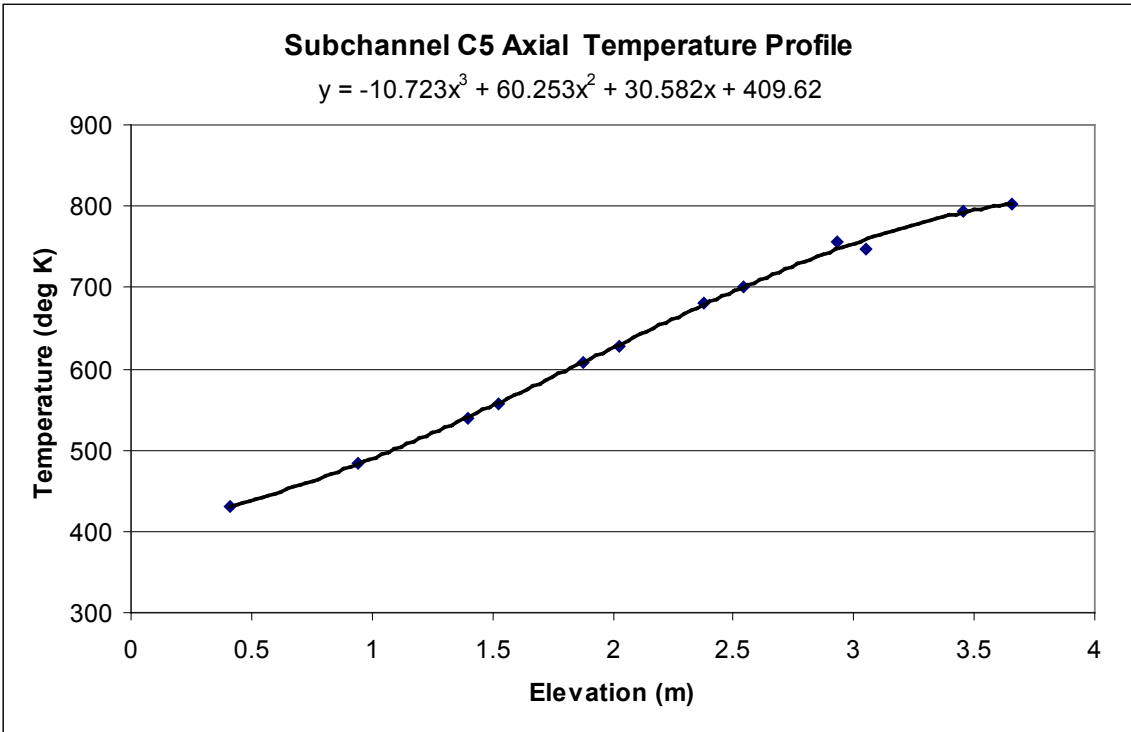
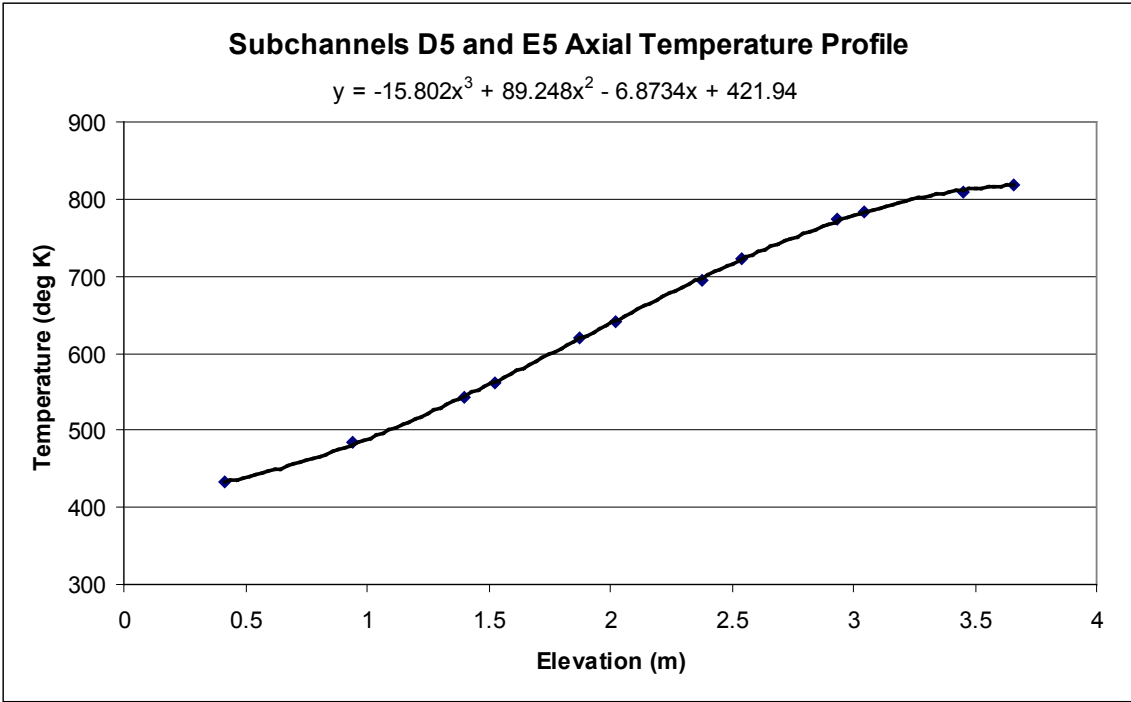


Table SC-3166-C.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohic (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	699.9	2738.7	677.2	1.50	684.7	820	181.24	29.08	16.05%	37.88
RodD3_91.3	186	2.319	0.071	715.2	2795.7	688.9	1.50	697.7	803	159.48	24.90	15.62%	32.45
RodD3_93.1	187	2.365	0.117	726.6	2830.1	695.8	1.50	706.1	792	138.05	21.09	15.27%	27.61
RodD3_95.3	188	2.421	0.173	739.2	2871.8	704.1	1.50	715.8	780	122.81	18.49	15.05%	24.07
RodD3_100.1	189	2.543	0.295	758.4	2961.6	721.7	1.50	733.9	758	121.13	18.17	15.00%	22.90
RodD3_106.1	190	2.695	0.447	774.4	3079.0	742.3	1.50	753.0	737	143.98	21.89	15.20%	26.23
RodD3_110	191	2.794	0.546	781.2	3038.9	754.8	1.50	763.6	726	172.33	26.62	15.45%	30.77
RodD3_142.1	192	3.609	0.218	818.8	1025.0	816.8	1.50	817.5	673	760.43	633.65	83.33%	123.00
RodC4_88.4	233	2.245	-0.003	700.3	2772.5	677.6	1.50	685.1	820	183.49	29.23	15.93%	38.32
RodC4_91.1	234	2.314	0.066	715.8	2824.9	688.1	1.50	697.3	803	153.23	23.56	15.37%	31.20
RodC4_93.4	235	2.372	0.124	727.9	2869.7	697.0	1.50	707.3	791	139.12	21.06	15.14%	27.75
RodC4_95.3	236	2.421	0.173	738.3	2905.0	704.1	1.50	715.5	780	127.43	19.08	14.97%	25.00
RodC4_100.1	237	2.543	0.295	759.0	2997.6	721.7	1.50	734.1	758	120.45	17.88	14.85%	22.77
RodC4_106.1	238	2.695	0.447	770.9	3115.0	742.3	1.50	751.8	738	163.58	25.04	15.31%	29.87
RodC4_110	239	2.794	0.546	775.9	3015.9	754.8	1.50	761.8	727	214.56	34.82	16.23%	38.44
RodC4_142.2	240	3.612	0.221	818.5	1115.3	816.9	1.50	817.4	673	1001.31	1002.40	100.11%	161.98
RodD4_88.3	241	2.243	-0.005	707.9	2761.0	677.2	1.50	687.4	817	134.93	20.49	15.19%	28.04
RodD4_91.3	242	2.319	0.071	722.0	2819.9	688.9	1.50	699.9	800	127.66	19.21	15.05%	25.85
RodD4_93.2	243	2.367	0.119	732.5	2856.3	696.2	1.50	708.3	789	117.89	17.58	14.91%	23.47
RodD4_95.2	244	2.418	0.170	743.0	2894.9	703.7	1.50	716.8	779	110.61	16.38	14.81%	21.64
RodD4_100.1	245	2.543	0.295	763.1	2898.1	721.7	1.50	735.5	757	104.90	15.83	15.09%	19.77
RodD4_106.1	246	2.695	0.447	776.0	2901.3	742.3	1.50	753.6	736	129.21	20.38	15.77%	23.52
RodD4_110	247	2.794	0.546	781.7	2904.4	754.8	1.50	763.8	725	162.06	25.73	15.87%	28.93
RodD4_142.1	248	3.609	0.218	822.0	1075.1	816.8	1.50	818.5	672	312.63	110.83	35.45%	50.48
RodE4_88.4	201	2.245	-0.003	702.0	2719.5	677.6	1.50	685.7	819	167.25	26.59	15.90%	34.89
RodE4_91.2	202	2.316	0.069	714.9	2771.8	688.5	1.50	697.3	804	157.32	24.68	15.69%	32.03
RodE4_95.3	204	2.421	0.173	735.3	2846.0	704.1	1.50	714.5	782	136.87	21.00	15.34%	26.90
RodE4_100.9	205	2.563	0.315	755.2	2950.6	724.5	1.50	734.8	757	144.20	22.18	15.38%	27.22
RodE4_142.3	208	3.614	0.224	818.1	1089.1	816.9	1.50	817.3	673	1348.25	1851.92	137.36%	218.15
RodE3_63.4	193	1.610	0.417	614.8	2256.9	576.3	1.50	589.1	977	88.05	13.13	14.91%	22.81
RodE3_113.6	194	2.885	0.022	788.1	2765.4	765.6	1.50	773.1	716	184.06	29.71	16.14%	32.28
RodE3_115.5	195	2.934	0.070	793.8	2661.4	770.9	1.50	778.5	710	174.82	28.12	16.08%	30.35
RodE3_118.5	196	3.010	0.146	799.8	2495.9	778.9	1.50	785.9	703	179.12	29.33	16.38%	30.67
RodE3_122.7	197	3.117	0.253	805.4	2262.9	789.1	1.50	794.5	694	207.98	36.46	17.53%	35.06
RodE3_126.5	198	3.213	0.349	808.6	2053.0	797.1	1.50	800.9	688	268.08	54.33	20.27%	44.67
RodE3_131.7	199	3.345	-0.046	812.3	1768.1	806.2	1.50	808.2	682	434.52	132.92	30.59%	71.46
RodE3_135.6	200	3.444	0.053	813.5	1550.8	811.4	1.50	812.1	678	1073.53	833.64	77.65%	175.32

Table SC-3166-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±chc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	615.3	2216.0	577.5	1.50	590.1	975	87.95	13.33	15.16%	22.73
RodC5_113.6	226	2.885	0.022	781.5	2700.5	765.6	1.50	770.9	718	254.44	45.70	17.96%	44.81
RodC5_115.7	227	2.939	0.075	788.7	2591.8	771.5	1.50	777.2	711	225.40	39.40	17.48%	39.22
RodC5_122.7	229	3.117	0.253	803.6	2223.2	789.1	1.50	793.9	695	229.05	42.20	18.42%	38.65
RodC5_126.7	230	3.218	0.354	808.1	2012.3	797.5	1.50	801.0	688	285.21	60.66	21.27%	47.51
RodC5_131.6	231	3.343	-0.048	812.9	1756.5	806.0	1.50	808.3	681	383.29	107.27	27.99%	63.02
RodC5_135.7	232	3.447	0.056	817.1	1539.6	811.5	1.50	813.4	677	410.18	133.79	32.62%	66.83
RodE5_63.6	209	1.615	0.422	614.6	2269.9	577.1	1.50	589.6	976	90.80	13.53	14.90%	23.49
RodE5_113.6	210	2.885	0.022	782.9	2786.2	765.6	1.50	771.3	717	240.76	41.36	17.18%	42.36
RodE5_115.4	211	2.931	0.067	787.9	2690.3	770.6	1.50	776.4	712	234.17	40.26	17.19%	40.81
RodE5_118.7	212	3.015	0.151	796.3	2510.3	779.4	1.50	785.0	704	223.82	38.70	17.29%	38.39
RodE5_122.6	213	3.114	0.250	803.1	2296.0	788.8	1.50	793.6	695	242.04	44.36	18.33%	40.87
RodE5_126.6	214	3.216	0.352	807.5	2078.5	797.3	1.50	800.7	689	304.73	65.36	21.45%	50.79
RodE5_131.6	215	3.343	-0.048	813.0	1807.5	806.0	1.50	808.3	681	386.66	106.02	27.42%	63.57
RodE5_135.6	216	3.444	0.053	815.2	1588.6	811.4	1.50	812.6	677	624.15	283.97	45.50%	101.83
RodC3_79.8	177	2.027	0.227	668.9	2563.0	643.1	1.50	651.7	868	149.21	23.45	15.71%	33.49
RodC3_85.6	178	2.174	0.374	683.5	2673.0	666.5	1.50	672.2	838	235.63	40.84	17.33%	50.58
RodC3_88.5	179	2.248	0.000	696.2	2729.2	678.0	1.50	684.0	821	224.93	38.20	16.98%	47.08
RodC3_92.4	180	2.347	0.099	715.7	2801.5	693.1	1.50	700.7	799	185.98	29.97	16.11%	37.61
RodC3_94.4	181	2.398	0.150	726.7	2838.4	700.7	1.50	709.4	788	163.92	25.75	15.71%	32.56
RodC3_97.2	182	2.469	0.221	740.5	2890.3	711.2	1.50	721.0	774	147.64	22.78	15.43%	28.64
RodC3_108.8	183	2.764	0.516	773.4	3044.4	751.0	1.50	758.5	731	204.02	32.94	16.15%	36.78
RodD5_50	217	1.270	0.076	567.3	2013.3	524.8	1.50	539.0	1085	70.97	10.45	14.73%	20.78
RodD5_54.1	218	1.374	0.180	585.5	2088.9	540.0	1.50	555.2	1048	68.86	10.11	14.68%	19.37
RodD5_56.9	219	1.445	0.251	596.2	2141.1	550.7	1.50	565.9	1024	70.57	10.37	14.69%	19.33
RodD5_60	220	1.524	0.330	606.8	2200.2	562.8	1.50	577.5	1000	74.96	11.04	14.73%	19.97
RodD5_66.1	221	1.679	0.485	625.9	2315.9	587.2	1.50	600.1	956	89.72	13.34	14.87%	22.65
RodD5_69.9	222	1.775	-0.025	634.0	2391.4	602.6	1.50	613.1	932	114.31	17.34	15.17%	27.99
RodD5_72.9	223	1.852	0.051	648.7	2446.7	614.9	1.50	626.2	909	108.47	16.36	15.08%	25.78
RodD5_74.9	224	1.902	0.102	658.2	2483.4	623.1	1.50	634.8	895	106.03	15.94	15.03%	24.71

Table SC-3166-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±hctic (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	536.4	1831.8	494.7	1.50	508.6	1163.0	65.96	9.76	14.79%	20.86
RodB5_52.9	154	1.344	0.150	574.0	2060.4	533.5	1.50	547.0	1066.3	76.24	11.30	14.82%	21.88
RodB5_55	155	1.397	0.203	580.4	2099.6	540.7	1.50	553.9	1050.4	79.32	11.78	14.85%	22.38
RodB5_57.8	156	1.468	0.274	590.0	2152.5	550.5	1.50	563.6	1029.1	81.71	12.15	14.86%	22.51
RodB5_64	157	1.626	0.432	608.0	2272.8	572.5	1.50	584.3	986.2	96.00	14.40	15.00%	25.15
RodB5_73.9	158	1.877	0.077	635.8	2462.5	608.4	1.50	617.5	924.3	134.59	20.82	15.47%	32.62
RodB5_75.9	159	1.928	0.128	645.3	2500.4	615.7	1.50	625.6	910.5	126.59	19.38	15.31%	30.12
RodB5_76.9	160	1.953	0.153	649.3	2519.3	619.3	1.50	629.3	904.1	125.87	19.28	15.31%	29.70
RodF5_41	105	1.041	0.343	533.4	1816.3	494.7	1.50	507.6	1165.8	70.48	10.55	14.97%	22.35
RodF5_53.1	106	1.349	0.155	568.6	2050.9	534.2	1.50	545.7	1069.4	89.21	13.47	15.10%	25.69
RodF5_55	107	1.397	0.203	576.8	2086.7	540.7	1.50	552.7	1053.1	86.59	13.02	15.04%	24.50
RodF5_57.8	108	1.468	0.274	586.8	2140.6	550.5	1.50	562.6	1031.4	88.35	13.28	15.03%	24.40
RodF5_64	109	1.626	0.432	604.6	2258.1	572.5	1.50	583.2	988.4	105.48	16.05	15.22%	27.71
RodF5_73.8	110	1.875	0.074	633.8	2447.5	608.0	1.50	616.6	925.9	142.56	22.34	15.67%	34.63
RodF5_75.8	111	1.925	0.125	643.2	2485.2	615.3	1.50	624.6	912.1	133.92	20.75	15.49%	31.94
RodF5_76.8	112	1.951	0.150	647.4	2504.7	619.0	1.50	628.4	905.6	131.95	20.37	15.44%	31.19
RodC2_41	57	1.041	0.343	532.0	1828.5	494.7	1.50	507.1	1167.0	73.52	10.98	14.94%	23.34
RodC2_53.1	58	1.349	0.155	569.6	2064.0	534.2	1.50	546.0	1068.6	87.27	13.08	14.99%	25.11
RodC2_55	59	1.397	0.203	576.2	2099.5	540.7	1.50	552.5	1053.6	88.75	13.31	15.00%	25.13
RodC2_57.8	60	1.468	0.274	585.6	2151.7	550.5	1.50	562.2	1032.2	91.88	13.80	15.02%	25.40
RodC2_63.9	61	1.623	0.429	602.4	2269.3	572.1	1.50	582.2	990.3	112.37	17.15	15.26%	29.59
RodC2_73.8	62	1.875	0.074	629.4	2461.4	608.0	1.50	615.1	928.5	172.96	28.00	16.19%	42.15
RodC2_75.8	63	1.925	0.125	635.8	2496.4	615.3	1.50	622.1	916.3	182.73	29.88	16.35%	43.82
RodC2_76.8	64	1.951	0.150	639.0	2514.7	619.0	1.50	625.7	910.3	187.86	30.87	16.44%	44.69
RodC6_40.9	137	1.039	0.340	536.4	1819.2	494.4	1.50	508.4	1163.6	64.96	9.64	14.85%	20.56
RodC6_52.8	138	1.341	0.147	573.9	2056.8	533.1	1.50	546.7	1066.9	75.60	11.21	14.83%	21.72
RodC6_54.8	139	1.392	0.198	581.9	2096.5	540.0	1.50	554.0	1050.4	75.06	11.10	14.79%	21.18
RodC6_57.8	140	1.468	0.274	591.1	2156.7	550.5	1.50	564.0	1028.3	79.66	11.80	14.81%	21.93
RodC6_63.8	141	1.621	0.427	609.2	2276.8	571.8	1.50	584.3	986.3	91.19	13.58	14.89%	23.90
RodC6_73.7	142	1.872	0.072	642.3	2475.0	607.7	1.50	619.2	921.4	107.33	16.07	14.97%	25.91
RodC6_75.8	143	1.925	0.125	649.6	2516.1	615.3	1.50	626.7	908.5	110.16	16.53	15.01%	26.14
RodC6_76.8	144	1.951	0.150	653.7	2536.2	619.0	1.50	630.5	902.2	109.62	16.43	14.98%	25.79

Table SC-3166-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	688.2	2719.3	660.7	1.50	669.8	841.3	148.16	23.09	15.58%	31.96
RodB4_91.3	162	2.319	0.071	703.3	2772.4	670.8	1.50	681.7	824.6	128.13	19.56	15.26%	26.96
RodB4_93.3	163	2.370	0.122	712.7	2808.4	677.8	1.50	689.4	814.0	120.72	18.30	15.16%	24.99
RodB4_95.1	164	2.416	0.168	719.9	2841.0	683.9	1.50	695.9	805.4	118.54	17.92	15.12%	24.21
RodB4_100	165	2.540	0.292	736.3	2930.6	700.3	1.50	712.3	784.4	122.14	18.48	15.13%	24.12
RodB4_106	166	2.692	0.445	754.0	3043.8	719.4	1.50	731.0	761.8	131.98	20.05	15.19%	25.10
RodB4_109.9	167	2.791	0.544	761.2	2945.2	731.2	1.50	741.2	750.0	147.49	22.88	15.51%	27.49
RodB4_142.3	168	3.614	0.224	801.5	1107.9	801.0	1.50	801.1	688.1	3233.81	10422.40	322.29%	538.59
RodF4_85.6	98	2.174	0.374	676.2	2679.2	650.7	1.50	659.2	856.9	157.99	24.85	15.73%	34.88
RodF4_88.4	99	2.245	-0.003	685.6	2736.0	660.7	1.50	669.0	842.5	164.50	25.94	15.77%	35.56
RodF4_92.4	100	2.347	0.099	707.0	2809.3	674.7	1.50	685.4	819.4	130.20	19.80	15.21%	27.17
RodF4_94.3	101	2.395	0.147	716.9	2843.9	681.2	1.50	693.1	809.1	119.48	17.99	15.06%	24.54
RodF4_97.2	102	2.469	0.221	730.8	2898.0	691.0	1.50	704.3	794.5	109.31	16.32	14.93%	21.94
RodF4_108.8	103	2.764	0.516	765.3	3059.7	728.0	1.50	740.4	750.9	122.85	18.39	14.97%	22.93
RodF4_111	104	2.819	-0.044	770.9	2934.1	734.5	1.50	746.6	744.0	120.82	18.12	15.00%	22.28
RodD2_103.2	65	2.621	0.373	740.8	3026.5	710.7	1.50	720.7	774.1	150.53	23.04	15.30%	29.22
RodD2_106	66	2.692	0.445	750.7	3080.4	719.4	1.50	729.9	763.1	148.04	22.56	15.24%	28.22
RodD2_112.6	67	2.860	-0.004	772.0	2824.5	739.1	1.50	750.0	740.2	128.80	19.61	15.22%	23.60
RodD2_114.9	68	2.918	0.055	778.1	2693.4	745.5	1.50	756.4	733.3	124.08	18.91	15.24%	22.46
RodD2_117.4	69	2.982	0.118	789.2	2347.9	752.3	1.50	764.6	724.5	95.39	15.26	15.99%	17.00
RodD2_120.8	70	3.068	0.204	789.2	2347.9	761.0	1.50	770.4	718.5	124.78	19.42	15.56%	22.00
RodD2_124.8	71	3.170	0.306	794.7	2114.5	770.5	1.50	778.5	710.1	130.58	20.86	15.97%	22.67
RodD2_128.6	72	3.266	0.403	798.1	1896.3	778.7	1.50	785.2	703.5	146.11	24.52	16.78%	25.05
RodD6_103.1	129	2.619	0.371	743.0	3036.4	710.3	1.50	721.2	773.5	139.65	21.11	15.12%	27.08
RodD6_106	130	2.692	0.445	748.9	3091.2	719.4	1.50	729.3	763.8	157.59	24.14	15.32%	30.07
RodD6_112.9	131	2.868	0.004	766.6	2822.3	739.9	1.50	748.8	741.5	158.71	24.75	15.60%	29.15
RodD6_114.9	132	2.918	0.055	772.4	2705.7	745.5	1.50	754.5	735.3	150.81	23.50	15.58%	27.40
RodD6_116.8	133	2.967	0.103	778.8	2591.4	750.7	1.50	760.1	729.3	138.02	21.39	15.50%	24.81
RodD6_120.9	134	3.071	0.207	787.7	2349.7	761.2	1.50	770.0	718.8	133.18	20.88	15.68%	23.49
RodD6_124.8	135	3.170	0.306	794.3	2118.1	770.5	1.50	778.4	710.3	133.34	21.35	16.01%	23.15
RodD6_128.7	136	3.269	0.405	799.5	1890.0	778.9	1.50	785.8	702.9	137.55	22.77	16.55%	23.56

Table SC-3166-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±h _{tic} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	556.9	2017.2	524.0	1.50	535.0	1094.9	92.08	13.86	15.05%	27.24
RodE2_54	74	1.372	0.178	574.2	2091.5	537.2	1.50	549.6	1060.3	84.86	12.63	14.88%	24.21
RodE2_56.9	75	1.445	0.251	583.7	2146.8	547.3	1.50	559.4	1038.2	88.48	13.19	14.91%	24.63
RodE2_59.9	76	1.521	0.328	593.8	2204.2	557.9	1.50	569.8	1015.8	91.99	13.73	14.93%	24.96
RodE2_66	77	1.676	0.483	610.6	2324.2	579.7	1.50	590.0	975.0	112.83	17.11	15.16%	29.17
RodE2_69.8	78	1.773	-0.027	616.8	2400.4	593.5	1.50	601.2	953.6	154.35	24.43	15.82%	38.85
RodE2_72.9	79	1.852	0.051	628.8	2460.2	604.8	1.50	612.8	932.7	153.25	24.11	15.73%	37.55
RodE2_74.9	80	1.902	0.102	636.3	2497.2	612.0	1.50	620.1	919.8	154.34	24.26	15.72%	37.19
RodB3_50.2	169	1.275	0.081	552.7	2006.1	524.3	1.50	533.8	1097.7	105.99	16.31	15.39%	31.45
RodB3_54.1	170	1.374	0.180	566.7	2079.3	537.6	1.50	547.3	1065.6	107.27	16.47	15.35%	30.77
RodB3_56.9	171	1.445	0.251	578.3	2133.1	547.3	1.50	557.6	1042.2	103.37	15.74	15.23%	28.90
RodB3_60.1	172	1.527	0.333	589.1	2193.9	558.6	1.50	568.7	1018.1	107.88	16.46	15.26%	29.35
RodB3_66.1	173	1.679	0.485	606.7	2307.7	580.1	1.50	589.0	977.0	129.69	20.17	15.55%	33.61
RodB3_69.9	174	1.775	-0.025	614.3	2383.3	593.8	1.50	600.6	954.8	174.95	28.62	16.36%	44.10
RodB3_73	175	1.854	0.054	626.7	2441.5	605.1	1.50	612.3	933.5	169.42	27.38	16.16%	41.56
RodB3_75	176	1.905	0.105	635.7	2479.7	612.4	1.50	620.2	919.7	159.72	25.42	15.92%	38.48
RodF3_50.1	89	1.273	0.079	558.4	2005.0	524.0	1.50	535.5	1093.6	87.42	13.15	15.04%	25.83
RodF3_54	90	1.372	0.178	574.5	2082.1	537.2	1.50	549.7	1060.1	83.84	12.51	14.92%	23.91
RodF3_57	91	1.448	0.254	584.6	2138.3	547.6	1.50	560.0	1037.0	86.71	12.95	14.94%	24.10
RodF3_60	92	1.524	0.330	594.1	2195.8	558.2	1.50	570.2	1015.1	91.77	13.75	14.98%	24.88
RodF3_66.1	93	1.679	0.485	611.4	2317.9	580.1	1.50	590.5	974.0	110.99	16.84	15.17%	28.66
RodF3_70	94	1.778	-0.022	619.2	2398.0	594.2	1.50	602.5	951.3	144.05	22.55	15.65%	36.15
RodF3_73	95	1.854	0.054	632.0	2456.6	605.1	1.50	614.1	930.4	137.33	21.24	15.47%	33.55
RodF3_75	96	1.905	0.105	641.9	2492.8	612.4	1.50	622.2	916.1	126.73	19.36	15.27%	30.39
RodE6_50.2	121	1.275	0.081	560.3	2004.5	524.3	1.50	536.3	1091.6	83.61	12.53	14.99%	24.65
RodE6_54.1	122	1.374	0.180	575.2	2075.4	537.6	1.50	550.1	1059.1	82.80	12.38	14.95%	23.59
RodE6_57	123	1.448	0.254	583.8	2129.4	547.6	1.50	559.7	1037.6	88.28	13.25	15.01%	24.56
RodE6_60.2	124	1.529	0.335	595.0	2191.6	558.9	1.50	571.0	1013.5	91.07	13.67	15.01%	24.65
RodE6_66.1	125	1.679	0.485	613.3	2305.1	580.1	1.50	591.1	972.8	104.13	15.76	15.13%	26.85
RodE6_70	126	1.778	-0.022	620.7	2380.5	594.2	1.50	603.0	950.3	134.52	20.95	15.57%	33.72
RodE6_73.1	127	1.857	0.056	634.3	2439.0	605.5	1.50	615.1	928.6	126.78	19.51	15.39%	30.90
RodE6_75	128	1.905	0.105	642.5	2471.3	612.4	1.50	622.4	915.8	123.06	18.86	15.32%	29.49

RBHT Steam Cooling Test SC-3171-A

Matrix test # 16

Test date – 3/24/2005

Steady state time window: 16560 - 17160 sec

Inlet flow: 0.48 m³/min (17.0 ft³/min)

Inlet steam temperature: 406 K (272 °F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 7.1 kW

Outlet steam temperature: 620 K (657 °F)

Bundle inlet Reynolds number: 1957

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

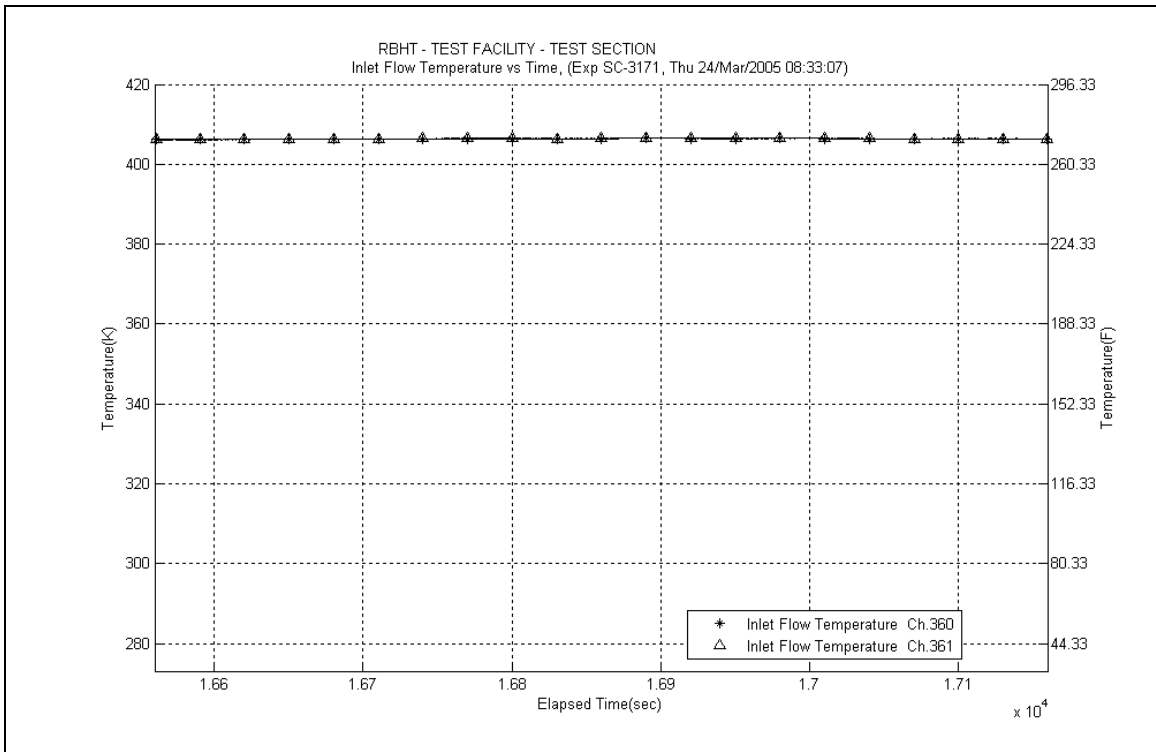
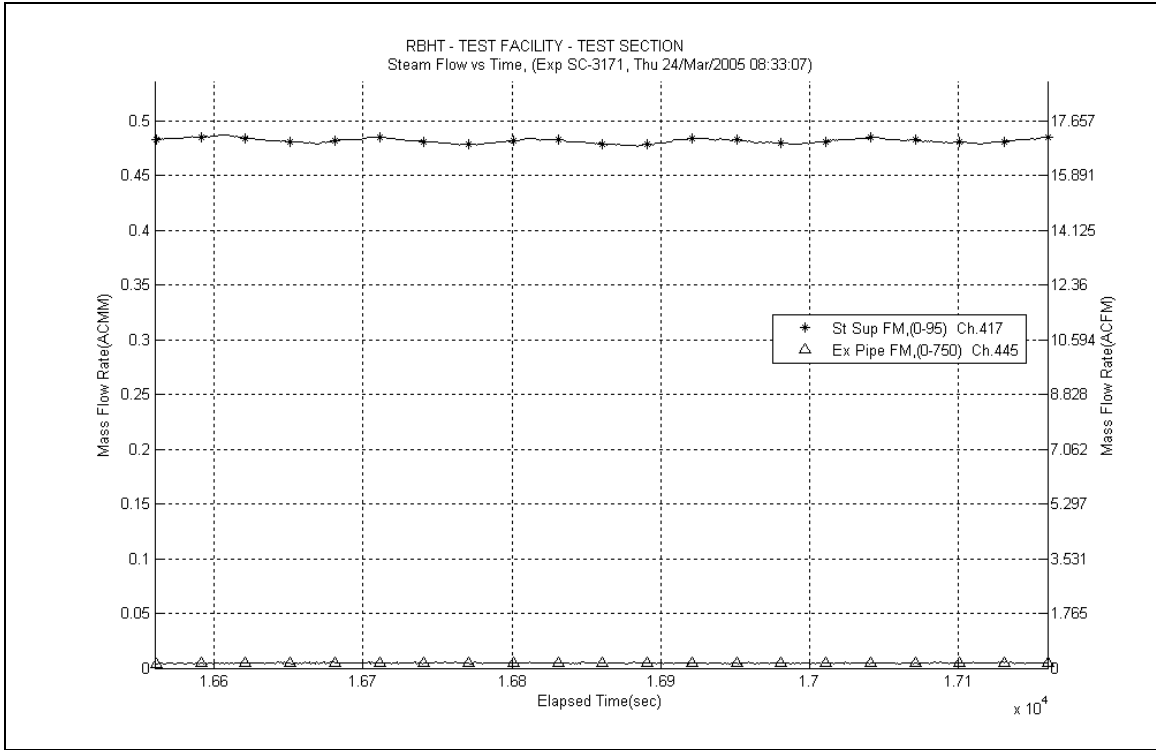
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

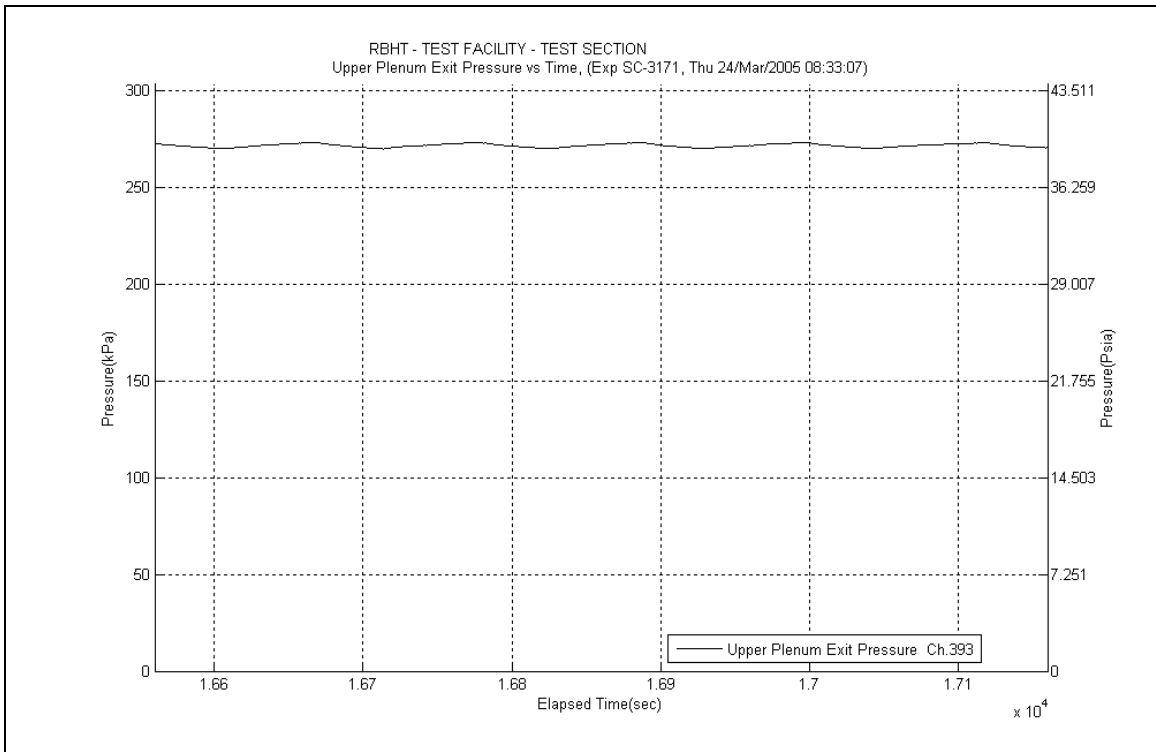
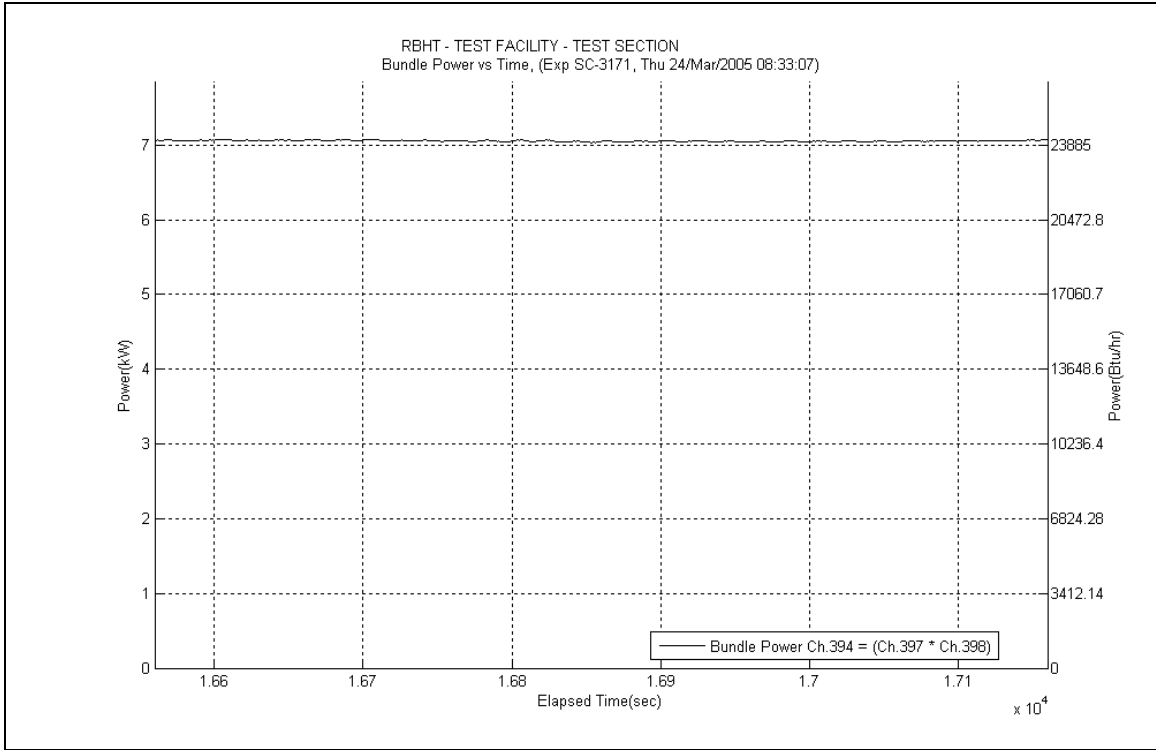
$$T_{cl} = -7.3809x^3 + 47.254x^2 - 16.084x + 417.71$$

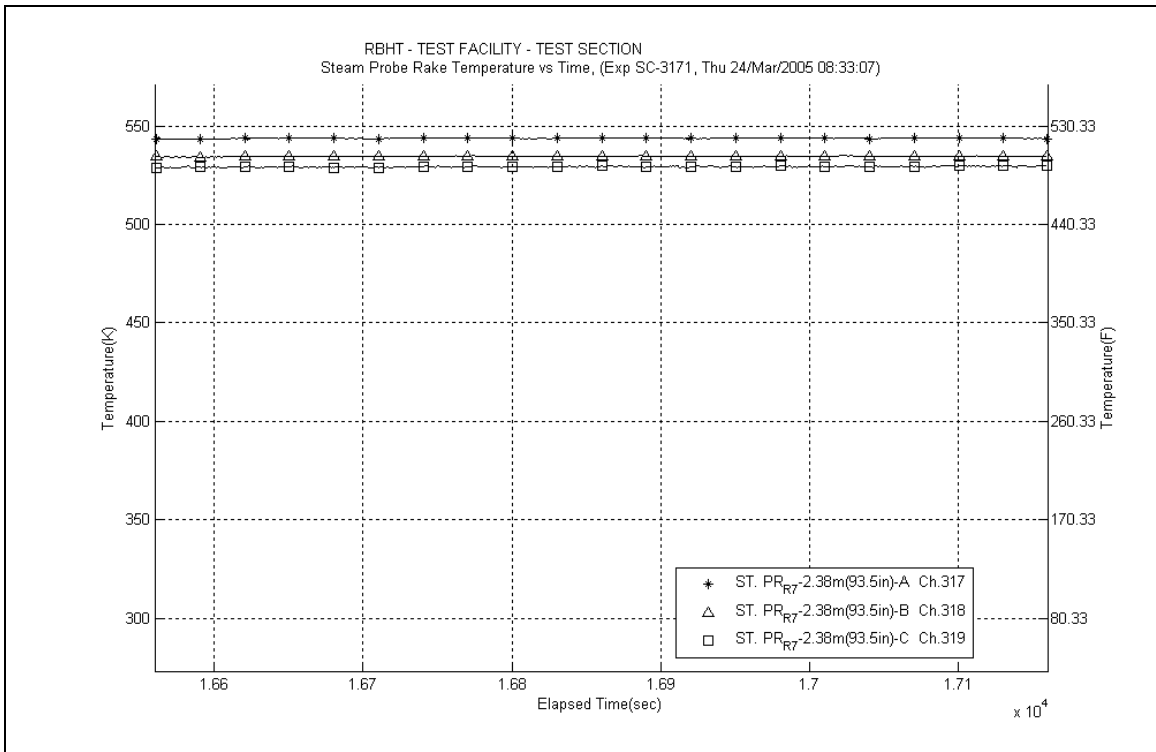
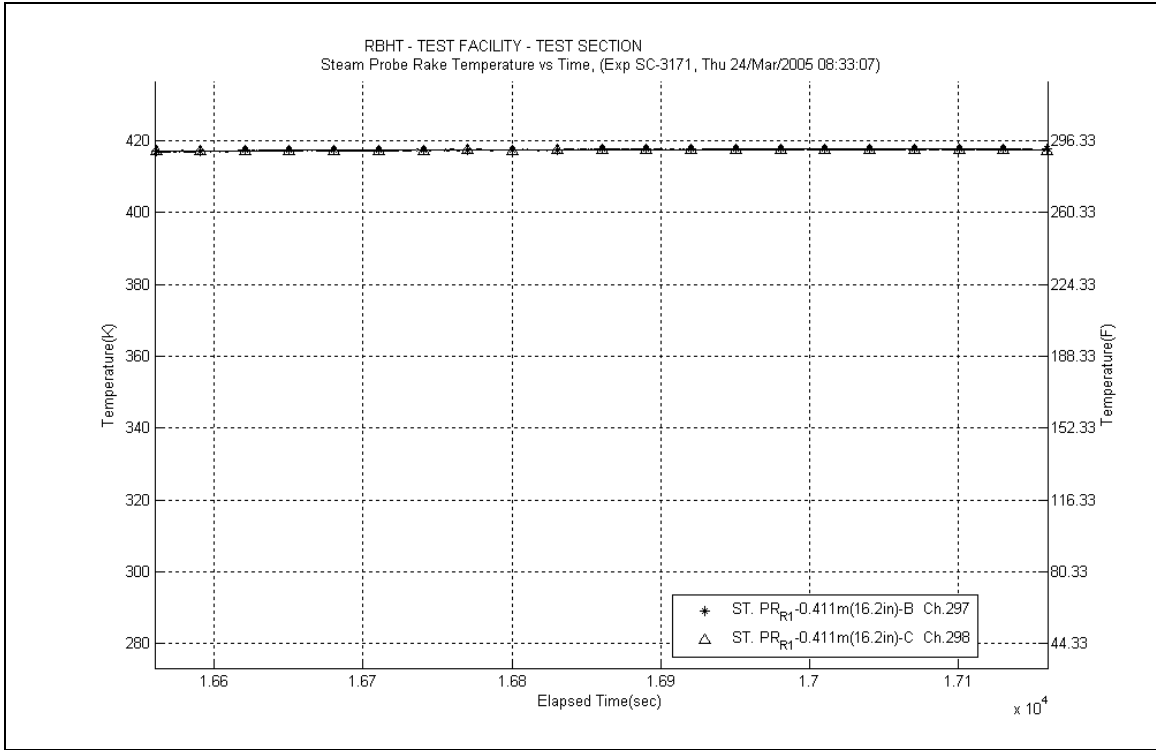
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

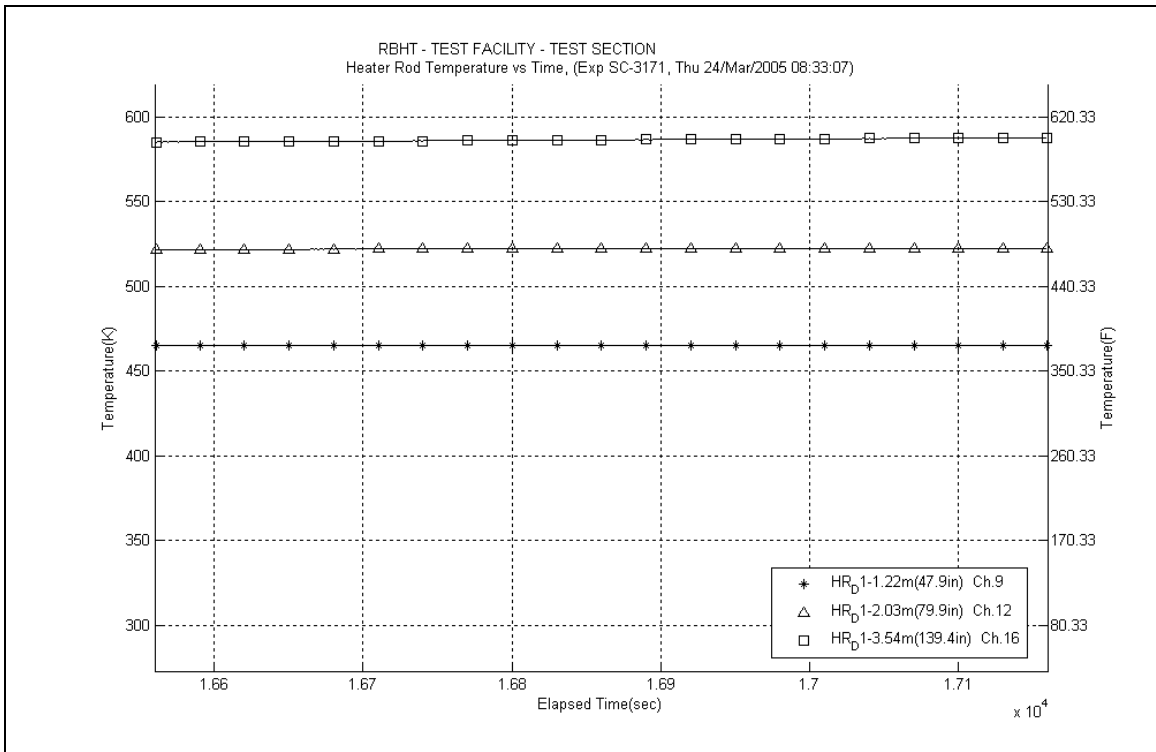
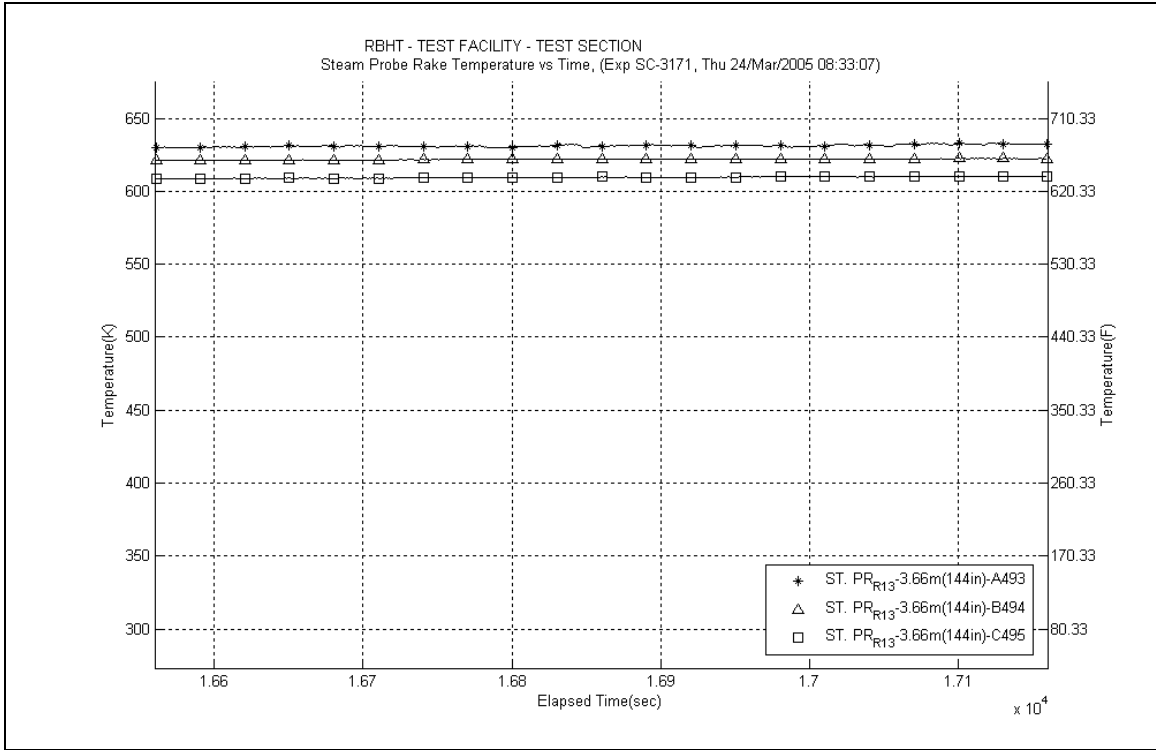
$$T_{cl} = -4.3898x^3 + 27.869x^2 + 12.056x + 408.04$$

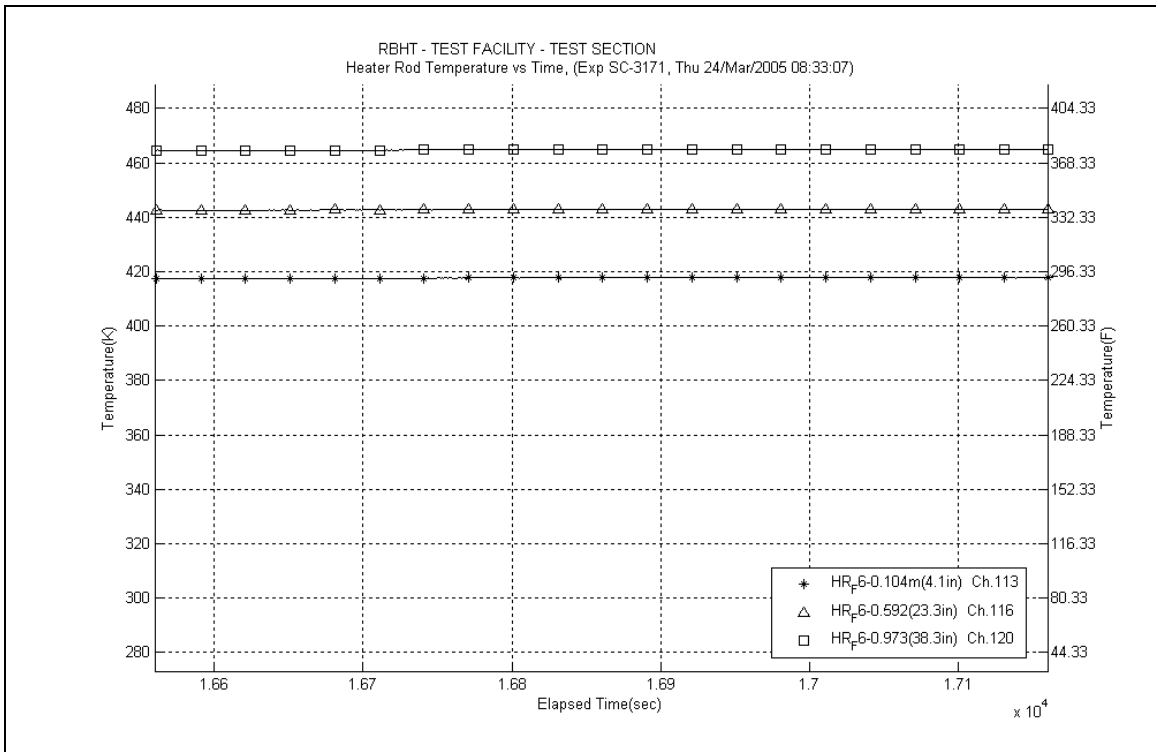
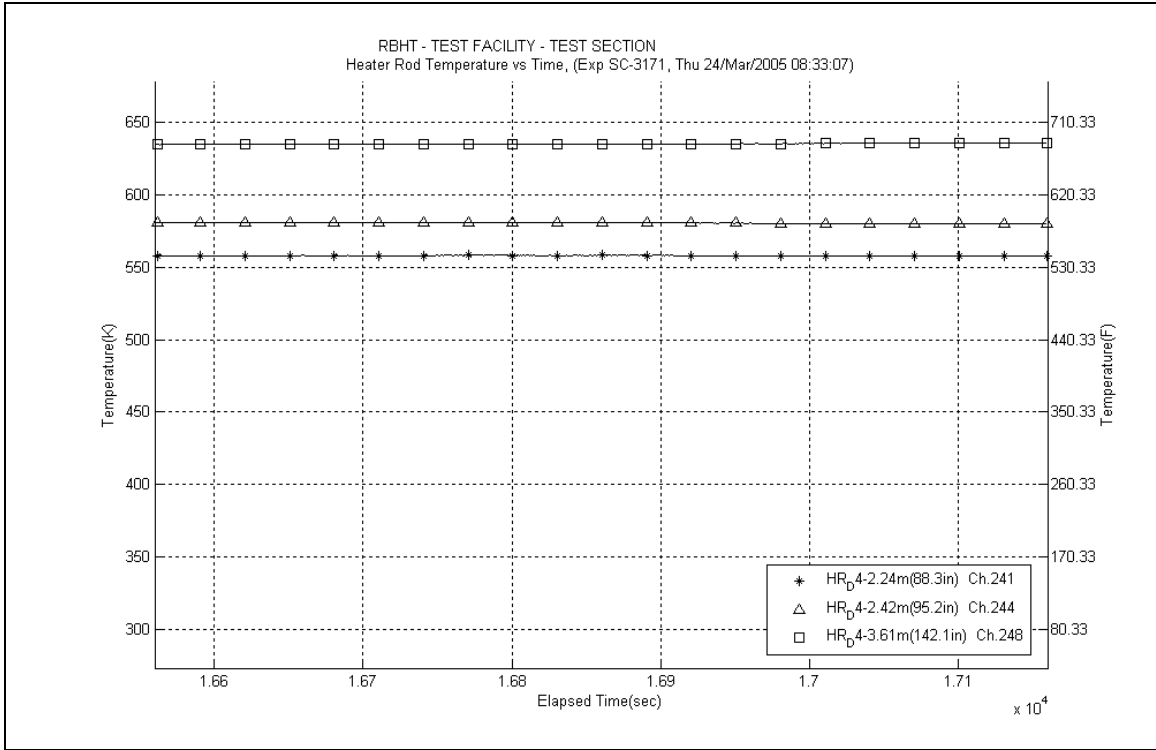
where x is the elevation (m) and T_{cl} is in (K)











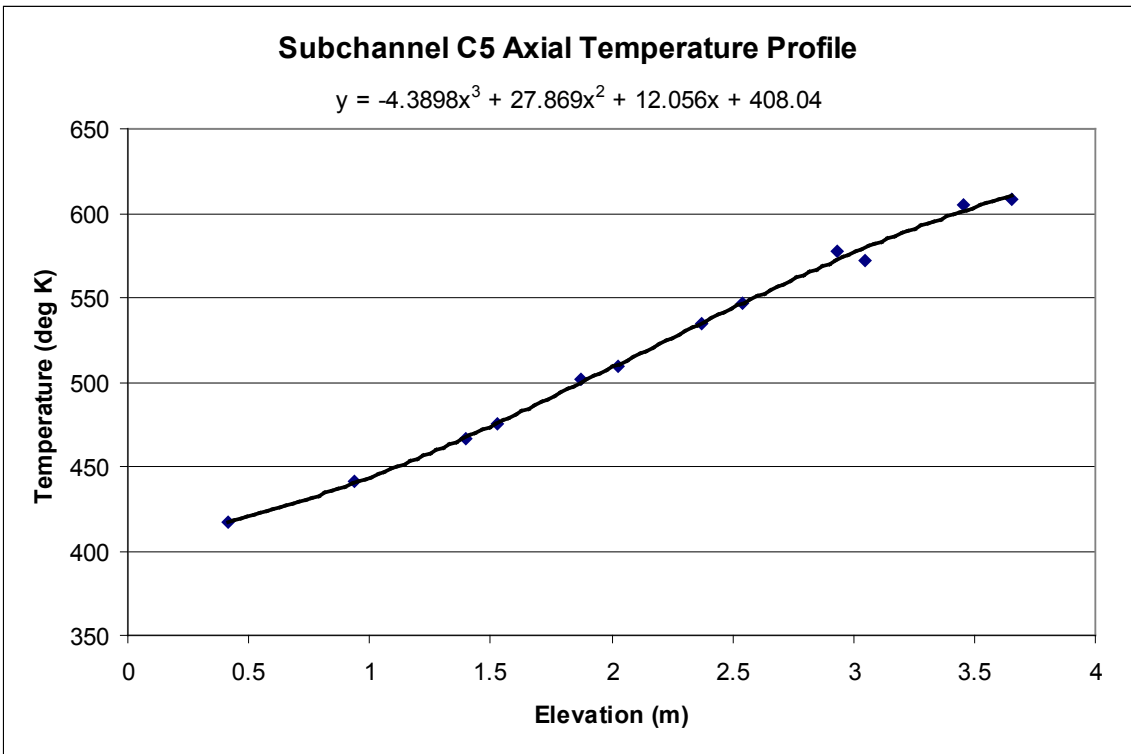
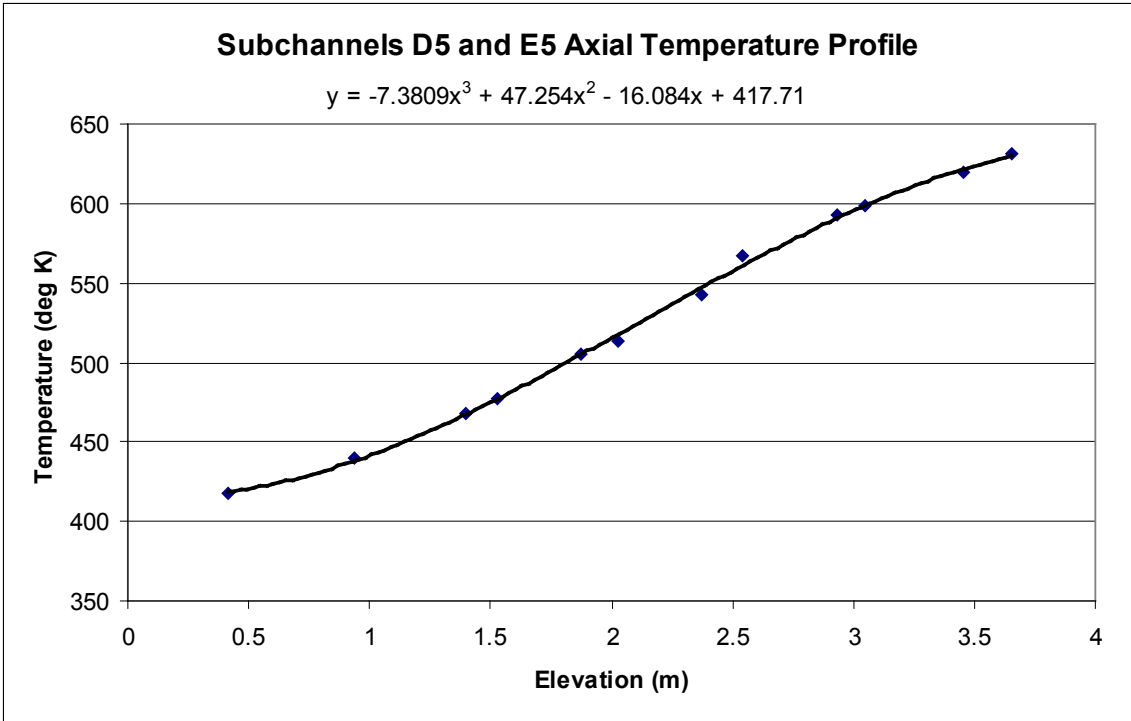


Table SC-3171-A.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (°F)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohic (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	553.4	1885.7	506.7	536.9	1.50	542.4	1596	171.41	37.50	21.88%	49.77
RodD3_91.3	186	2.319	0.071	564.0	1925.8	518.4	543.4	1.50	549.5	1571	139.99	29.48	21.06%	39.86
RodD3_93.1	187	2.365	0.117	570.8	1950.4	525.3	547.2	1.50	555.1	1553	123.82	25.63	20.70%	34.84
RodD3_95.3	188	2.421	0.173	578.9	1981.1	533.7	551.9	1.50	560.9	1534	110.15	22.49	20.42%	30.55
RodD3_100.1	189	2.543	0.295	592.2	2045.9	551.6	561.8	1.50	571.9	1499	101.18	20.46	20.22%	27.32
RodD3_106.1	190	2.695	0.447	603.0	2126.1	573.1	573.7	1.50	583.2	1464	112.36	22.83	20.32%	29.52
RodD3_110	191	2.794	0.546	603.0	2102.1	586.3	581.1	1.50	588.4	1449	144.02	29.64	20.58%	37.37
RodD3_142.1	192	3.609	0.218	628.2	718.1	661.3	622.8	1.50	624.6	1352	199.03	73.38	36.87%	47.47
RodC4_88.4	233	2.245	-0.003	552.7	1906.7	507.1	537.1	1.50	542.3	1596	183.63	40.38	21.99%	53.33
RodC4_91.1	234	2.314	0.066	562.7	1944.1	517.6	542.9	1.50	549.5	1571	147.52	31.01	21.02%	42.08
RodC4_93.4	235	2.372	0.124	570.5	1977.1	526.5	547.9	1.50	555.4	1552	131.19	27.05	20.62%	36.88
RodC4_95.3	236	2.421	0.173	577.3	2004.3	533.7	551.9	1.50	560.4	1535	118.09	24.02	20.34%	32.80
RodC4_100.1	237	2.543	0.295	590.3	2069.9	551.6	561.8	1.50	571.3	1500	109.13	21.96	20.13%	29.51
RodC4_106.1	238	2.695	0.447	599.2	2150.2	573.1	573.7	1.50	582.2	1467	126.57	25.73	20.33%	33.33
RodC4_110	239	2.794	0.546	600.8	2078.0	586.3	581.1	1.50	587.7	1451	157.87	33.26	21.07%	41.04
RodC4_142.2	240	3.612	0.221	631.0	771.6	661.4	622.8	1.50	625.6	1349	141.22	39.72	28.13%	33.60
RodD4_88.3	241	2.243	-0.005	558.0	1907.8	506.7	536.9	1.50	543.9	1590	135.29	28.14	20.80%	39.13
RodD4_91.3	242	2.319	0.071	566.7	1948.9	518.4	543.4	1.50	551.1	1566	125.20	25.72	20.54%	35.57
RodD4_93.2	243	2.367	0.119	573.6	1975.8	525.7	547.4	1.50	556.1	1549	113.43	23.01	20.29%	31.83
RodD4_95.2	244	2.418	0.170	580.5	2004.4	533.3	551.7	1.50	561.3	1532	104.14	20.93	20.10%	28.86
RodD4_100.1	245	2.543	0.295	593.4	2071.5	551.6	561.8	1.50	572.4	1497	98.43	19.65	19.96%	26.55
RodD4_106.1	246	2.695	0.447	603.0	2151.0	573.1	573.7	1.50	583.5	1464	110.34	22.16	20.08%	28.97
RodD4_110	247	2.794	0.546	605.7	2072.6	586.3	581.1	1.50	589.3	1447	126.17	25.89	20.52%	32.67
RodD4_142.1	248	3.609	0.218	635.3	752.6	661.3	622.8	1.50	626.9	1346	90.08	21.84	24.24%	21.37
RodE4_88.4	201	2.245	-0.003	553.8	1867.0	507.1	537.1	1.50	542.7	1595	167.61	36.85	21.99%	48.64
RodE4_91.2	202	2.316	0.069	562.9	1904.4	518.0	543.1	1.50	549.7	1571	144.83	30.94	21.36%	41.29
RodE4_95.3	204	2.421	0.173	577.0	1959.2	533.7	551.9	1.50	560.3	1536	116.76	24.21	20.73%	32.44
RodE4_100.9	205	2.563	0.315	590.0	2031.6	554.5	563.5	1.50	572.3	1497	114.67	23.67	20.64%	30.93
RodE4_142.3	208	3.614	0.224	634.0	749.6	661.5	622.9	1.50	626.6	1346	101.11	25.35	25.07%	24.00
RodE3_63.4	193	1.610	0.417	514.1	1547.6	410.3	483.3	1.50	493.6	1786	75.43	15.33	20.32%	24.79
RodE3_113.6	194	2.885	0.022	608.1	1910.7	597.9	587.5	1.50	594.4	1432	139.78	29.56	21.15%	35.76
RodE3_115.5	195	2.934	0.070	612.5	1838.9	603.8	590.8	1.50	598.0	1422	127.25	26.68	20.96%	32.27
RodE3_118.5	196	3.010	0.146	618.3	1726.3	612.7	595.7	1.50	603.3	1407	114.67	23.86	20.81%	28.73
RodE3_122.7	197	3.117	0.253	623.4	1567.7	624.2	602.2	1.50	609.2	1391	110.98	23.20	20.90%	27.42
RodE3_126.5	198	3.213	0.349	625.6	1423.7	633.8	607.5	1.50	613.5	1380	117.39	25.03	21.32%	28.72
RodE3_131.7	199	3.345	-0.046	626.3	1226.0	645.1	613.8	1.50	617.9	1368	147.32	34.21	23.22%	35.67
RodE3_135.6	200	3.444	0.053	627.3	1075.7	652.3	617.7	1.50	620.9	1361	169.12	43.32	25.62%	40.67

Table SC-3171-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (°F)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±chtc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	513.6	1520.9	411.8	484.1	1.50	493.9	1785	77.45	16.05	20.72%	25.43
RodC5_113.6	226	2.885	0.022	605.0	1854.2	597.7	587.4	1.50	593.3	1435	157.95	34.98	22.15%	40.51
RodC5_115.7	227	2.939	0.075	611.8	1777.3	604.5	591.2	1.50	598.1	1422	129.46	27.96	21.60%	32.83
RodC5_122.7	229	3.117	0.253	624.2	1525.1	626.0	603.1	1.50	610.1	1389	108.71	23.23	21.37%	26.80
RodC5_126.7	230	3.218	0.354	627.5	1379.4	637.1	609.3	1.50	615.4	1375	113.67	24.70	21.73%	27.69
RodC5_131.6	231	3.343	-0.048	628.4	1201.0	649.6	616.3	1.50	620.3	1362	148.48	35.30	23.77%	35.76
RodC5_135.7	232	3.447	0.056	631.2	1050.6	658.9	621.4	1.50	624.7	1351	161.02	41.20	25.59%	38.39
RodE5_63.6	209	1.615	0.422	513.0	1556.8	411.4	483.9	1.50	493.6	1786	80.43	16.35	20.33%	26.44
RodE5_113.6	210	2.885	0.022	604.6	1904.3	597.7	587.4	1.50	593.1	1436	166.14	36.25	21.82%	42.63
RodE5_115.4	211	2.931	0.067	610.8	1836.8	603.6	590.7	1.50	597.4	1424	136.60	28.99	21.22%	34.70
RodE5_118.7	212	3.015	0.151	618.5	1713.3	614.0	596.5	1.50	603.8	1406	116.45	24.35	20.91%	29.14
RodE5_122.6	213	3.114	0.250	623.8	1567.6	625.7	603.0	1.50	609.9	1390	112.99	23.72	20.99%	27.87
RodE5_126.6	214	3.216	0.352	627.0	1417.6	636.9	609.2	1.50	615.1	1376	119.67	25.65	21.44%	29.17
RodE5_131.6	215	3.343	-0.048	628.9	1228.4	649.6	616.3	1.50	620.5	1362	145.24	33.59	23.12%	34.97
RodE5_135.6	216	3.444	0.053	630.4	1074.6	658.7	621.3	1.50	624.3	1352	177.78	46.63	26.23%	42.42
RodC3_79.8	177	2.027	0.227	540.5	1763.9	472.3	517.8	1.50	525.4	1658	116.39	24.30	20.88%	35.28
RodC3_85.6	178	2.174	0.374	546.7	1840.3	494.8	530.3	1.50	535.7	1619	188.21	36.97	21.98%	49.67
RodC3_88.5	179	2.248	0.000	550.4	1878.8	506.0	536.5	1.50	541.1	1600	203.28	46.46	22.86%	59.22
RodC3_92.4	180	2.347	0.099	563.2	1930.0	521.0	544.8	1.50	551.0	1566	157.24	33.83	21.52%	44.70
RodC3_94.4	181	2.398	0.150	569.8	1957.2	528.7	549.1	1.50	556.0	1550	141.76	29.95	21.13%	39.80
RodC3_97.2	182	2.469	0.221	579.0	1994.8	539.3	555.0	1.50	563.0	1527	124.41	25.80	20.74%	34.33
RodC3_108.8	183	2.764	0.516	598.7	2104.1	581.4	578.4	1.50	585.1	1459	155.33	32.84	21.14%	40.62
RodD5_50	217	1.270	0.076	485.0	1373.7	365.4	458.4	1.50	467.2	1908	77.52	15.90	20.52%	27.25
RodD5_54.1	218	1.374	0.180	495.5	1428.1	378.6	465.7	1.50	475.6	1867	71.76	14.58	20.32%	24.69
RodD5_56.9	219	1.445	0.251	501.7	1464.9	387.9	470.9	1.50	481.2	1842	71.27	14.45	20.28%	24.18
RodD5_60	220	1.524	0.330	508.0	1505.8	398.6	476.8	1.50	487.2	1814	72.53	14.70	20.27%	24.23
RodD5_66.1	221	1.679	0.485	516.6	1586.6	420.5	489.0	1.50	498.2	1766	86.15	17.62	20.45%	27.98
RodD5_69.9	222	1.775	-0.025	516.4	1636.0	434.6	496.8	1.50	503.3	1745	124.96	26.58	21.27%	40.06
RodD5_72.9	223	1.852	0.051	525.5	1675.0	445.9	503.1	1.50	510.6	1715	111.98	23.40	20.89%	35.24
RodD5_74.9	224	1.902	0.102	532.3	1701.7	453.5	507.3	1.50	515.6	1695	102.36	21.14	20.65%	31.80

Table SC-3171-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±onic (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	474.2	1247.1	445.9	1.50	455.3	1968.1	65.92	13.52	20.51%	23.88
RodB5_52.9	154	1.344	0.150	492.6	1406.3	463.9	1.50	473.5	1877.6	73.41	15.01	20.45%	25.40
RodB5_55	155	1.397	0.203	496.3	1434.4	467.3	1.50	477.0	1861.1	74.12	15.14	20.43%	25.42
RodB5_57.8	156	1.468	0.274	502.1	1472.5	471.9	1.50	482.0	1838.0	73.17	14.90	20.36%	24.77
RodB5_64	157	1.626	0.432	512.1	1554.9	482.4	1.50	492.3	1791.7	78.49	15.99	20.37%	25.88
RodB5_73.9	158	1.877	0.077	525.9	1686.4	499.8	1.50	508.5	1723.5	96.87	19.94	20.58%	30.65
RodB5_75.9	159	1.928	0.128	532.1	1713.1	503.4	1.50	513.0	1705.6	89.57	18.29	20.42%	28.02
RodB5_76.9	160	1.953	0.153	534.4	1726.5	505.2	1.50	514.9	1697.8	88.55	18.05	20.38%	27.56
RodF5_41	105	1.041	0.343	471.9	1240.5	445.9	1.50	454.5	1972.2	71.49	14.83	20.74%	25.95
RodF5_53.1	106	1.349	0.155	490.0	1403.3	464.2	1.50	472.8	1880.8	81.57	16.89	20.71%	28.27
RodF5_55	107	1.397	0.203	494.7	1427.9	467.3	1.50	476.4	1863.6	78.09	16.08	20.60%	26.82
RodF5_57.8	108	1.468	0.274	499.9	1464.5	471.9	1.50	481.3	1841.3	78.38	16.12	20.56%	26.59
RodF5_64	109	1.626	0.432	508.8	1546.2	482.4	1.50	491.2	1796.5	87.89	18.16	20.66%	29.06
RodF5_73.8	110	1.875	0.074	520.2	1674.3	499.7	1.50	506.5	1731.7	122.04	25.93	21.25%	38.81
RodF5_75.8	111	1.925	0.125	526.0	1701.6	503.2	1.50	510.8	1714.2	111.99	23.48	20.97%	35.22
RodF5_76.8	112	1.951	0.150	528.5	1714.8	505.0	1.50	512.9	1706.1	109.37	22.85	20.89%	34.22
RodC2_41	57	1.041	0.343	473.1	1244.8	445.9	1.50	454.9	1970.1	68.62	14.14	20.61%	24.88
RodC2_53.1	58	1.349	0.155	490.0	1407.5	464.2	1.50	472.8	1880.8	81.85	16.91	20.66%	28.37
RodC2_55	59	1.397	0.203	493.7	1433.3	467.3	1.50	476.1	1865.3	81.49	16.79	20.61%	28.01
RodC2_57.8	60	1.468	0.274	499.3	1471.0	471.9	1.50	481.0	1842.3	80.63	16.55	20.53%	27.37
RodC2_63.9	61	1.623	0.429	508.8	1553.0	482.3	1.50	491.1	1797.1	87.82	18.06	20.57%	29.05
RodC2_73.8	62	1.875	0.074	517.9	1682.8	499.7	1.50	505.7	1734.9	138.65	29.91	21.58%	44.18
RodC2_75.8	63	1.925	0.125	522.6	1711.4	503.2	1.50	509.7	1718.7	132.22	28.20	21.33%	41.70
RodC2_76.8	64	1.951	0.150	524.6	1724.9	505.0	1.50	511.5	1711.3	132.17	28.15	21.30%	41.49
RodC6_40.9	137	1.039	0.340	474.6	1239.7	445.7	1.50	455.3	1967.9	64.39	13.24	20.56%	23.32
RodC6_52.8	138	1.341	0.147	493.3	1406.5	463.7	1.50	473.6	1877.1	71.36	14.55	20.39%	24.68
RodC6_54.8	139	1.392	0.198	497.9	1434.7	467.0	1.50	477.3	1859.7	69.55	14.12	20.30%	23.83
RodC6_57.8	140	1.468	0.274	503.4	1476.2	471.9	1.50	482.4	1836.0	70.33	14.25	20.26%	23.79
RodC6_63.8	141	1.621	0.427	513.3	1559.0	482.1	1.50	492.5	1790.9	74.82	15.14	20.23%	24.66
RodC6_73.7	142	1.872	0.072	527.7	1695.9	499.5	1.50	508.9	1722.1	90.24	18.34	20.33%	28.52
RodC6_75.8	143	1.925	0.125	533.0	1725.0	503.2	1.50	513.1	1705.0	87.02	17.61	20.23%	27.21
RodC6_76.8	144	1.951	0.150	535.9	1738.9	505.0	1.50	515.3	1696.4	84.57	17.06	20.17%	26.29

Table SC-3171-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	548.2	1865.9	525.9	1.50	533.3	1628.1	125.73	26.45	21.04%	37.35
RodB4_91.3	162	2.319	0.071	558.5	1903.6	531.1	1.50	540.3	1603.3	104.29	21.49	20.60%	30.45
RodB4_93.3	163	2.370	0.122	565.5	1929.8	534.7	1.50	545.0	1586.9	93.98	19.19	20.42%	27.11
RodB4_95.1	164	2.416	0.168	570.9	1954.0	537.9	1.50	548.9	1573.4	88.94	18.08	20.33%	25.41
RodB4_100	165	2.540	0.292	581.3	2017.0	546.5	1.50	558.1	1542.6	87.07	17.66	20.28%	24.32
RodB4_106	166	2.692	0.445	591.2	2091.3	556.8	1.50	568.3	1510.0	91.41	18.58	20.33%	24.90
RodB4_109.9	167	2.791	0.544	593.5	2021.4	563.4	1.50	573.4	1494.0	100.48	20.72	20.62%	27.03
RodB4_142.3	168	3.614	0.224	618.3	760.6	608.4	1.50	611.7	1384.7	115.72	30.09	26.00%	28.43
RodF4_85.6	98	2.174	0.374	544.4	1840.8	520.9	1.50	528.7	1645.2	117.62	24.47	20.80%	35.35
RodF4_88.4	99	2.245	-0.003	547.0	1877.6	525.9	1.50	532.9	1629.6	133.80	28.21	21.08%	39.79
RodF4_92.4	100	2.347	0.099	560.3	1930.5	533.1	1.50	542.2	1596.6	106.26	21.79	20.50%	30.87
RodF4_94.3	101	2.395	0.147	566.7	1956.3	536.5	1.50	546.6	1581.4	97.00	19.72	20.33%	27.87
RodF4_97.2	102	2.469	0.221	575.6	1994.1	541.6	1.50	552.9	1559.7	87.96	17.76	20.19%	24.88
RodF4_108.8	103	2.764	0.516	597.0	2104.3	561.5	1.50	573.4	1494.2	89.11	17.91	20.10%	23.98
RodF4_111	104	2.819	-0.044	599.1	2015.8	565.2	1.50	576.5	1484.6	89.01	17.94	20.16%	23.77
RodD2_103.2	65	2.621	0.373	578.9	2084.0	552.1	1.50	561.0	1533.2	116.61	23.84	20.44%	32.34
RodD2_106	66	2.692	0.445	584.0	2121.7	556.8	1.50	565.9	1517.4	116.99	23.88	20.41%	32.05
RodD2_112.6	67	2.860	-0.004	591.6	1945.7	567.8	1.50	575.7	1486.9	122.58	25.49	20.80%	32.79
RodD2_114.9	68	2.918	0.055	597.0	1855.1	571.5	1.50	580.0	1474.0	108.82	22.47	20.65%	28.81
RodD2_117.4	69	2.982	0.118	600.5	1757.0	575.4	1.50	583.8	1462.8	104.89	21.70	20.68%	27.52
RodD2_120.8	70	3.068	0.204	605.5	1622.3	580.6	1.50	588.9	1447.8	97.70	20.24	20.72%	25.32
RodD2_124.8	71	3.170	0.306	609.6	1462.7	586.5	1.50	594.2	1432.7	94.91	19.85	20.91%	24.29
RodD2_128.6	72	3.266	0.403	611.7	1312.3	591.8	1.50	598.4	1420.8	98.96	21.13	21.35%	25.08
RodD6_103.1	129	2.619	0.371	586.0	2085.8	551.9	1.50	563.3	1525.9	91.83	18.43	20.07%	25.32
RodD6_106	130	2.692	0.445	589.5	2123.9	556.8	1.50	567.7	1511.7	97.50	19.62	20.13%	26.59
RodD6_112.9	131	2.868	0.004	599.5	1922.4	568.3	1.50	578.7	1478.0	92.34	18.86	20.42%	24.53
RodD6_114.9	132	2.918	0.055	605.5	1832.2	571.5	1.50	582.8	1465.6	80.85	16.52	20.43%	21.26
RodD6_116.8	133	2.967	0.103	611.3	1755.2	574.5	1.50	586.7	1454.1	71.49	14.57	20.38%	18.63
RodD6_120.9	134	3.071	0.207	617.5	1593.2	580.7	1.50	593.0	1436.1	65.08	13.29	20.42%	16.71
RodD6_124.8	135	3.170	0.306	622.3	1436.9	586.5	1.50	598.4	1420.8	60.19	12.35	20.52%	15.25
RodD6_128.7	136	3.269	0.405	624.6	1279.3	591.9	1.50	602.8	1408.7	58.69	12.16	20.72%	14.72

Table SC-3171-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±onic (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	482.1	1377.9	459.5	1.50	467.0	1909.0	91.37	19.03	20.83%	32.14
RodE2_54	74	1.372	0.178	492.0	1431.3	465.7	1.50	474.5	1873.0	81.42	16.67	20.48%	28.10
RodE2_56.9	75	1.445	0.251	497.6	1470.9	470.4	1.50	479.5	1849.4	81.15	16.56	20.41%	27.65
RodE2_59.9	76	1.521	0.328	503.7	1511.7	475.4	1.50	484.9	1824.8	80.20	16.31	20.33%	26.96
RodE2_66	77	1.676	0.483	511.3	1594.3	485.9	1.50	494.4	1782.9	94.16	19.31	20.51%	30.89
RodE2_69.8	78	1.773	-0.027	510.9	1644.3	492.5	1.50	498.7	1764.4	134.42	28.78	21.41%	43.61
RodE2_72.9	79	1.852	0.051	518.3	1686.0	498.0	1.50	504.8	1738.8	125.07	26.36	21.08%	39.95
RodE2_74.9	80	1.902	0.102	523.6	1713.8	501.6	1.50	508.9	1721.8	116.99	24.37	20.83%	36.97
RodB3_50.2	169	1.275	0.081	480.2	1368.6	459.6	1.50	466.5	1911.5	99.65	21.13	21.20%	35.10
RodB3_54.1	170	1.374	0.180	487.9	1420.9	465.8	1.50	473.2	1879.0	96.62	20.29	21.00%	33.46
RodB3_56.9	171	1.445	0.251	493.9	1458.9	470.4	1.50	478.3	1855.2	93.19	19.42	20.84%	31.86
RodB3_60.1	172	1.527	0.333	500.0	1502.8	475.8	1.50	483.8	1829.4	93.02	19.30	20.75%	31.35
RodB3_66.1	173	1.679	0.485	509.8	1582.8	486.1	1.50	494.0	1784.5	100.03	20.79	20.79%	32.85
RodB3_69.9	174	1.775	-0.025	510.2	1633.1	492.7	1.50	498.5	1764.9	140.27	30.46	21.72%	45.52
RodB3_73	175	1.854	0.054	517.6	1673.0	498.2	1.50	504.7	1739.2	129.64	27.68	21.35%	41.42
RodB3_75	176	1.905	0.105	523.3	1699.8	501.8	1.50	509.0	1721.7	118.67	24.96	21.04%	37.50
RodF3_50.1	89	1.273	0.079	485.0	1368.2	459.5	1.50	468.0	1904.3	80.52	16.65	20.68%	28.26
RodF3_54	90	1.372	0.178	494.8	1422.1	465.7	1.50	475.4	1868.6	73.24	14.95	20.42%	25.22
RodF3_57	91	1.448	0.254	500.5	1463.3	470.6	1.50	480.6	1844.4	73.31	14.92	20.35%	24.91
RodF3_60	92	1.524	0.330	505.8	1504.6	475.6	1.50	485.7	1821.2	74.81	15.21	20.33%	25.09
RodF3_66.1	93	1.679	0.485	512.3	1587.1	486.1	1.50	494.8	1780.8	90.57	18.59	20.53%	29.67
RodF3_70	94	1.778	-0.022	513.0	1639.5	492.9	1.50	499.6	1760.5	122.61	25.97	21.18%	39.68
RodF3_73	95	1.854	0.054	521.0	1680.4	498.2	1.50	505.8	1734.5	110.56	23.01	20.82%	35.22
RodF3_75	96	1.905	0.105	527.6	1708.1	501.8	1.50	510.4	1716.0	99.43	20.42	20.54%	31.31
RodE6_50.2	121	1.275	0.081	482.0	1369.2	459.6	1.50	467.1	1908.6	91.66	19.22	20.97%	32.23
RodE6_54.1	122	1.374	0.180	491.0	1421.4	465.8	1.50	474.2	1874.1	84.77	17.55	20.70%	29.28
RodE6_57	123	1.448	0.254	496.1	1460.2	470.6	1.50	479.1	1851.2	85.71	17.71	20.66%	29.23
RodE6_60.2	124	1.529	0.335	502.8	1502.5	475.9	1.50	484.9	1824.6	83.77	17.22	20.56%	28.15
RodE6_66.1	125	1.679	0.485	510.9	1579.7	486.1	1.50	494.3	1783.0	95.53	19.80	20.72%	31.34
RodE6_70	126	1.778	-0.022	510.1	1629.9	492.9	1.50	498.6	1764.5	142.10	31.01	21.82%	46.10
RodE6_73.1	127	1.857	0.056	518.2	1670.1	498.4	1.50	505.0	1737.9	126.61	27.00	21.32%	40.42
RodE6_75	128	1.905	0.105	524.0	1695.3	501.8	1.50	509.2	1720.7	114.36	24.00	20.99%	36.12

RBHT Steam Cooling Test SC-3173-A

Matrix test # 17

Test date – 3/25/2005

Steady state time window: 11340 - 12240 sec

Inlet flow: 0.90 m³/min (31.9 ft³/min)

Inlet steam temperature: 409 K (276 °F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 10.1 kW

Outlet steam temperature: 580 K (585 °F)

Bundle inlet Reynolds number: 3614

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

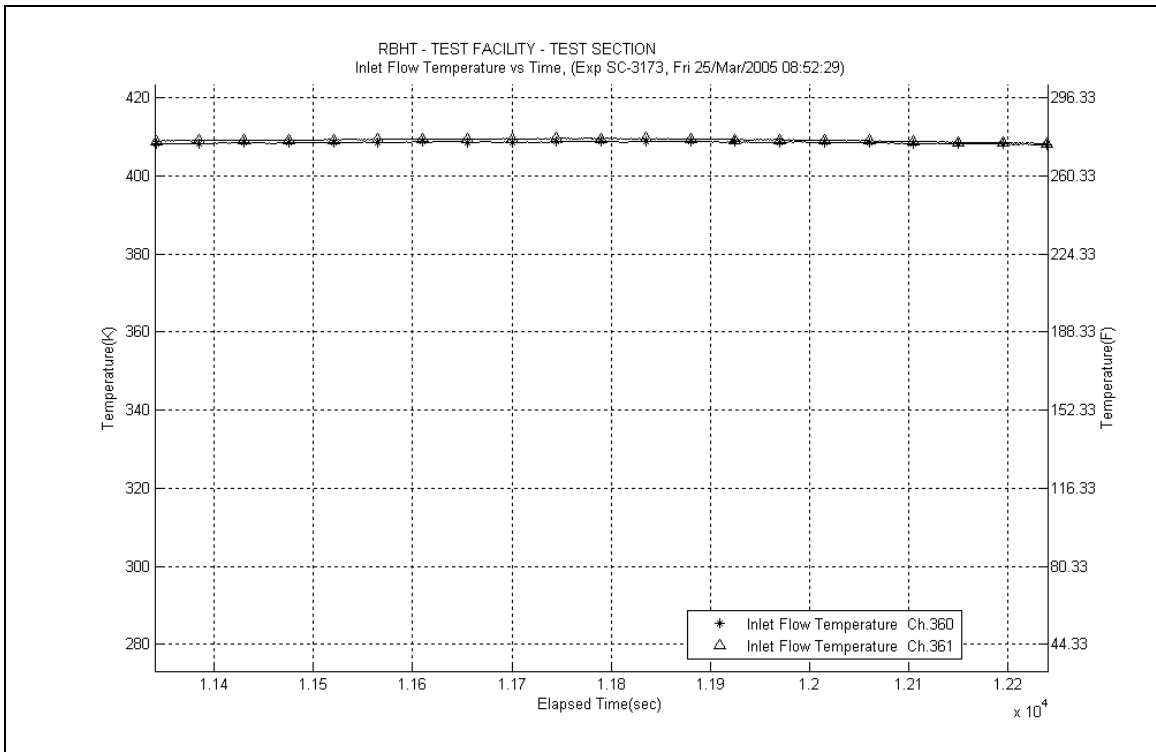
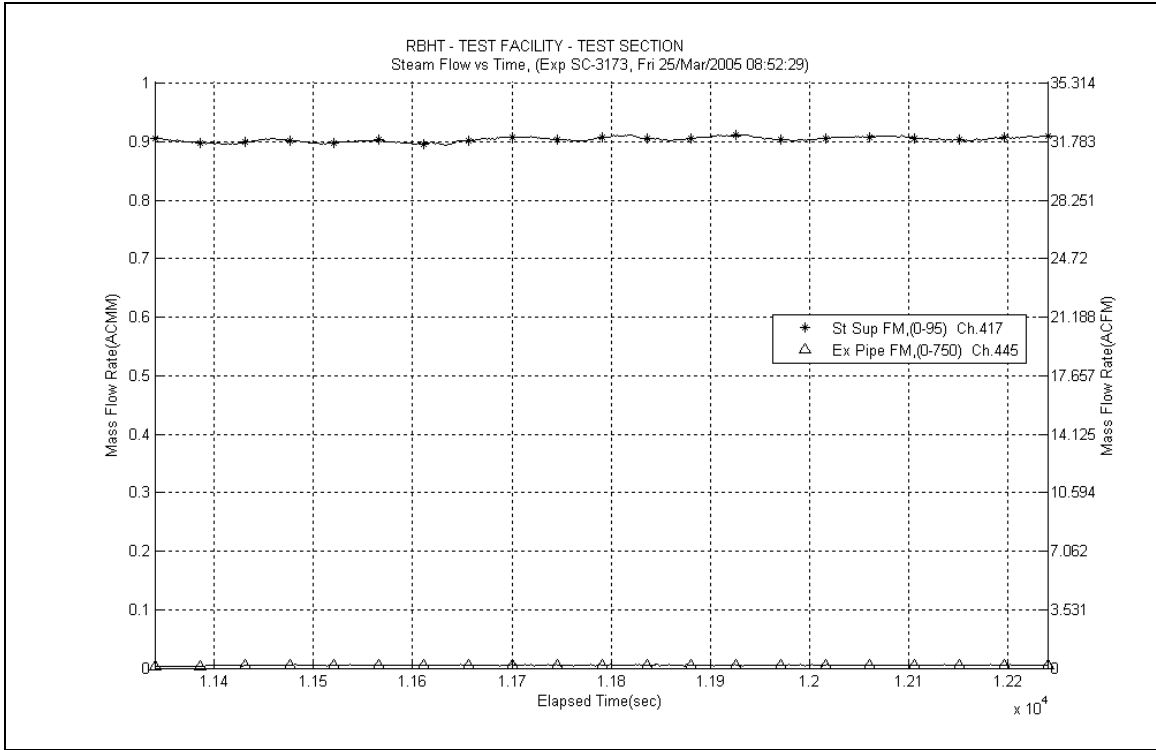
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

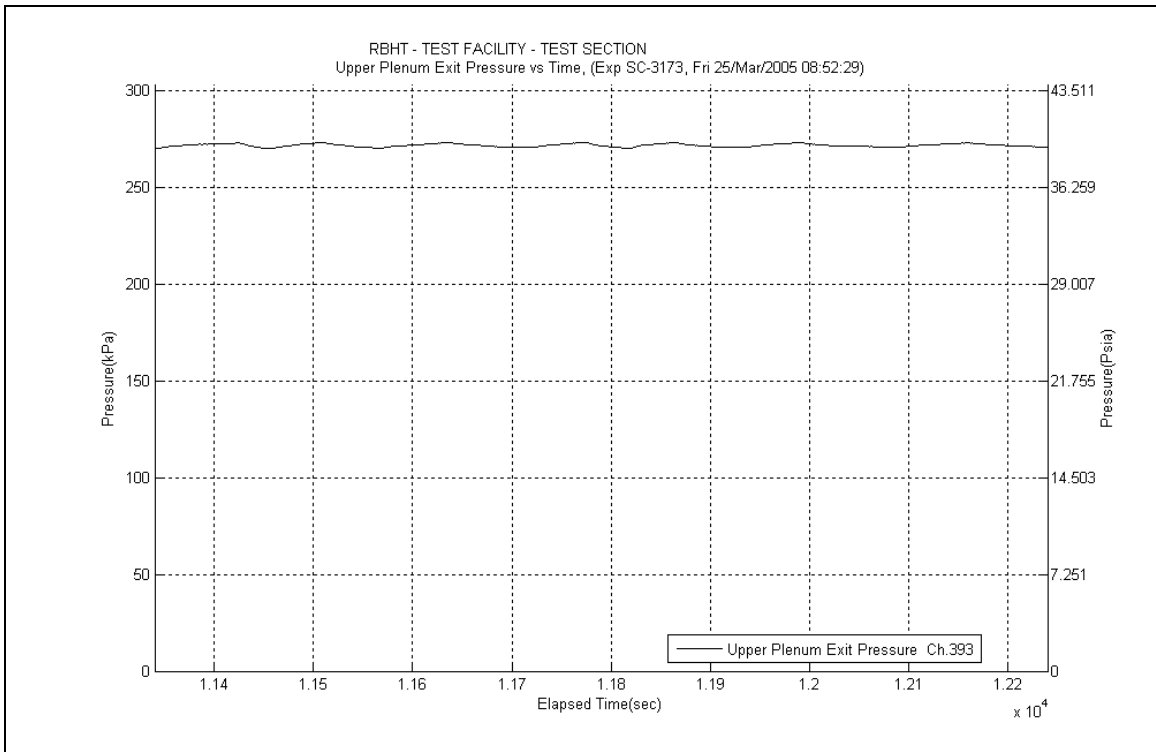
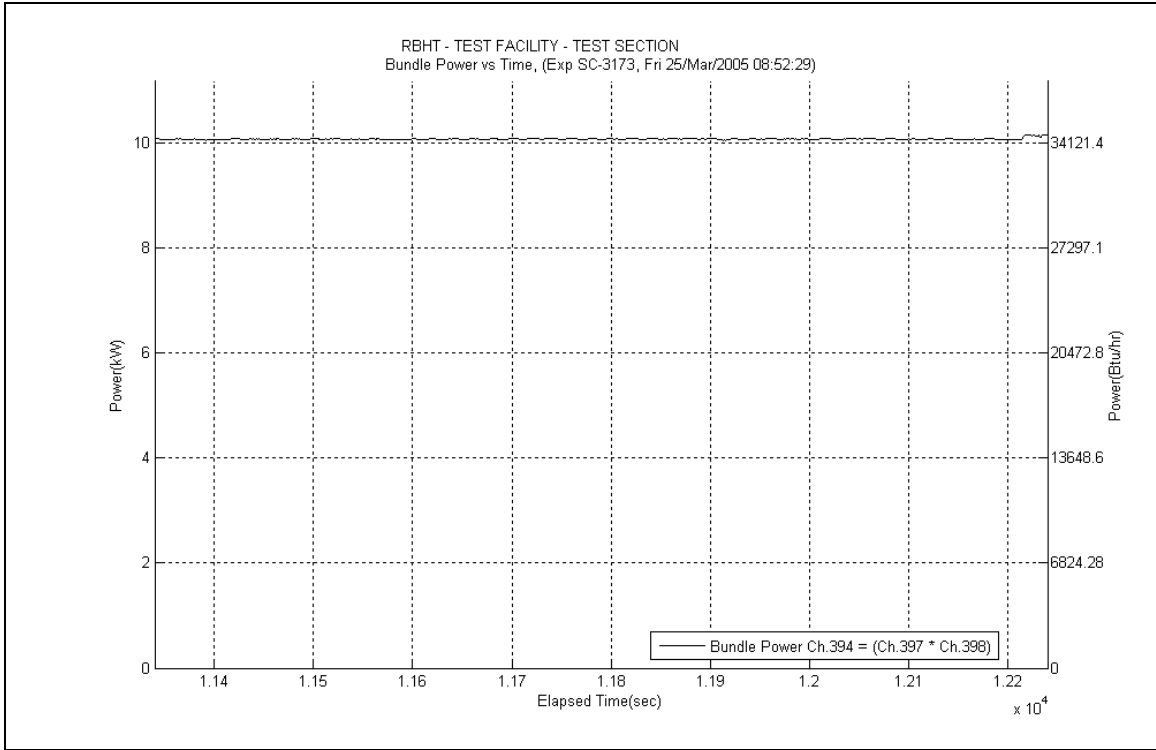
$$T_{cl} = -5.4909x^3 + 37.468x^2 - 16.632x + 420.07$$

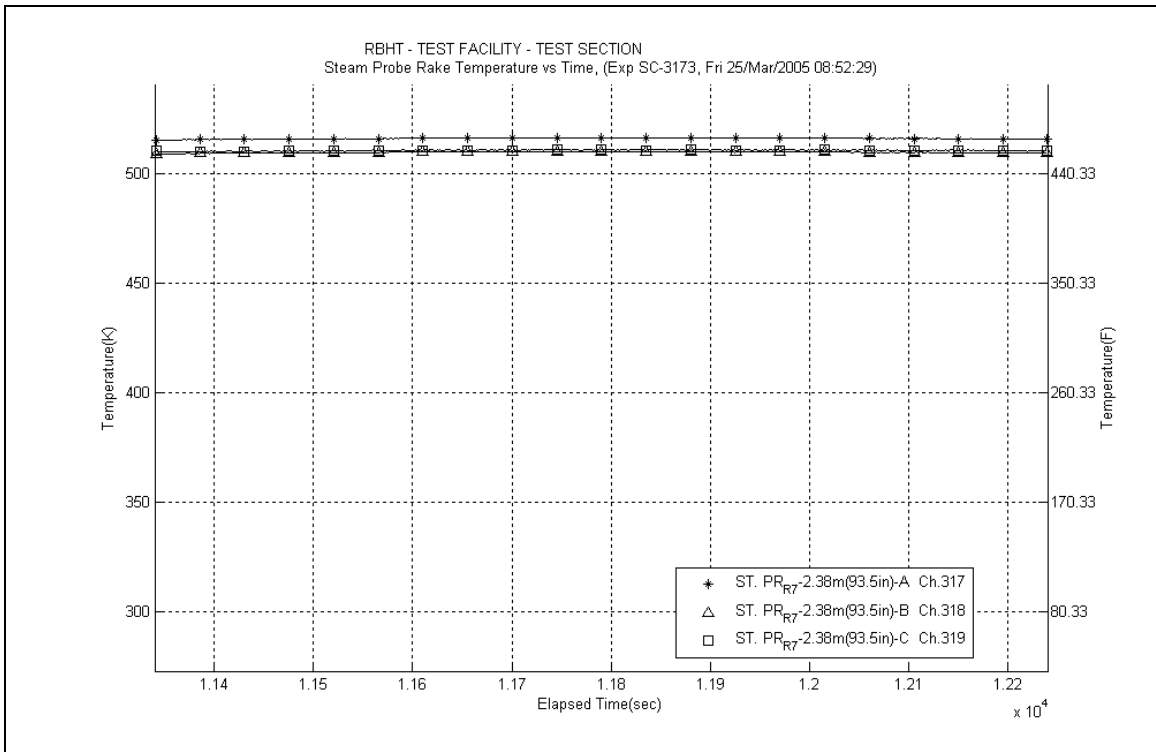
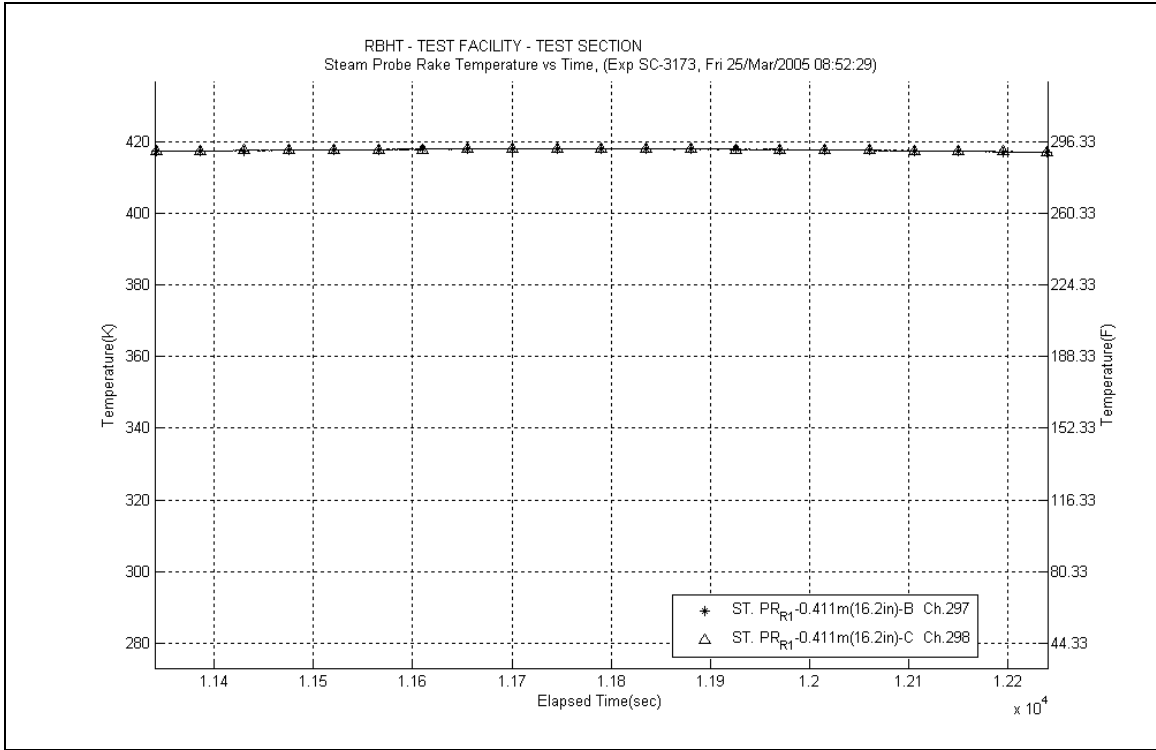
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

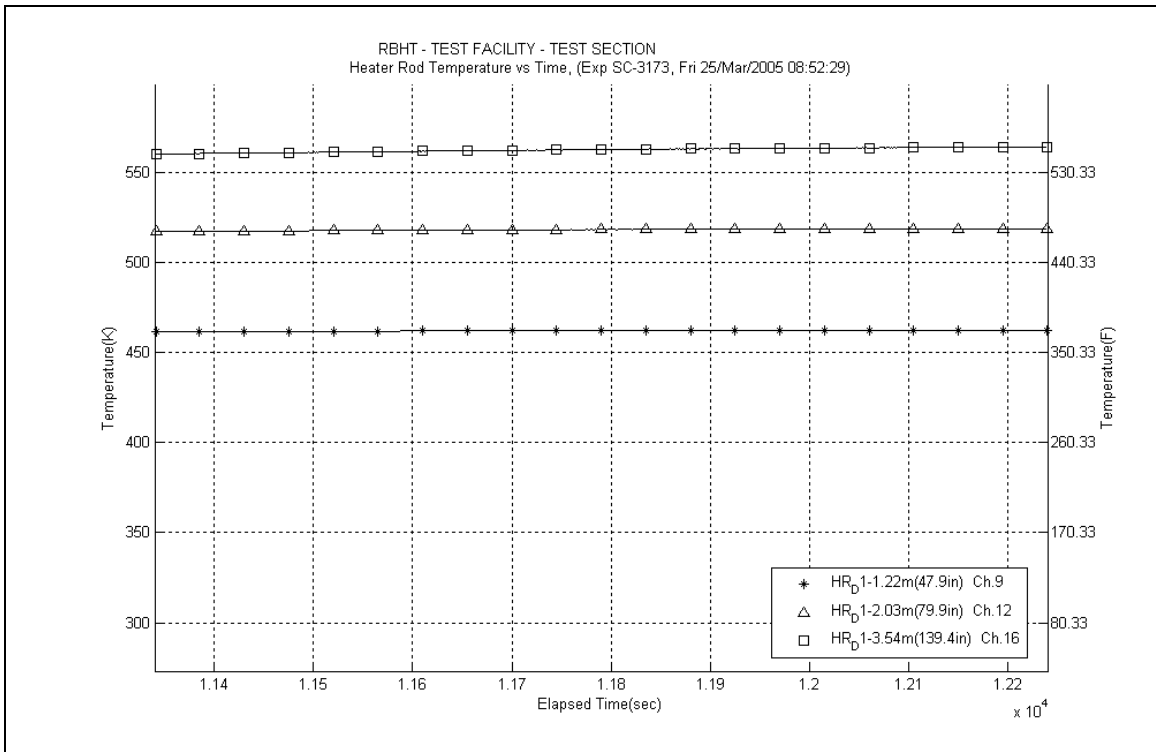
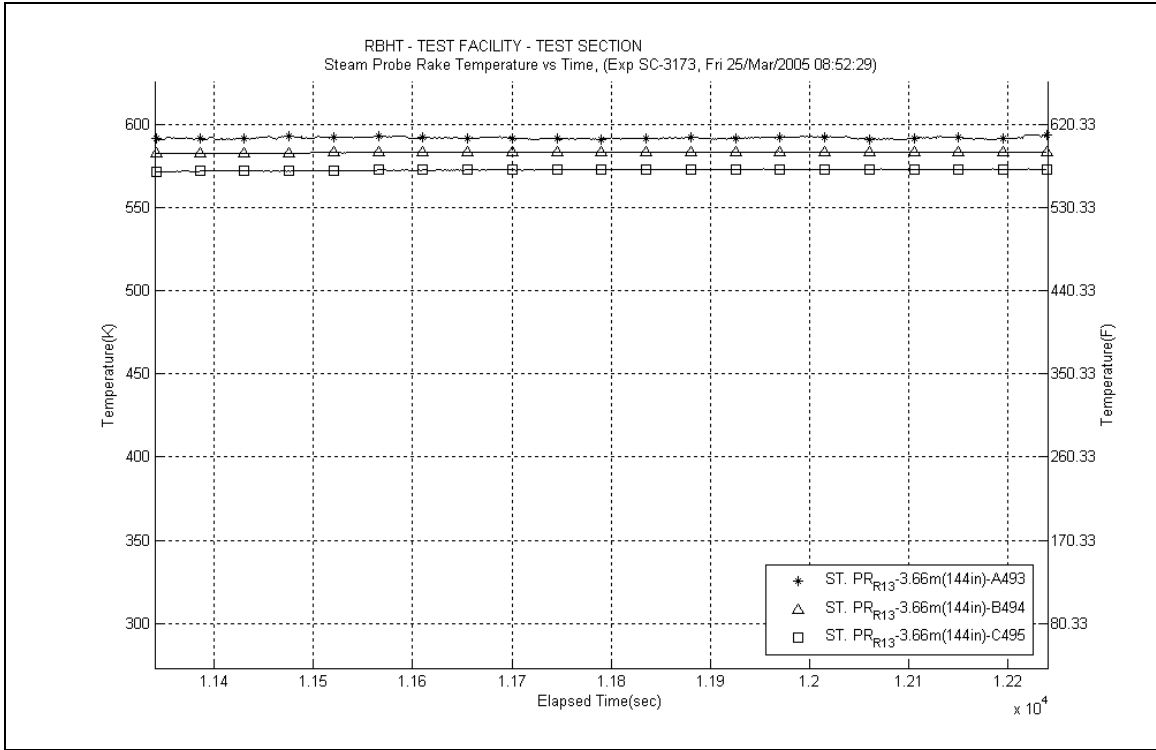
$$T_{cl} = -3.7844x^3 + 25.883x^2 - 0.3224x + 414.53$$

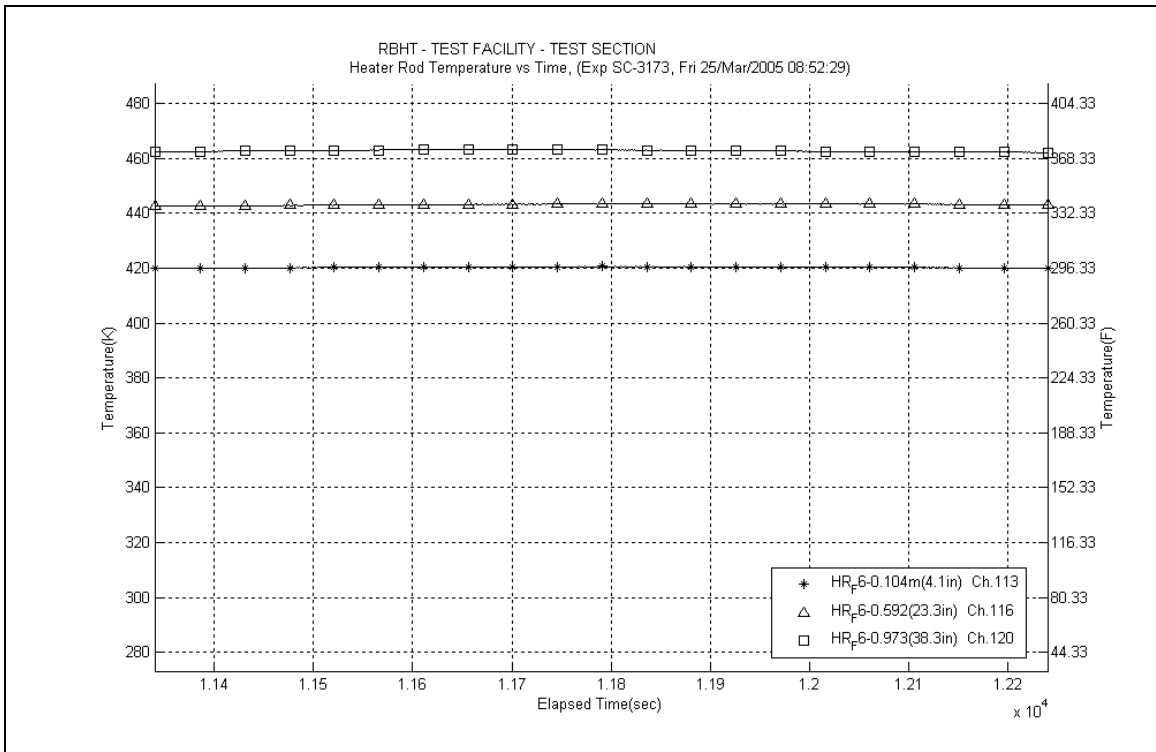
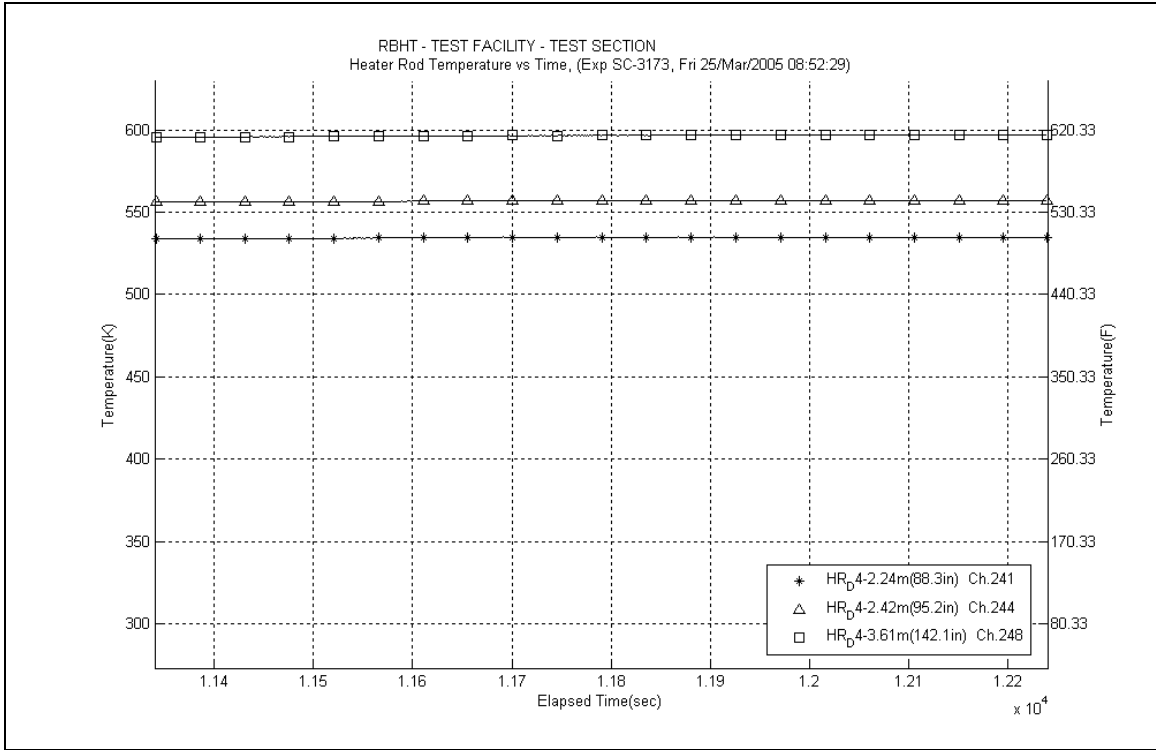
where x is the elevation (m) and T_{cl} is in (K)











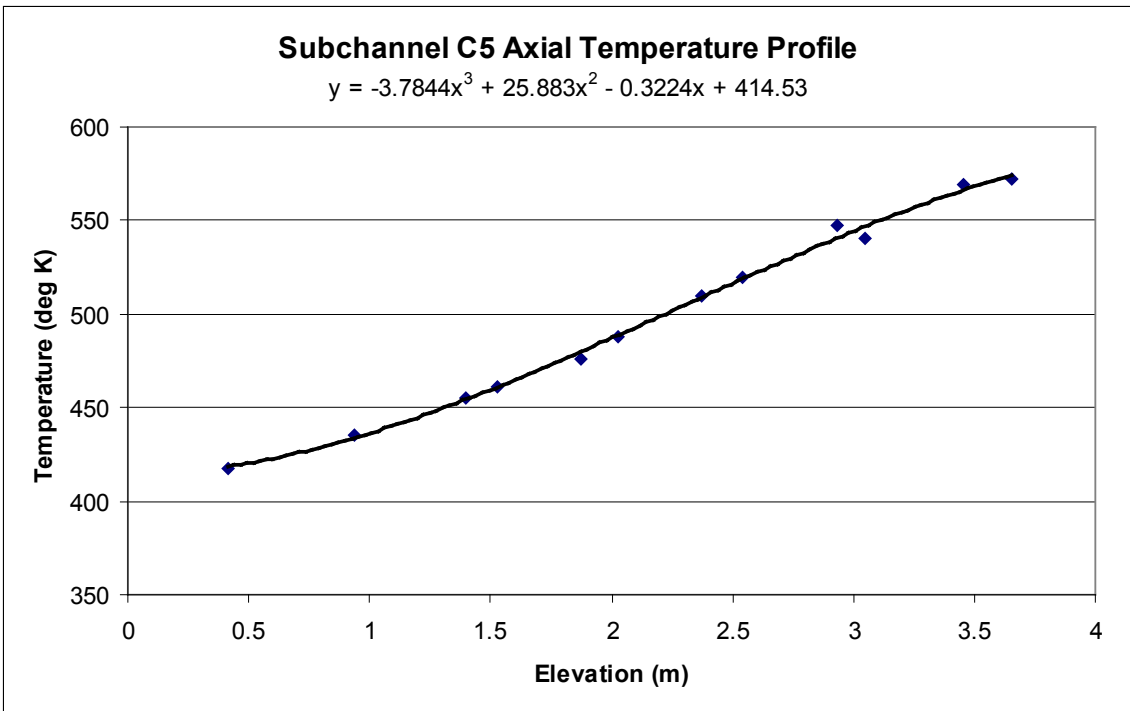
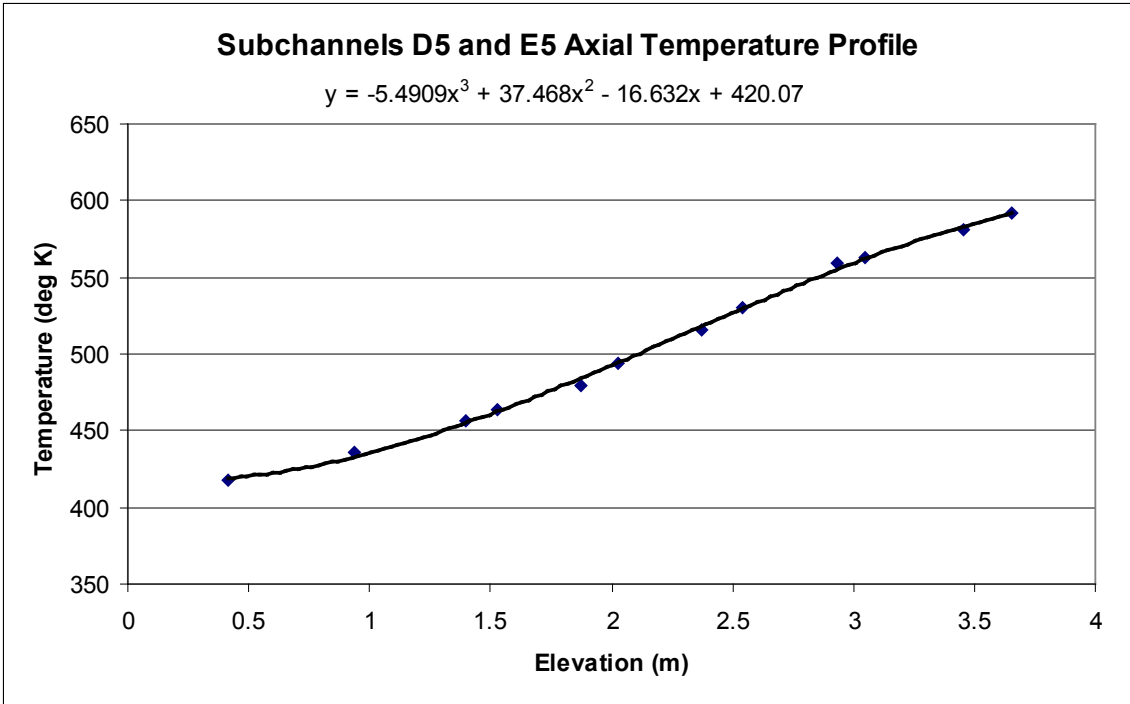


Table SC-3173-A.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	532.4	2688.0	509.5	1.27	514.2	3164	147.85	22.78	15.41%	46.09
RodD3_91.3	186	2.319	0.071	545.4	2744.4	514.5	1.27	521.1	3114	113.27	16.65	14.69%	34.70
RodD3_93.1	187	2.365	0.117	552.2	2779.0	517.7	1.27	525.0	3087	102.46	14.86	14.50%	31.08
RodD3_95.3	188	2.421	0.173	558.9	2820.7	521.5	1.27	529.5	3056	95.82	13.78	14.38%	28.74
RodD3_100.1	189	2.543	0.295	570.0	2913.5	529.7	1.27	538.4	2996	92.20	13.17	14.29%	27.05
RodD3_106.1	190	2.695	0.447	581.0	3028.1	539.9	1.27	548.7	2929	93.77	13.37	14.26%	26.81
RodD3_110	191	2.794	0.546	578.1	2990.5	546.3	1.27	553.1	2901	119.73	17.29	14.44%	33.85
RodD3_142.1	192	3.609	0.218	591.9	1033.6	590.0	1.27	590.4	2686	682.64	585.11	85.71%	176.31
RodC4_88.4	233	2.245	-0.003	530.2	2718.3	509.5	1.27	513.9	3167	166.77	26.16	15.69%	52.04
RodC4_91.1	234	2.314	0.066	541.4	2770.7	514.2	1.27	520.0	3122	129.55	19.23	14.84%	39.80
RodC4_93.4	235	2.372	0.124	548.3	2815.8	518.2	1.27	524.6	3090	118.93	17.38	14.61%	36.12
RodC4_95.3	236	2.421	0.173	554.5	2852.3	521.5	1.27	528.6	3062	109.76	15.85	14.44%	33.00
RodC4_100.1	237	2.543	0.295	566.2	2945.4	529.7	1.27	537.5	3001	102.90	14.70	14.29%	30.25
RodC4_106.1	238	2.695	0.447	575.8	3062.8	539.9	1.27	547.6	2936	108.67	15.54	14.30%	31.15
RodC4_110	239	2.794	0.546	572.3	2964.4	546.3	1.27	551.9	2909	145.49	21.80	14.98%	41.26
RodC4_142.2	240	3.612	0.221	595.3	1123.9	590.1	1.27	591.2	2682	270.95	91.40	33.73%	69.84
RodD4_88.3	241	2.243	-0.005	534.3	2706.6	509.3	1.27	514.6	3161	137.89	20.83	15.11%	42.95
RodD4_91.3	242	2.319	0.071	544.9	2764.1	514.5	1.27	521.0	3115	115.91	16.98	14.65%	35.52
RodD4_93.2	243	2.367	0.119	551.0	2800.6	517.8	1.27	524.9	3087	107.40	15.55	14.48%	32.59
RodD4_95.2	244	2.418	0.170	556.5	2839.7	521.3	1.27	528.8	3060	102.53	14.75	14.38%	30.80
RodD4_100.1	245	2.543	0.295	567.9	2933.9	529.7	1.27	537.9	2999	97.93	13.98	14.27%	28.76
RodD4_106.1	246	2.695	0.447	577.2	3048.8	539.9	1.27	547.9	2934	104.04	14.88	14.30%	29.80
RodD4_110	247	2.794	0.546	574.4	2945.2	546.3	1.27	552.3	2906	133.43	19.83	14.86%	37.80
RodD4_142.1	248	3.609	0.218	596.3	1086.0	590.0	1.27	591.3	2681	217.59	63.73	29.29%	56.07
RodE4_88.4	201	2.245	-0.003	532.2	2666.2	509.5	1.27	514.3	3164	149.58	23.29	15.57%	46.62
RodE4_91.2	202	2.316	0.069	543.1	2717.2	514.3	1.27	520.5	3119	120.05	17.93	14.94%	36.84
RodE4_95.3	204	2.421	0.173	556.6	2792.8	521.5	1.27	529.0	3059	101.29	14.78	14.59%	30.42
RodE4_100.9	205	2.563	0.315	567.8	2896.9	531.1	1.27	539.0	2992	100.51	14.60	14.53%	29.44
RodE4_142.3	208	3.614	0.224	594.3	1095.4	590.2	1.27	591.1	2682	333.59	137.97	41.36%	86.02
RodE3_63.4	193	1.610	0.417	504.0	2205.9	467.5	1.27	475.3	3477	77.04	11.16	14.48%	26.53
RodE3_113.6	194	2.885	0.022	579.8	2720.6	552.1	1.27	568.0	2871	125.13	18.75	14.98%	34.95
RodE3_115.5	195	2.934	0.070	585.0	2618.5	555.1	1.27	561.5	2850	111.44	16.49	14.80%	30.86
RodE3_118.5	196	3.010	0.146	590.6	2458.9	559.7	1.27	566.3	2821	101.32	14.89	14.69%	27.73
RodE3_122.7	197	3.117	0.253	595.2	2233.9	565.9	1.27	572.2	2787	97.12	14.32	14.74%	26.20
RodE3_126.5	198	3.213	0.349	596.4	2031.0	571.3	1.27	576.7	2761	103.06	15.51	15.05%	27.51
RodE3_131.7	199	3.345	-0.046	590.1	1754.2	578.2	1.27	580.7	2739	186.86	35.77	19.14%	49.39
RodE3_135.6	200	3.444	0.053	591.2	1543.5	582.9	1.27	584.7	2717	237.70	56.53	23.78%	62.23

Table SC-3173-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohic (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	503.1	2165.7	468.0	1.27	475.5	3476	78.45	11.59	14.78%	27.00
RodC5_113.6	226	2.885	0.022	572.8	2655.1	552.1	1.27	556.5	2880	163.58	26.39	16.13%	45.86
RodC5_115.7	227	2.939	0.075	580.1	2549.0	555.4	1.27	560.7	2855	131.31	20.36	15.50%	36.44
RodC5_122.7	229	3.117	0.253	591.6	2194.4	565.9	1.27	571.4	2791	108.81	16.60	15.25%	29.41
RodC5_126.7	230	3.218	0.354	593.1	1991.6	571.6	1.27	576.2	2764	117.58	18.44	15.69%	31.42
RodC5_131.6	231	3.343	-0.048	588.3	1743.4	578.0	1.27	580.2	2741	217.01	45.37	20.91%	57.43
RodC5_135.7	232	3.447	0.056	591.0	1533.6	583.0	1.27	584.7	2716	244.29	59.52	24.36%	63.95
RodE5_63.6	209	1.615	0.422	499.7	2223.0	467.8	1.27	474.6	3483	88.89	13.00	14.63%	30.66
RodE5_113.6	210	2.885	0.022	568.8	2739.5	552.1	1.27	555.7	2885	208.39	35.00	16.80%	58.54
RodE5_115.4	211	2.931	0.067	574.0	2645.1	555.0	1.27	559.0	2865	176.54	28.44	16.11%	49.19
RodE5_118.7	212	3.015	0.151	579.4	2470.8	560.0	1.27	564.2	2834	162.26	25.94	15.98%	44.65
RodE5_122.6	213	3.114	0.250	583.0	2264.9	565.8	1.27	569.5	2802	167.17	27.56	16.49%	45.40
RodE5_126.6	214	3.216	0.352	585.6	2054.2	571.4	1.27	574.5	2774	184.88	32.67	17.67%	49.61
RodE5_131.6	215	3.343	-0.048	583.0	1799.6	578.0	1.27	579.1	2748	460.39	162.33	35.26%	122.16
RodE5_135.6	216	3.444	0.053	584.8	1581.2	582.9	1.27	583.3	2724	1048.94	899.87	85.79%	275.52
RodC3_79.8	177	2.027	0.227	522.5	2510.1	494.6	1.27	500.5	3268	114.38	17.13	14.98%	36.93
RodC3_85.6	178	2.174	0.374	527.2	2620.1	504.6	1.27	509.4	3200	147.38	22.92	15.55%	46.52
RodC3_88.5	179	2.248	0.000	529.6	2675.1	509.6	1.27	513.9	3167	170.58	27.32	16.02%	53.23
RodC3_92.4	180	2.347	0.099	544.1	2748.2	516.4	1.27	522.4	3106	126.50	18.97	14.99%	38.64
RodC3_94.4	181	2.398	0.150	549.2	2786.3	519.9	1.27	526.2	3079	121.04	17.99	14.86%	36.61
RodC3_97.2	182	2.469	0.221	558.0	2838.9	524.8	1.27	531.9	3039	108.60	15.89	14.63%	32.38
RodC3_108.8	183	2.764	0.516	576.0	2993.7	544.4	1.27	551.1	2913	120.35	17.68	14.69%	34.19
RodD5_50	217	1.270	0.076	477.4	1959.2	448.1	1.27	454.4	3671	85.11	12.62	14.82%	30.90
RodD5_54.1	218	1.374	0.180	487.6	2037.1	453.7	1.27	461.0	3608	76.56	11.15	14.56%	27.35
RodD5_56.9	219	1.445	0.251	493.0	2089.7	457.7	1.27	465.3	3568	75.32	10.92	14.49%	26.61
RodD5_60	220	1.524	0.330	498.4	2148.2	462.3	1.27	470.0	3525	75.79	10.96	14.46%	26.45
RodD5_66.1	221	1.679	0.485	504.5	2263.7	471.8	1.27	478.8	3447	87.91	12.84	14.61%	30.01
RodD5_69.9	222	1.775	-0.025	499.3	2336.9	477.9	1.27	482.5	3415	139.03	21.82	15.70%	47.01
RodD5_72.9	223	1.852	0.051	510.2	2392.5	482.9	1.27	488.7	3363	111.35	16.67	14.97%	37.06
RodD5_74.9	224	1.902	0.102	516.9	2429.8	486.2	1.27	492.8	3330	100.84	14.85	14.73%	33.21

Table SC-3173-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	470.4	1781.7	438.0	1.27	444.9	3765.1	69.96	10.27	14.68%	26.01
RodB5_52.9	154	1.344	0.150	485.6	2007.5	451.6	1.27	458.9	3627.5	75.27	10.98	14.59%	27.02
RodB5_55	155	1.397	0.203	489.3	2047.7	454.3	1.27	461.8	3600.4	74.32	10.80	14.54%	26.49
RodB5_57.8	156	1.468	0.274	495.1	2101.0	457.9	1.27	465.8	3562.8	71.90	10.39	14.45%	25.37
RodB5_64	157	1.626	0.432	503.4	2219.6	466.1	1.27	474.1	3488.2	75.91	10.96	14.44%	26.22
RodB5_73.9	158	1.877	0.077	514.0	2408.2	480.1	1.27	487.3	3374.7	90.46	13.18	14.57%	30.21
RodB5_75.9	159	1.928	0.128	519.8	2446.1	483.0	1.27	490.9	3345.6	84.54	12.21	14.44%	27.98
RodB5_76.9	160	1.953	0.153	522.0	2465.2	484.4	1.27	492.5	3332.4	83.49	12.03	14.41%	27.52
RodF5_41	105	1.041	0.343	468.6	1772.4	438.0	1.27	444.5	3769.1	73.76	10.95	14.85%	27.44
RodF5_53.1	106	1.349	0.155	482.6	2000.1	451.9	1.27	458.5	3631.8	82.88	12.29	14.83%	29.79
RodF5_55	107	1.397	0.203	487.0	2036.3	454.3	1.27	461.3	3605.2	79.29	11.67	14.71%	28.30
RodF5_57.8	108	1.468	0.274	491.8	2089.7	457.9	1.27	465.1	3569.3	78.43	11.49	14.65%	27.72
RodF5_64	109	1.626	0.432	499.3	2207.6	466.1	1.27	473.2	3495.9	84.83	12.45	14.68%	29.37
RodF5_73.8	110	1.875	0.074	506.8	2394.5	479.9	1.27	485.7	3388.5	113.66	17.15	15.09%	38.12
RodF5_75.8	111	1.925	0.125	512.4	2432.6	482.8	1.27	489.2	3359.6	104.71	15.57	14.86%	34.81
RodF5_76.8	112	1.951	0.150	514.9	2451.4	484.3	1.27	490.9	3345.8	101.94	15.08	14.80%	33.74
RodC2_41	57	1.041	0.343	469.9	1777.4	438.0	1.27	444.8	3766.3	70.94	10.46	14.74%	26.38
RodC2_53.1	58	1.349	0.155	487.3	2007.2	451.9	1.27	459.5	3622.3	72.23	10.51	14.55%	25.89
RodC2_55	59	1.397	0.203	491.1	2043.7	454.3	1.27	462.2	3597.0	70.67	10.24	14.49%	25.16
RodC2_57.8	60	1.468	0.274	496.6	2097.5	457.9	1.27	466.2	3559.8	68.94	9.94	14.42%	24.30
RodC2_63.9	61	1.623	0.429	504.1	2214.3	466.0	1.27	474.2	3487.7	73.94	10.67	14.43%	25.54
RodC2_73.8	62	1.875	0.074	507.7	2402.9	479.9	1.27	485.9	3386.9	110.29	16.51	14.97%	36.97
RodC2_75.8	63	1.925	0.125	512.4	2440.7	482.8	1.27	489.2	3359.5	105.04	15.57	14.83%	34.91
RodC2_76.8	64	1.951	0.150	514.2	2459.3	484.3	1.27	490.7	3347.0	104.70	15.50	14.81%	34.67
RodC6_40.9	137	1.039	0.340	470.2	1766.2	437.9	1.27	444.8	3766.4	69.52	10.27	14.77%	25.85
RodC6_52.8	138	1.341	0.147	486.3	2004.7	451.5	1.27	459.0	3626.9	73.27	10.67	14.56%	26.30
RodC6_54.8	139	1.392	0.198	491.0	2045.3	454.0	1.27	461.9	3599.0	70.46	10.19	14.46%	25.10
RodC6_57.8	140	1.468	0.274	496.6	2104.7	457.9	1.27	466.2	3559.7	69.09	9.94	14.38%	24.36
RodC6_63.8	141	1.621	0.427	505.6	2225.1	465.9	1.27	474.4	3485.9	71.33	10.21	14.31%	24.63
RodC6_73.7	142	1.872	0.072	515.5	2420.8	479.8	1.27	487.4	3373.9	86.34	12.44	14.41%	28.83
RodC6_75.8	143	1.925	0.125	520.7	2462.4	482.8	1.27	490.9	3345.0	82.82	11.86	14.32%	27.41
RodC6_76.8	144	1.951	0.150	523.6	2482.4	484.3	1.27	492.7	3330.5	80.31	11.46	14.27%	26.45

Table SC-3173-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohic (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	528.9	2665.7	501.5	1.27	507.3	3215.9	123.65	18.60	15.04%	39.24
RodB4_91.3	162	2.319	0.071	541.1	2718.6	505.8	1.27	513.3	3171.0	98.02	14.29	14.58%	30.63
RodB4_93.3	163	2.370	0.122	547.6	2755.3	508.8	1.27	517.1	3143.6	90.35	13.06	14.45%	27.97
RodB4_95.1	164	2.416	0.168	552.8	2788.2	511.4	1.27	520.3	3120.3	85.72	12.33	14.38%	26.32
RodB4_100	165	2.540	0.292	561.9	2877.7	518.7	1.27	527.9	3066.4	84.68	12.15	14.35%	25.50
RodB4_106	166	2.692	0.445	571.0	2987.9	527.4	1.27	536.8	3006.5	87.20	12.51	14.35%	25.68
RodB4_109.9	167	2.791	0.544	567.9	2892.8	533.0	1.27	540.5	2982.0	105.59	15.51	14.69%	30.81
RodB4_142.3	168	3.614	0.224	587.2	1108.8	572.8	1.27	575.9	2765.8	98.05	17.52	17.87%	26.22
RodF4_85.6	98	2.174	-0.074	525.0	2628.5	497.3	1.27	503.2	3247.4	120.77	18.06	14.95%	38.73
RodF4_88.4	99	2.245	-0.003	526.7	2680.4	501.5	1.27	506.9	3219.6	135.33	20.56	15.19%	43.00
RodF4_92.4	100	2.347	0.099	541.9	2755.7	507.4	1.27	514.8	3160.2	101.81	14.81	14.54%	31.70
RodF4_94.3	101	2.395	0.147	548.0	2791.1	510.2	1.27	518.3	3134.5	94.09	13.56	14.42%	29.03
RodF4_97.2	102	2.469	0.221	555.8	2846.1	514.5	1.27	523.4	3098.4	87.89	12.58	14.31%	26.77
RodF4_108.8	103	2.764	0.516	571.2	3006.1	531.4	1.27	539.9	2985.3	96.19	13.76	14.31%	28.10
RodF4_111	104	2.819	-0.044	568.1	2883.7	534.5	1.27	541.7	2973.7	109.41	15.91	14.54%	31.82
RodD2_103.2	65	2.621	0.373	562.6	2973.7	523.4	1.27	531.8	3040.1	96.46	13.80	14.31%	28.77
RodD2_106	66	2.692	0.445	567.4	3027.1	527.4	1.27	536.0	3011.7	96.41	13.77	14.29%	28.45
RodD2_112.6	67	2.860	-0.004	565.0	2776.6	536.8	1.27	542.8	2966.4	125.05	18.67	14.93%	36.27
RodD2_114.9	68	2.918	0.055	572.1	2645.2	540.0	1.27	546.8	2940.6	104.86	15.41	14.69%	30.11
RodD2_117.4	69	2.982	0.118	575.3	2504.3	543.4	1.27	550.2	2919.3	99.82	14.68	14.71%	28.43
RodD2_120.8	70	3.068	0.204	579.0	2311.3	547.9	1.27	554.6	2892.1	94.50	13.96	14.77%	26.62
RodD2_124.8	71	3.170	0.306	581.7	2085.2	553.0	1.27	559.2	2863.8	92.70	13.86	14.95%	25.82
RodD2_128.6	72	3.266	0.403	582.0	1871.6	557.7	1.27	562.9	2841.2	98.12	15.09	15.38%	27.08
RodD6_103.1	129	2.619	0.371	565.9	2980.4	523.2	1.27	532.4	3036.1	88.89	12.61	14.18%	26.47
RodD6_106	130	2.692	0.445	569.0	3035.4	527.4	1.27	536.3	3009.4	92.99	13.22	14.21%	27.42
RodD6_112.9	131	2.868	0.004	564.2	2769.1	537.2	1.27	543.0	2965.5	130.62	19.60	15.00%	37.87
RodD6_114.9	132	2.918	0.055	570.4	2653.7	540.0	1.27	546.5	2942.9	110.93	16.37	14.75%	31.89
RodD6_116.8	133	2.967	0.103	575.5	2545.3	542.6	1.27	549.6	2923.1	98.46	14.40	14.62%	28.08
RodD6_120.9	134	3.071	0.207	580.0	2311.9	548.0	1.27	554.9	2890.2	92.02	13.52	14.69%	25.90
RodD6_124.8	135	3.170	0.306	583.7	2090.0	553.0	1.27	559.6	2861.2	86.71	12.82	14.78%	24.13
RodD6_128.7	136	3.269	0.405	585.0	1868.9	557.9	1.27	563.7	2836.8	87.67	13.21	15.07%	24.15

Table SC-3173-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	476.7	1965.3	448.2	1.27	454.3	3671.6	87.78	13.04	14.86%	31.88
RodE2_54	74	1.372	0.178	486.4	2040.6	453.0	1.27	460.2	3615.7	77.82	11.32	14.55%	27.85
RodE2_56.9	75	1.445	0.251	491.8	2096.6	456.7	1.27	464.2	3577.8	76.06	11.00	14.47%	26.94
RodE2_59.9	76	1.521	0.328	497.6	2154.4	460.6	1.27	468.5	3538.1	74.20	10.67	14.39%	26.00
RodE2_66	77	1.676	0.483	503.0	2271.8	468.9	1.27	476.2	3469.8	84.77	12.28	14.49%	29.13
RodE2_69.8	78	1.773	-0.027	496.8	2345.2	474.2	1.27	479.1	3444.9	132.17	20.43	15.46%	45.09
RodE2_72.9	79	1.852	0.051	506.3	2404.1	478.6	1.27	484.6	3397.9	110.54	16.46	14.89%	37.18
RodE2_74.9	80	1.902	0.102	511.2	2442.6	481.5	1.27	487.9	3370.2	104.83	15.45	14.73%	34.96
RodB3_50.2	169	1.275	0.081	473.9	1955.8	448.4	1.27	453.8	3676.4	97.28	14.77	15.18%	35.37
RodB3_54.1	170	1.374	0.180	480.4	2030.4	453.1	1.27	459.0	3627.0	94.94	14.26	15.02%	34.08
RodB3_56.9	171	1.445	0.251	485.2	2084.0	456.7	1.27	462.8	3591.0	93.19	13.90	14.91%	33.13
RodB3_60.1	172	1.527	0.333	489.9	2145.2	460.9	1.27	467.1	3551.2	94.14	14.00	14.87%	33.11
RodB3_66.1	173	1.679	0.485	499.0	2259.7	469.0	1.27	475.5	3476.3	95.91	14.19	14.79%	33.02
RodB3_69.9	174	1.775	-0.025	495.3	2331.9	474.4	1.27	478.9	3446.7	141.44	22.33	15.78%	48.27
RodB3_73	175	1.854	0.054	504.9	2390.7	478.8	1.27	484.4	3399.6	116.74	17.63	15.10%	39.28
RodB3_75	176	1.905	0.105	510.3	2428.7	481.7	1.27	487.8	3370.8	107.96	16.06	14.88%	36.01
RodF3_50.1	89	1.273	0.079	479.0	1952.5	448.2	1.27	454.8	3666.8	80.77	11.94	14.78%	29.30
RodF3_54	90	1.372	0.178	488.6	2028.2	453.0	1.27	460.6	3611.3	72.57	10.54	14.52%	25.94
RodF3_57	91	1.448	0.254	494.3	2086.7	456.8	1.27	464.9	3571.8	70.80	10.22	14.44%	25.04
RodF3_60	92	1.524	0.330	499.6	2145.2	460.8	1.27	469.1	3533.1	70.19	10.09	14.38%	24.56
RodF3_66.1	93	1.679	0.485	502.8	2264.1	469.0	1.27	476.3	3469.3	85.41	12.44	14.56%	29.35
RodF3_70	94	1.778	-0.022	498.3	2341.0	474.5	1.27	479.6	3440.2	125.15	19.18	15.33%	42.63
RodF3_73	95	1.854	0.054	507.7	2398.3	478.8	1.27	485.0	3394.4	105.53	15.64	14.82%	35.46
RodF3_75	96	1.905	0.105	514.1	2436.9	481.7	1.27	488.6	3364.2	95.75	13.98	14.60%	31.87
RodE6_50.2	121	1.275	0.081	473.9	1956.4	448.4	1.27	453.8	3676.6	97.62	14.83	15.19%	35.50
RodE6_54.1	122	1.374	0.180	481.9	2030.7	453.1	1.27	459.3	3623.8	89.70	13.36	14.89%	32.17
RodE6_57	123	1.448	0.254	486.4	2085.7	456.8	1.27	463.2	3587.5	89.78	13.32	14.83%	31.89
RodE6_60.2	124	1.529	0.335	492.2	2146.0	461.0	1.27	467.7	3545.8	87.72	12.92	14.73%	30.80
RodE6_66.1	125	1.679	0.485	498.4	2257.1	469.0	1.27	475.3	3477.5	97.85	14.53	14.85%	33.70
RodE6_70	126	1.778	-0.022	494.1	2330.1	474.5	1.27	478.7	3448.0	151.23	24.32	16.08%	51.64
RodE6_73.1	127	1.857	0.056	503.5	2388.0	478.9	1.27	484.2	3401.0	123.54	18.88	15.28%	41.59
RodE6_75	128	1.905	0.105	509.2	2424.9	481.7	1.27	487.6	3372.7	111.99	16.78	14.98%	37.38

RBHT Steam Cooling Test SC-3178-A

Matrix test # 10

Test date – 3/31/2005

Steady state time window: 17100 - 18400 sec

Inlet flow: 0.94 m³/min (33.0 ft³/min)

Inlet steam temperature: 389 K (240 °F)

Upper plenum pressure: 133.8 kPa (19.4 psia)

Bundle power: 13.9 kW

Outlet steam temperature: 835 K (1044 °F)

Bundle inlet Reynolds number: 2019

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

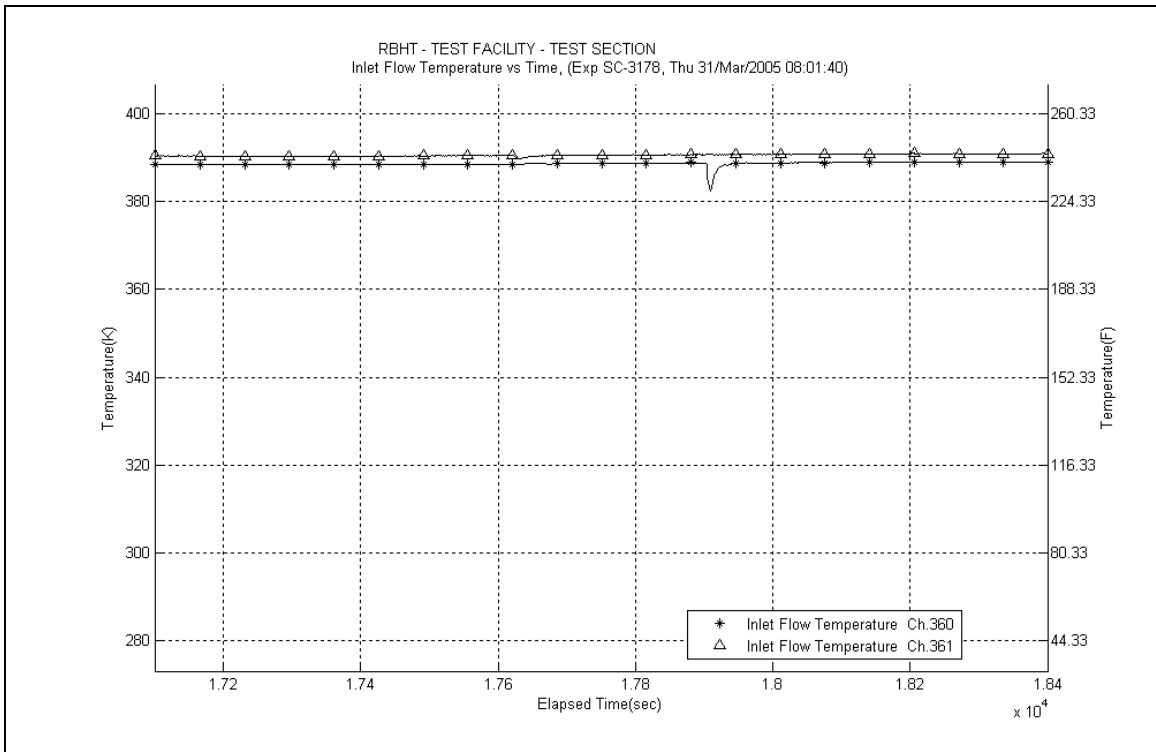
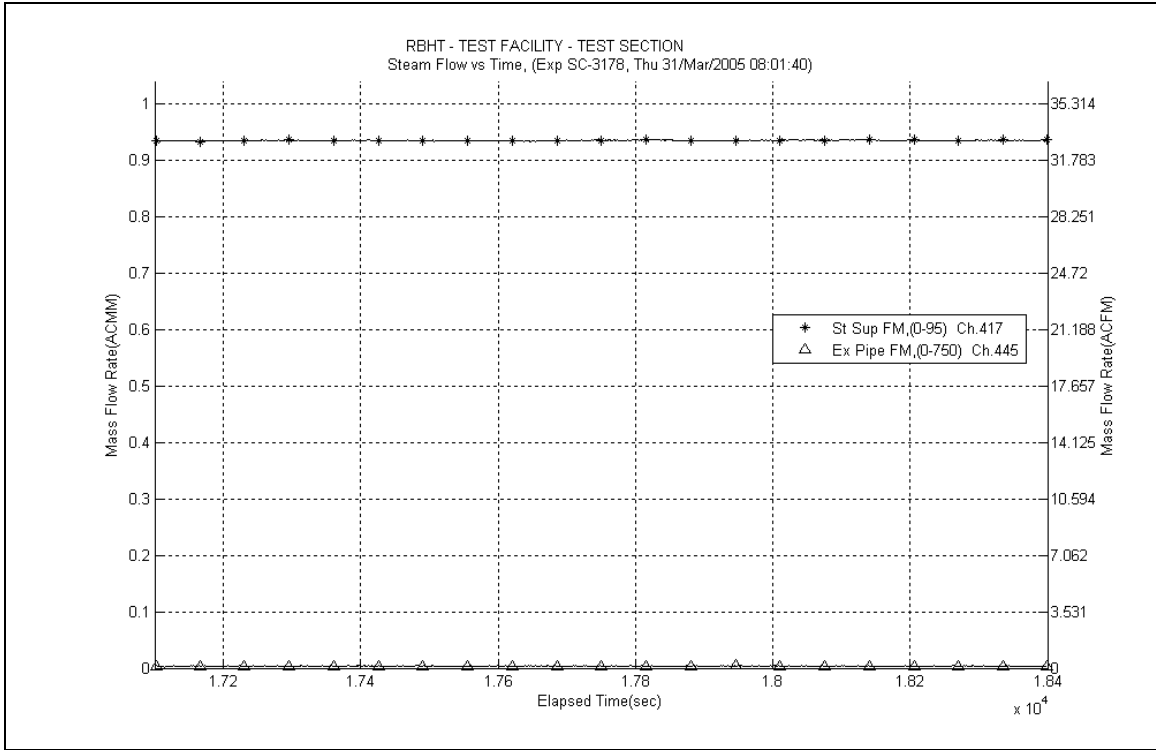
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

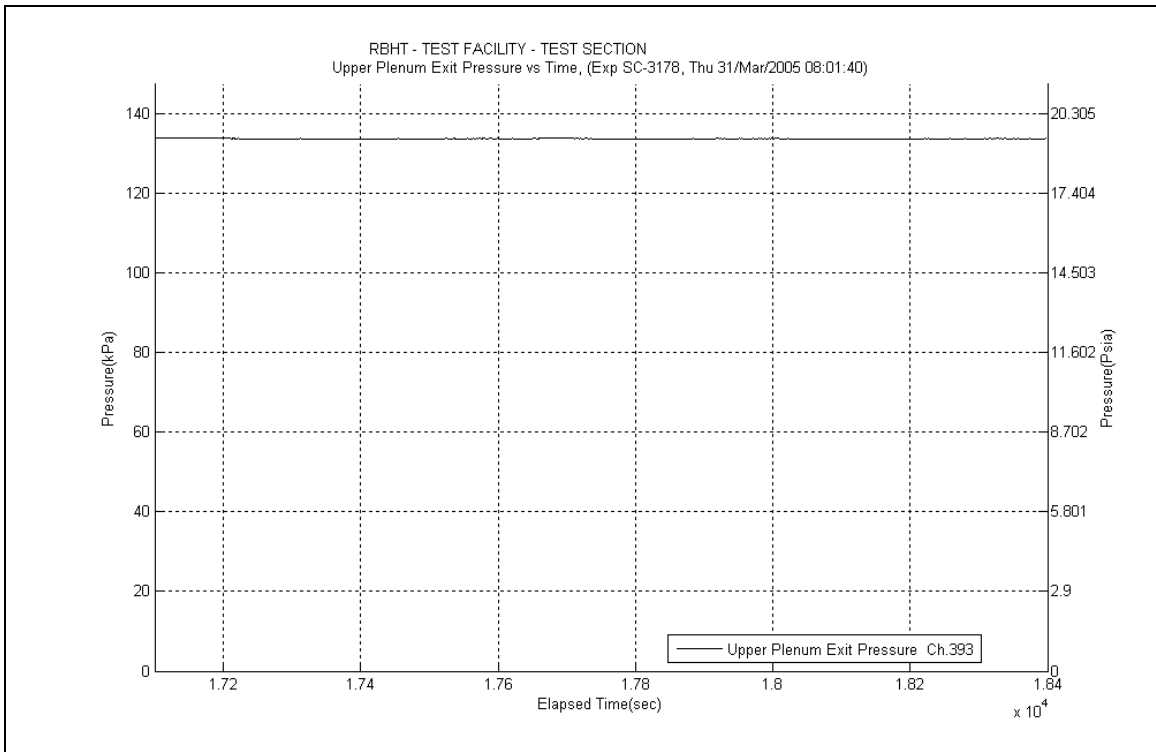
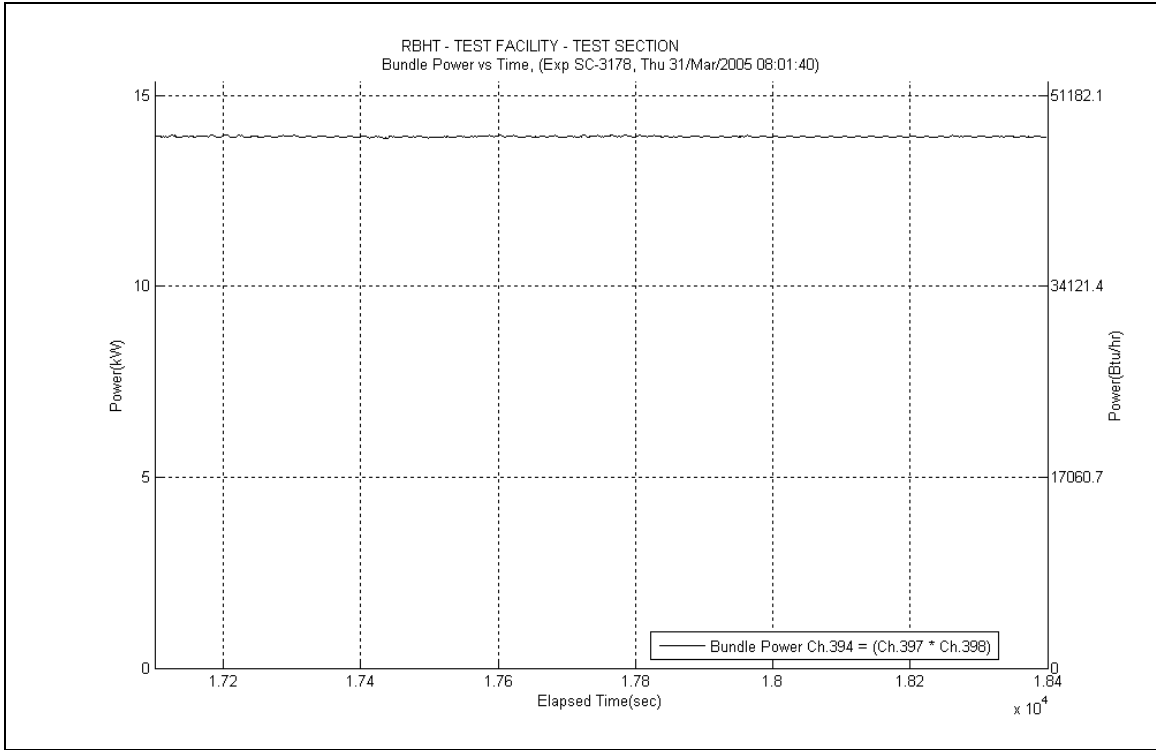
$$T_{cl} = -17.396x^3 + 100.73x^2 - 16.897x + 410.81$$

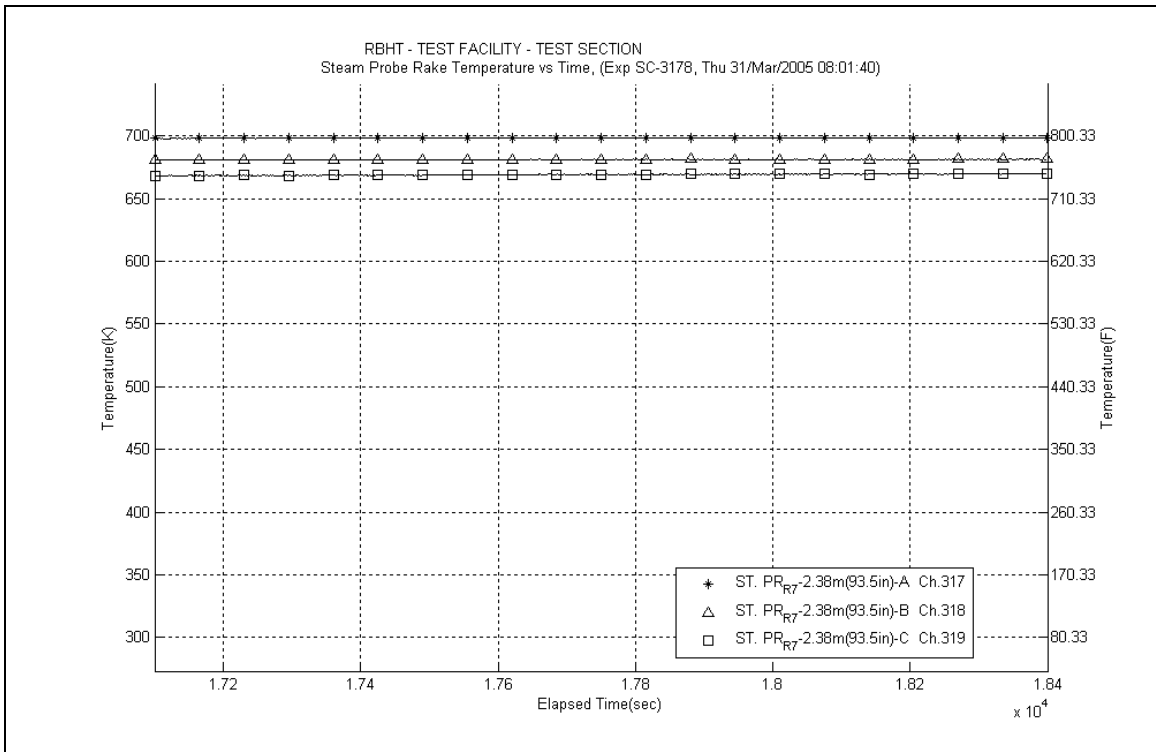
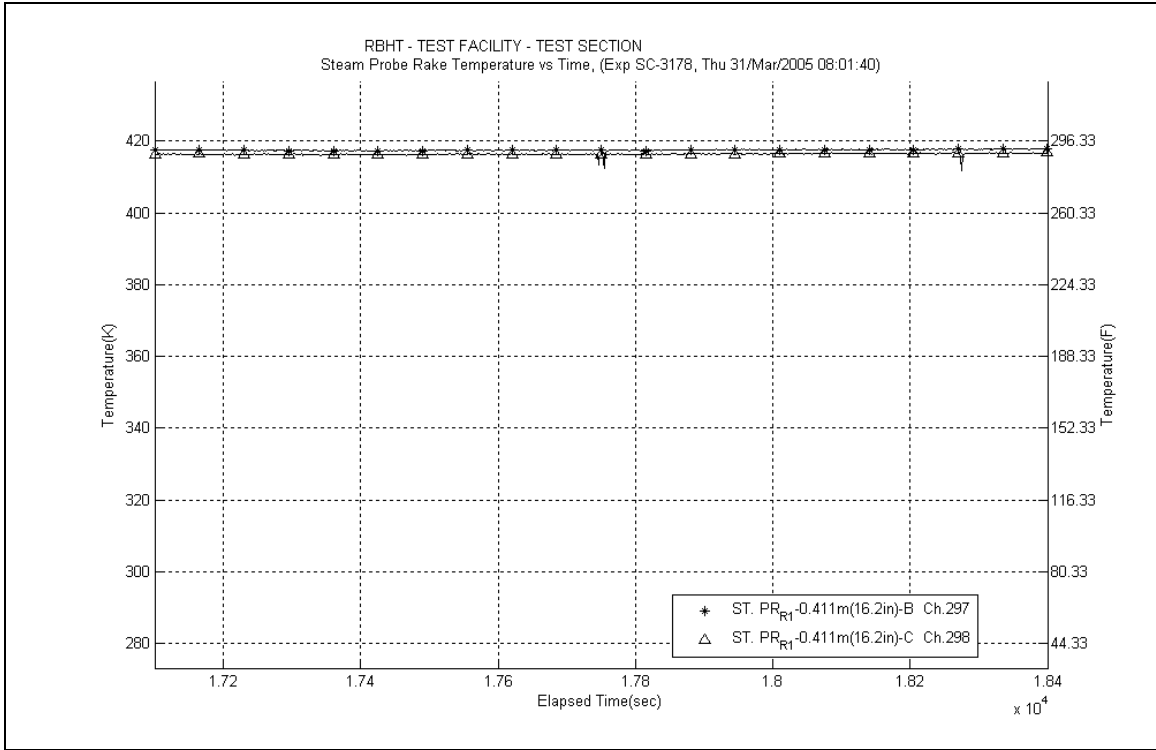
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

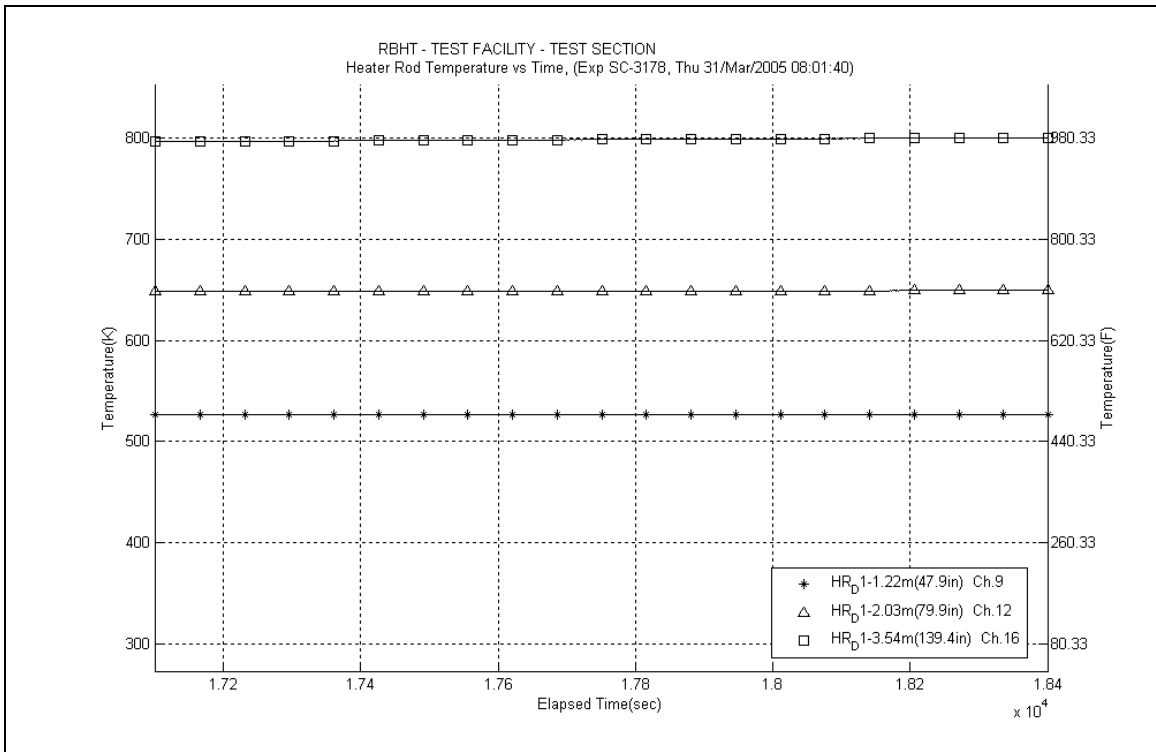
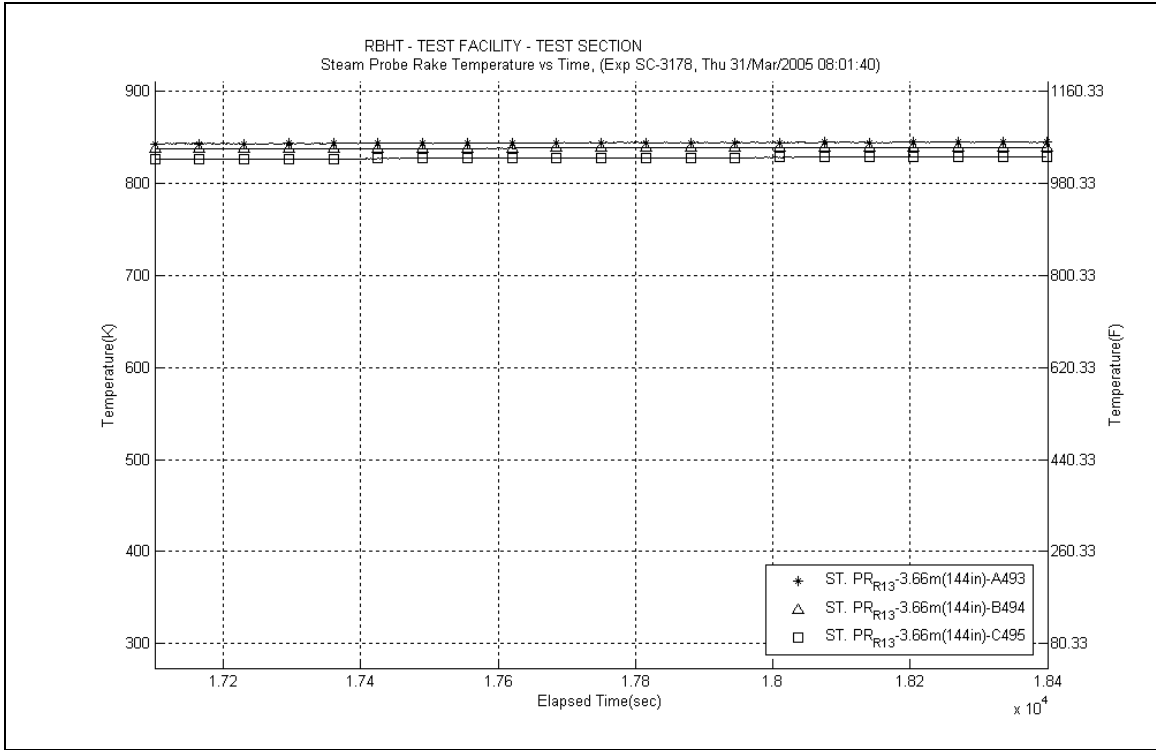
$$T_{cl} = -11.39x^3 + 66.36x^2 + 28.17x + 395.56$$

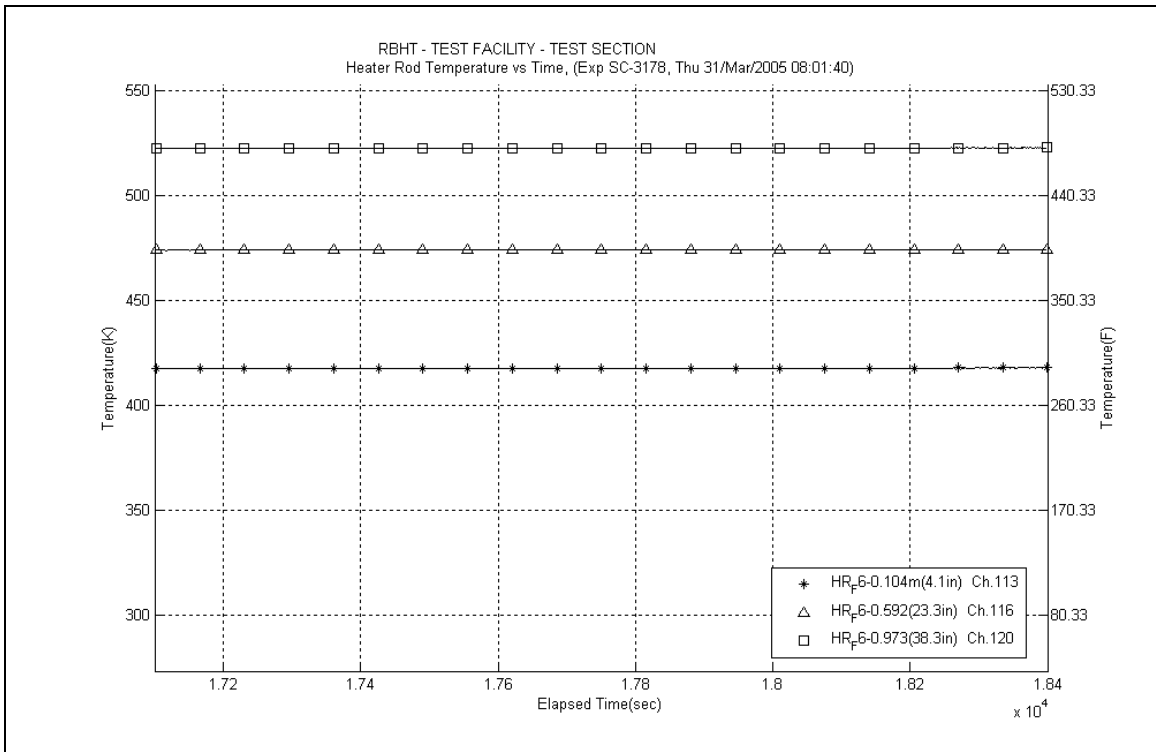
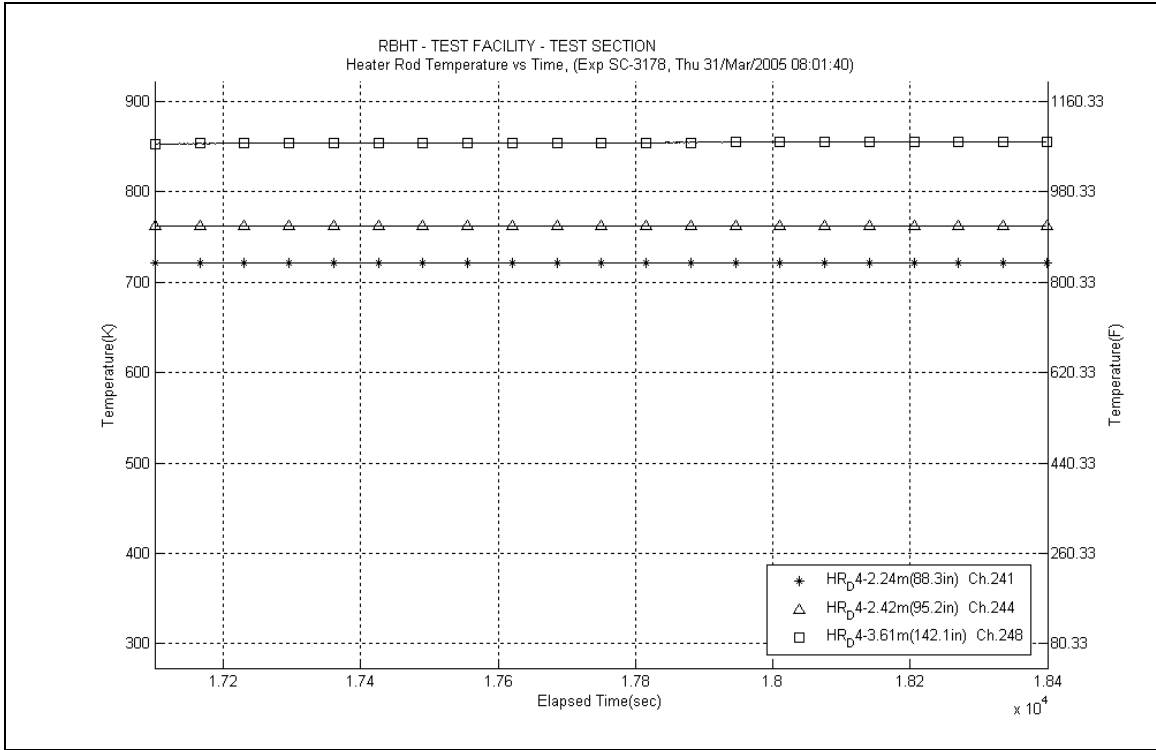
where x is the elevation (m) and T_{cl} is in (K)











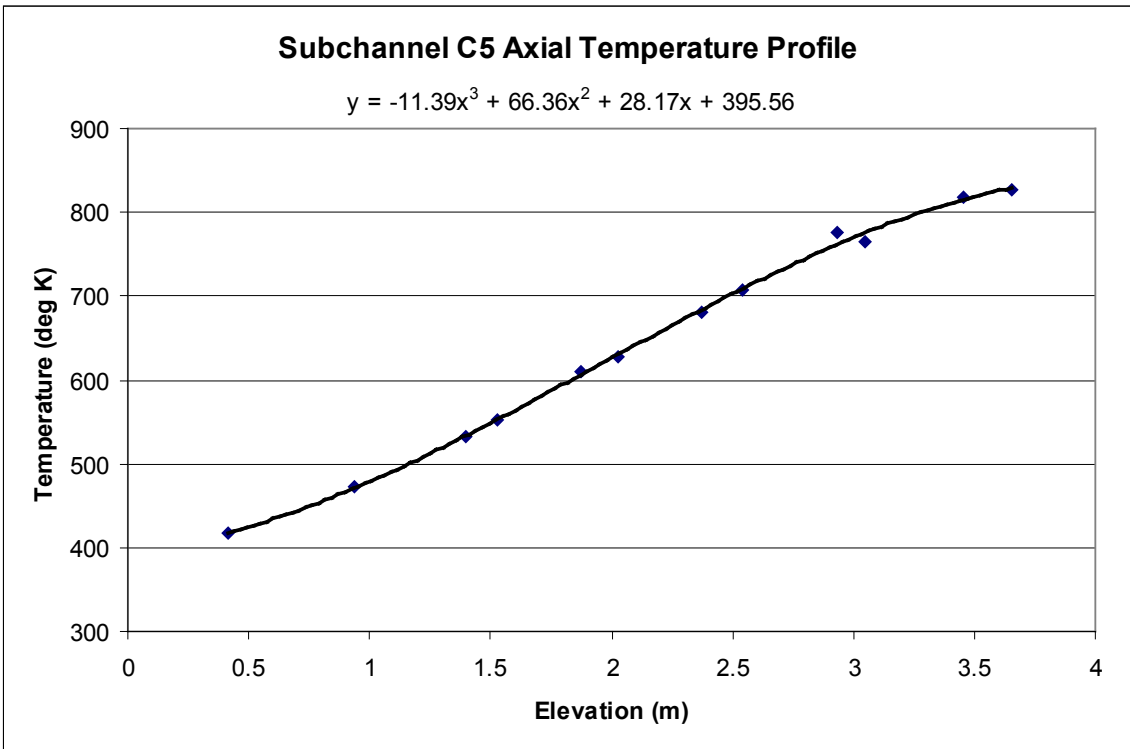
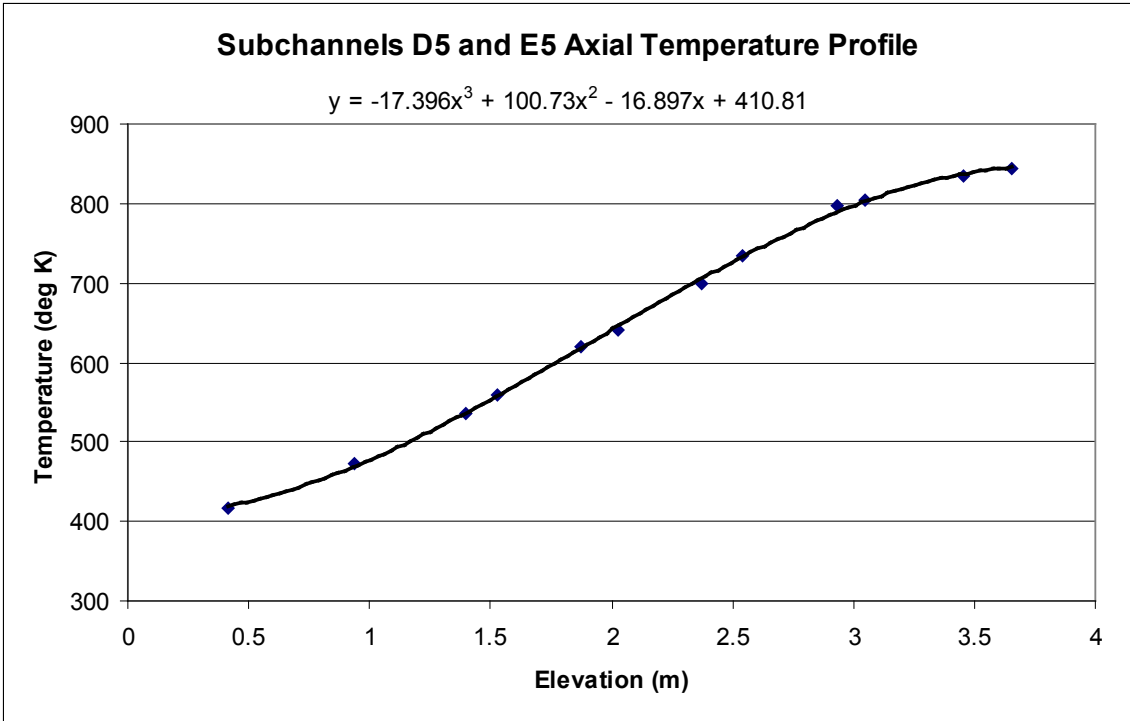


Table SC-3178-A.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohic (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	713.0	3721.3	683.3	1.50	693.2	1182	188.36	23.99	12.73%	38.76
RodD3_91.3	186	2.319	0.071	732.4	3799.9	696.4	1.50	708.4	1153	158.19	19.51	12.33%	31.54
RodD3_93.1	187	2.365	0.117	745.0	3847.4	704.1	1.50	717.7	1136	141.16	17.13	12.14%	27.62
RodD3_95.3	188	2.421	0.173	759.5	3905.6	713.4	1.50	728.8	1117	126.93	15.22	11.99%	24.29
RodD3_100.1	189	2.543	0.295	783.0	4031.5	733.1	1.50	749.7	1082	121.18	14.43	11.91%	22.25
RodD3_106.1	190	2.695	0.447	800.8	4187.8	756.3	1.50	771.2	1048	141.15	16.98	12.03%	24.88
RodD3_110	191	2.794	0.546	805.6	4135.9	770.5	1.50	782.2	1032	176.97	21.70	12.26%	30.56
RodD3_142.1	192	3.609	0.218	847.3	1427.5	844.1	1.50	845.2	948	670.77	357.16	53.25%	103.52
RodC4_88.4	233	2.245	-0.003	714.0	3765.4	683.8	1.50	693.9	1180	186.64	23.53	12.61%	38.35
RodC4_91.1	234	2.314	0.066	731.9	3837.7	695.5	1.50	707.6	1154	158.12	19.35	12.23%	31.58
RodC4_93.4	235	2.372	0.124	745.4	3899.5	705.4	1.50	718.7	1134	146.07	17.65	12.09%	28.52
RodC4_95.3	236	2.421	0.173	757.2	3950.2	713.4	1.50	728.0	1118	135.17	16.18	11.97%	25.91
RodC4_100.1	237	2.543	0.295	782.1	4076.9	733.1	1.50	749.4	1082	124.68	14.77	11.85%	22.91
RodC4_106.1	238	2.695	0.447	798.3	4238.9	756.3	1.50	770.3	1050	151.45	18.20	12.02%	26.74
RodC4_110	239	2.794	0.546	801.0	4102.6	770.5	1.50	780.7	1034	201.92	25.46	12.61%	34.96
RodC4_142.2	240	3.612	0.221	850.1	1549.9	844.2	1.50	846.2	947	388.63	116.39	29.95%	59.87
RodD4_88.3	241	2.243	-0.005	720.9	3751.9	683.3	1.50	695.8	1176	149.92	18.30	12.21%	30.68
RodD4_91.3	242	2.319	0.071	738.0	3831.7	696.4	1.50	710.2	1150	138.14	16.65	12.06%	27.44
RodD4_93.2	243	2.367	0.119	749.8	3882.0	704.5	1.50	719.6	1133	128.62	15.37	11.95%	25.07
RodD4_95.2	244	2.418	0.170	761.8	3935.7	713.0	1.50	729.2	1116	120.81	14.34	11.87%	23.09
RodD4_100.1	245	2.543	0.295	787.1	4064.3	733.1	1.50	751.1	1080	112.93	13.31	11.79%	20.68
RodD4_106.1	246	2.695	0.447	804.1	4223.5	756.3	1.50	772.3	1047	132.78	15.79	11.90%	23.35
RodD4_110	247	2.794	0.546	807.7	4079.4	770.5	1.50	782.9	1031	164.64	20.18	12.26%	28.39
RodD4_142.1	248	3.609	0.218	854.0	1500.4	844.1	1.50	847.4	946	227.63	46.58	20.46%	35.00
RodE4_88.4	201	2.245	-0.003	718.1	3696.4	683.8	1.50	695.2	1178	161.76	20.18	12.47%	33.15
RodE4_91.2	202	2.316	0.069	732.5	3767.1	695.9	1.50	708.1	1153	154.51	19.10	12.36%	30.83
RodE4_95.3	204	2.421	0.173	756.1	3871.5	713.4	1.50	727.6	1119	135.97	16.51	12.14%	26.08
RodE4_100.9	205	2.563	0.315	779.6	4013.3	736.3	1.50	750.7	1080	139.05	16.87	12.13%	25.49
RodE4_142.3	208	3.614	0.224	850.4	1515.4	844.2	1.50	846.3	947	370.53	108.82	29.37%	57.07
RodE3_63.4	193	1.610	0.417	625.2	3061.9	572.2	1.50	589.8	1424	86.67	10.28	11.87%	22.51
RodE3_113.6	194	2.885	0.022	815.3	3766.2	782.8	1.50	793.6	1016	173.77	21.83	12.56%	29.38
RodE3_115.5	195	2.934	0.070	821.9	3626.3	788.9	1.50	799.9	1007	164.79	20.63	12.52%	27.54
RodE3_118.5	196	3.010	0.146	830.0	3403.9	798.1	1.50	808.8	995	160.38	20.16	12.57%	26.38
RodE3_122.7	197	3.117	0.253	836.6	3092.2	809.9	1.50	818.8	982	174.08	22.61	12.99%	28.13
RodE3_126.5	198	3.213	0.349	839.7	2811.0	819.4	1.50	826.2	972	206.99	28.92	13.97%	33.01
RodE3_131.7	199	3.345	-0.046	842.3	2426.3	830.3	1.50	834.3	962	302.70	53.88	17.80%	47.60
RodE3_135.6	200	3.444	0.053	844.1	2135.7	836.8	1.50	839.2	956	438.00	110.61	25.25%	68.29

Table SC-3178-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	624.1	3002.2	573.5	1.50	590.3	1422	88.96	10.74	12.07%	23.08
RodC5_113.6	226	2.885	0.022	809.4	3672.9	782.8	1.50	791.6	1018	207.12	27.41	13.23%	35.14
RodC5_115.7	227	2.939	0.075	818.0	3525.4	789.6	1.50	799.1	1008	185.72	24.19	13.02%	31.09
RodC5_122.7	229	3.117	0.253	835.1	3033.4	809.9	1.50	818.3	982	180.99	24.07	13.30%	29.27
RodC5_126.7	230	3.218	0.354	839.3	2751.6	819.8	1.50	826.3	972	212.58	30.40	14.30%	33.90
RodC5_131.6	231	3.343	-0.048	842.1	2407.4	830.1	1.50	834.1	962	299.37	53.34	17.82%	47.09
RodC5_135.7	232	3.447	0.056	846.6	2118.2	836.9	1.50	840.2	955	326.52	66.58	20.39%	50.82
RodE5_63.6	209	1.615	0.422	624.4	3075.9	573.0	1.50	590.2	1423	89.77	10.66	11.87%	23.30
RodE5_113.6	210	2.885	0.022	811.9	3789.3	782.8	1.50	792.5	1017	194.93	24.89	12.77%	33.02
RodE5_115.4	211	2.931	0.067	818.3	3658.6	788.6	1.50	798.5	1009	184.89	23.49	12.71%	30.98
RodE5_118.7	212	3.015	0.151	826.5	3417.4	798.7	1.50	808.0	996	184.63	23.72	12.85%	30.41
RodE5_122.6	213	3.114	0.250	833.7	3133.3	809.7	1.50	817.7	983	195.52	25.92	13.26%	31.65
RodE5_126.6	214	3.216	0.352	837.6	2842.5	819.6	1.50	825.6	973	236.94	34.45	14.54%	37.83
RodE5_131.6	215	3.343	-0.048	842.2	2477.7	830.1	1.50	834.1	962	305.56	53.77	17.60%	48.06
RodE5_135.6	216	3.444	0.053	844.8	2185.1	836.8	1.50	839.4	955	408.03	95.39	23.38%	63.59
RodC3_79.8	177	2.027	0.227	680.7	3480.8	645.5	1.50	657.2	1256	148.50	18.43	12.41%	33.01
RodC3_85.6	178	2.174	0.374	694.9	3631.1	671.4	1.50	679.2	1209	232.60	31.36	13.48%	49.30
RodC3_88.5	179	2.248	0.000	706.5	3707.0	684.2	1.50	691.6	1185	249.48	34.12	13.67%	51.50
RodC3_92.4	180	2.347	0.099	730.0	3808.3	701.1	1.50	710.7	1149	197.57	25.35	12.83%	39.21
RodC3_94.4	181	2.398	0.150	743.3	3859.3	709.6	1.50	720.8	1130	171.89	21.48	12.49%	33.42
RodC3_97.2	182	2.469	0.221	759.9	3932.2	721.3	1.50	734.2	1107	152.68	18.72	12.26%	28.91
RodC3_108.8	183	2.764	0.516	797.3	4143.4	766.2	1.50	776.6	1040	200.27	25.34	12.65%	34.94
RodD5_50	217	1.270	0.076	568.8	2718.2	516.2	1.50	533.7	1602	77.54	9.19	11.86%	23.20
RodD5_54.1	218	1.374	0.180	590.7	2825.2	532.6	1.50	552.0	1539	72.99	8.60	11.79%	20.83
RodD5_56.9	219	1.445	0.251	603.3	2898.5	544.3	1.50	563.9	1501	73.69	8.68	11.77%	20.40
RodD5_60	220	1.524	0.330	615.4	2979.4	557.4	1.50	576.8	1462	77.04	9.08	11.79%	20.66
RodD5_66.1	221	1.679	0.485	634.6	3138.6	584.0	1.50	600.9	1393	93.11	11.07	11.89%	23.55
RodD5_69.9	222	1.775	-0.025	637.6	3237.7	601.0	1.50	613.2	1361	132.48	16.27	12.28%	32.55
RodD5_72.9	223	1.852	0.051	655.0	3315.7	614.4	1.50	627.9	1324	122.76	14.92	12.16%	29.15
RodD5_74.9	224	1.902	0.102	667.1	3367.3	623.4	1.50	638.0	1300	115.84	13.98	12.06%	26.88

Table SC-3178-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±h _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	538.1	2471.9	484.0	1.50	502.1	1722	68.50	8.13	11.87%	22.29
RodB5_52.9	154	1.344	0.150	577.6	2784.5	525.6	1.50	542.9	1570	80.39	9.56	11.89%	23.48
RodB5_55	155	1.397	0.203	585.2	2839.9	533.4	1.50	550.7	1544	82.16	9.77	11.89%	23.53
RodB5_57.8	156	1.468	0.274	596.6	2913.6	543.9	1.50	561.5	1509	82.90	9.85	11.88%	23.10
RodB5_64	157	1.626	0.432	616.9	3077.3	567.8	1.50	584.2	1440	94.06	11.22	11.93%	24.77
RodB5_73.9	158	1.877	0.077	646.7	3337.8	607.0	1.50	620.2	1343	126.03	15.34	12.17%	30.46
RodB5_75.9	159	1.928	0.128	657.8	3389.8	614.9	1.50	629.2	1321	118.51	14.33	12.09%	28.06
RodB5_76.9	160	1.953	0.153	662.6	3416.0	618.9	1.50	633.5	1310	117.36	14.17	12.07%	27.52
RodF5_41	105	1.041	0.343	534.8	2454.3	484.0	1.50	500.9	1727	72.50	8.68	11.97%	23.66
RodF5_53.1	106	1.349	0.155	574.1	2773.1	526.3	1.50	542.2	1572	87.15	10.47	12.01%	25.50
RodF5_55	107	1.397	0.203	583.4	2823.0	533.4	1.50	550.1	1546	84.64	10.13	11.97%	24.27
RodF5_57.8	108	1.468	0.274	594.8	2896.8	543.9	1.50	560.9	1511	85.41	10.21	11.95%	23.83
RodF5_64	109	1.626	0.432	614.4	3059.9	567.8	1.50	583.3	1442	98.51	11.85	12.03%	26.00
RodF5_73.8	110	1.875	0.074	642.4	3317.3	606.6	1.50	618.5	1347	138.82	17.16	12.36%	33.69
RodF5_75.8	111	1.925	0.125	654.0	3369.5	614.5	1.50	627.7	1324	128.15	15.69	12.24%	30.45
RodF5_76.8	112	1.951	0.150	659.0	3396.1	618.5	1.50	632.0	1314	126.78	15.35	12.20%	29.59
RodC2_41	57	1.041	0.343	535.6	2467.1	484.0	1.50	501.2	1726	71.66	8.54	11.92%	23.37
RodC2_53.1	58	1.349	0.155	572.6	2786.2	526.3	1.50	541.8	1574	90.31	10.84	12.01%	26.46
RodC2_55	59	1.397	0.203	580.3	2836.3	533.4	1.50	549.0	1549	90.77	10.89	11.99%	26.10
RodC2_57.8	60	1.468	0.274	591.5	2910.1	543.9	1.50	559.8	1514	91.76	10.99	11.98%	25.68
RodC2_63.9	61	1.623	0.429	610.9	3070.9	567.4	1.50	581.9	1447	105.83	12.77	12.07%	28.02
RodC2_73.8	62	1.875	0.074	636.3	3329.1	606.6	1.50	616.5	1352	167.93	21.34	12.71%	40.95
RodC2_75.8	63	1.925	0.125	645.6	3381.4	614.5	1.50	624.9	1331	163.50	20.62	12.61%	39.10
RodC2_76.8	64	1.951	0.150	649.7	3408.0	618.5	1.50	628.9	1321	163.83	20.70	12.64%	38.81
RodC6_40.9	137	1.039	0.340	538.4	2454.7	483.7	1.50	501.9	1723	67.31	8.01	11.90%	21.91
RodC6_52.8	138	1.341	0.147	578.1	2781.9	525.2	1.50	542.8	1570	78.97	9.38	11.88%	23.07
RodC6_54.8	139	1.392	0.198	587.0	2836.7	532.6	1.50	550.8	1543	78.22	9.27	11.85%	22.39
RodC6_57.8	140	1.468	0.274	598.0	2919.4	543.9	1.50	561.9	1507	81.04	9.60	11.84%	22.55
RodC6_63.8	141	1.621	0.427	618.8	3084.2	567.0	1.50	584.3	1440	89.42	10.60	11.86%	23.54
RodC6_73.7	142	1.872	0.072	651.2	3355.3	606.2	1.50	621.2	1340	111.68	13.38	11.98%	26.94
RodC6_75.8	143	1.925	0.125	660.8	3413.2	614.5	1.50	630.0	1319	110.58	13.21	11.95%	26.13
RodC6_76.8	144	1.951	0.150	666.0	3440.7	618.5	1.50	634.3	1308	108.69	12.96	11.92%	25.43

Table SC-3178-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohic (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	701.5	3691.2	664.5	1.50	676.8	1214	149.45	18.45	12.35%	31.84
RodB4_91.3	162	2.319	0.071	720.2	3764.4	675.8	1.50	690.6	1187	127.02	15.37	12.10%	26.28
RodB4_93.3	163	2.370	0.122	731.3	3814.7	683.5	1.50	699.4	1170	119.51	14.37	12.03%	24.28
RodB4_95.1	164	2.416	0.168	740.4	3860.0	690.3	1.50	707.0	1155	115.61	13.86	11.99%	23.12
RodB4_100	165	2.540	0.292	759.6	3983.5	708.7	1.50	725.7	1122	117.23	14.04	11.98%	22.57
RodB4_106	166	2.692	0.445	780.3	4135.0	730.2	1.50	746.9	1086	123.93	14.87	12.00%	22.88
RodB4_109.9	167	2.791	0.544	785.6	4003.5	743.6	1.50	757.6	1069	143.01	17.49	12.23%	25.86
RodB4_142.3	168	3.614	1.367	834.2	1536.1	826.7	1.50	829.2	968	306.51	76.14	24.84%	48.63
RodF4_85.6	98	2.174	0.374	691.2	3642.0	653.5	1.50	666.1	1237	144.77	17.77	12.27%	31.57
RodF4_88.4	99	2.245	-0.003	703.7	3715.0	664.5	1.50	677.5	1213	142.27	17.38	12.22%	30.26
RodF4_92.4	100	2.347	0.099	726.5	3818.1	680.0	1.50	695.5	1177	123.29	14.80	12.01%	25.25
RodF4_94.3	101	2.395	0.147	737.8	3867.7	687.3	1.50	704.1	1161	114.93	13.70	11.92%	23.12
RodF4_97.2	102	2.469	0.221	753.4	3942.6	698.3	1.50	716.7	1138	107.17	12.70	11.85%	21.01
RodF4_108.8	103	2.764	0.516	791.6	4162.0	739.9	1.50	757.1	1070	120.81	14.35	11.88%	21.87
RodF4_111	104	2.819	-0.044	796.4	3991.7	747.3	1.50	763.7	1060	121.93	14.54	11.93%	21.80
RodD2_103.2	65	2.621	0.373	764.8	4117.3	720.3	1.50	735.1	1106	138.70	16.67	12.02%	26.21
RodD2_106	66	2.692	0.445	774.8	4191.6	730.2	1.50	745.1	1089	141.07	16.95	12.02%	26.14
RodD2_112.6	67	2.860	-0.004	793.0	3843.3	752.6	1.50	766.1	1056	142.53	17.38	12.19%	25.37
RodD2_114.9	68	2.918	0.055	803.1	3663.1	760.0	1.50	774.4	1044	127.24	15.41	12.11%	22.29
RodD2_117.4	69	2.982	0.118	809.5	3469.1	767.7	1.50	781.6	1033	124.74	15.16	12.16%	21.56
RodD2_120.8	70	3.068	0.204	818.3	3203.4	777.8	1.50	791.3	1019	118.75	14.49	12.20%	20.16
RodD2_124.8	71	3.170	0.306	823.5	2890.2	789.0	1.50	800.5	1006	125.72	15.67	12.47%	20.99
RodD2_128.6	72	3.266	0.403	826.6	2594.5	798.8	1.50	808.1	996	140.02	18.15	12.96%	23.06
RodD6_103.1	129	2.619	0.371	767.9	4124.2	719.9	1.50	735.9	1104	128.89	15.37	11.92%	24.32
RodD6_106	130	2.692	0.445	777.2	4200.2	730.2	1.50	745.9	1088	134.16	16.03	11.95%	24.82
RodD6_112.9	131	2.868	0.004	796.5	3831.3	753.6	1.50	767.9	1053	133.85	16.19	12.09%	23.74
RodD6_114.9	132	2.918	0.055	803.8	3673.2	760.0	1.50	774.6	1043	125.66	15.17	12.07%	22.01
RodD6_116.8	133	2.967	0.103	809.1	3522.6	765.9	1.50	780.3	1035	122.41	14.81	12.10%	21.21
RodD6_120.9	134	3.071	0.207	816.4	3199.3	778.1	1.50	790.9	1020	125.52	15.41	12.28%	21.33
RodD6_124.8	135	3.170	0.306	820.3	2891.2	789.0	1.50	799.4	1008	138.42	17.52	12.66%	23.15
RodD6_128.7	136	3.269	0.405	825.5	2584.1	799.0	1.50	807.8	996	146.77	19.25	13.11%	24.18

Table SC-3178-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±hctic (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	560.2	2726.3	515.4	1.50	530.3	1614	91.37	10.96	12.00%	27.58
RodE2_54	74	1.372	0.178	580.5	2830.0	529.7	1.50	546.6	1557	83.53	9.91	11.87%	24.17
RodE2_56.9	75	1.445	0.251	591.8	2907.4	540.5	1.50	557.6	1521	85.06	10.09	11.86%	23.93
RodE2_59.9	76	1.521	0.328	603.7	2987.4	551.9	1.50	569.2	1485	86.64	10.26	11.85%	23.68
RodE2_66	77	1.676	0.483	620.5	3150.0	575.6	1.50	590.6	1422	105.39	12.62	11.98%	27.33
RodE2_69.8	78	1.773	-0.027	623.1	3250.9	590.6	1.50	601.5	1392	150.14	18.71	12.46%	37.93
RodE2_72.9	79	1.852	0.051	636.9	3332.5	603.0	1.50	614.3	1358	147.39	18.25	12.38%	36.12
RodE2_74.9	80	1.902	0.102	647.0	3385.2	610.9	1.50	623.0	1336	140.74	17.27	12.27%	33.80
RodB3_50.2	169	1.275	0.081	551.7	2710.8	515.8	1.50	527.7	1623	113.20	13.97	12.34%	34.39
RodB3_54.1	170	1.374	0.180	568.9	2813.2	530.0	1.50	543.0	1569	108.47	13.25	12.22%	31.68
RodB3_56.9	171	1.445	0.251	581.7	2886.2	540.5	1.50	554.2	1532	105.23	12.78	12.14%	29.86
RodB3_60.1	172	1.527	0.333	594.3	2971.3	552.7	1.50	566.6	1493	107.07	12.98	12.12%	29.45
RodB3_66.1	173	1.679	0.485	614.6	3129.7	576.0	1.50	588.9	1426	121.66	14.87	12.22%	31.67
RodB3_69.9	174	1.775	-0.025	618.2	3230.3	591.0	1.50	600.1	1395	178.61	23.11	12.94%	45.27
RodB3_73	175	1.854	0.054	632.0	3311.2	603.4	1.50	612.9	1361	173.27	22.17	12.79%	42.60
RodB3_75	176	1.905	0.105	643.5	3363.6	611.3	1.50	622.1	1338	156.85	19.66	12.53%	37.75
RodF3_50.1	89	1.273	0.079	564.1	2710.8	515.4	1.50	531.6	1609	83.50	9.98	11.95%	25.11
RodF3_54	90	1.372	0.178	583.8	2816.3	529.7	1.50	547.7	1553	78.01	9.25	11.85%	22.51
RodF3_57	91	1.448	0.254	595.3	2896.6	540.9	1.50	559.0	1516	79.89	9.46	11.84%	22.40
RodF3_60	92	1.524	0.330	605.6	2977.5	552.3	1.50	570.1	1482	83.75	9.93	11.85%	22.83
RodF3_66.1	93	1.679	0.485	621.2	3141.2	576.0	1.50	591.1	1420	104.39	12.52	12.00%	27.03
RodF3_70	94	1.778	-0.022	625.2	3245.9	591.4	1.50	602.7	1388	144.08	17.88	12.41%	36.29
RodF3_73	95	1.854	0.054	640.8	3325.6	603.4	1.50	615.9	1354	133.10	16.28	12.23%	32.50
RodF3_75	96	1.905	0.105	653.2	3379.5	611.3	1.50	625.3	1330	120.95	14.63	12.09%	28.89
RodE6_50.2	121	1.275	0.081	561.2	2708.8	515.8	1.50	530.9	1612	89.40	10.76	12.03%	26.94
RodE6_54.1	122	1.374	0.180	579.9	2810.3	530.0	1.50	546.7	1557	84.54	10.10	11.94%	24.46
RodE6_57	123	1.448	0.254	590.6	2885.8	540.9	1.50	557.5	1521	87.06	10.40	11.94%	24.50
RodE6_60.2	124	1.529	0.335	603.0	2969.3	553.1	1.50	569.7	1483	89.24	10.65	11.94%	24.35
RodE6_66.1	125	1.679	0.485	620.7	3122.9	576.0	1.50	590.9	1421	104.81	12.63	12.05%	27.15
RodE6_70	126	1.778	-0.022	622.9	3224.5	591.4	1.50	601.9	1390	153.68	19.36	12.60%	38.78
RodE6_73.1	127	1.857	0.056	638.3	3305.0	603.8	1.50	615.3	1355	143.60	17.83	12.42%	35.11
RodE6_75	128	1.905	0.105	649.7	3354.8	611.3	1.50	624.1	1333	131.21	16.10	12.27%	31.43

RBHT Steam Cooling Test SC-3178-B

Matrix test # 11

Test date – 3/31/2005

Steady state time window: 24000 - 24300 sec

Inlet flow: 2.78 m³/min (98.3 ft³/min)

Inlet steam temperature: 409 K (277 °F)

Upper plenum pressure: 133.8 kPa (19.4 psia)

Bundle power: 30.1 kW

Outlet steam temperature: 805 K (990 °F)

Bundle inlet Reynolds number: 5359

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

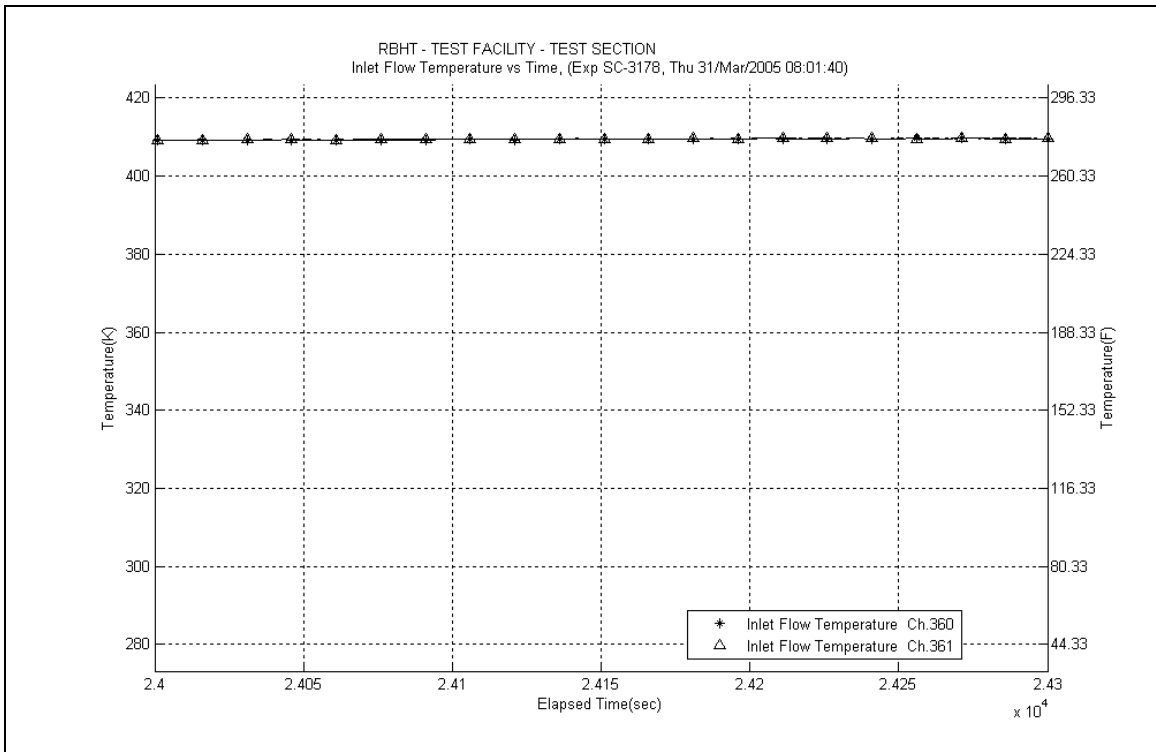
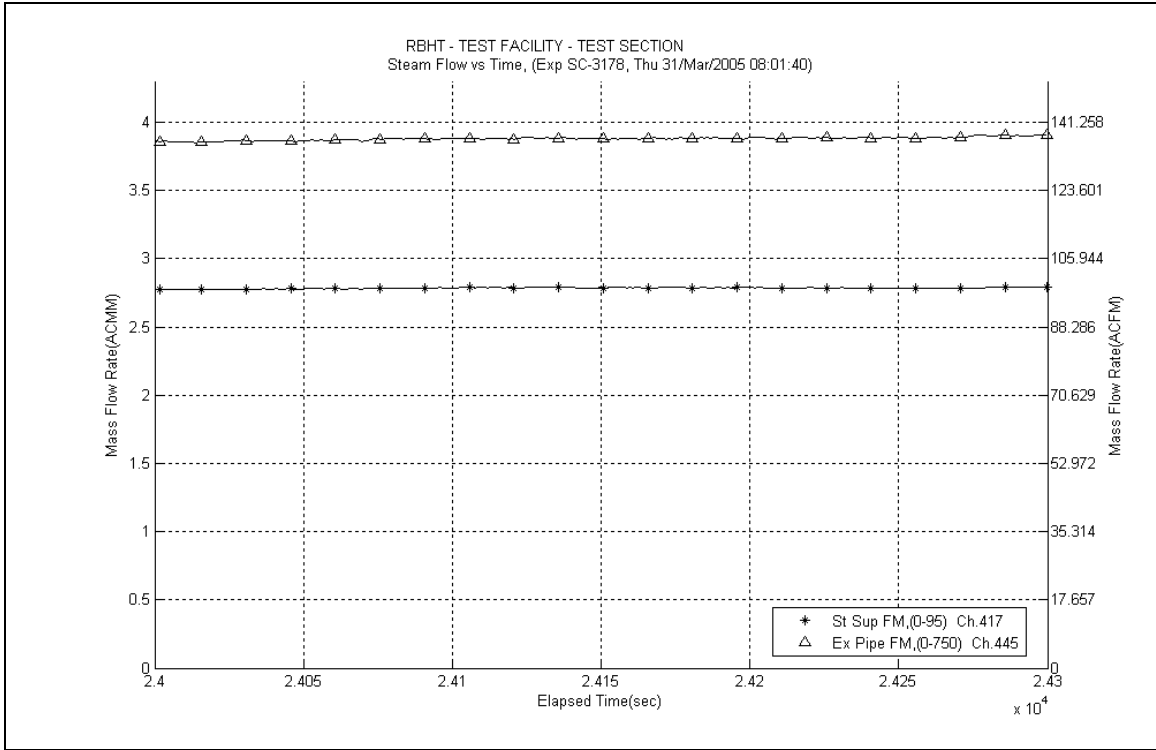
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

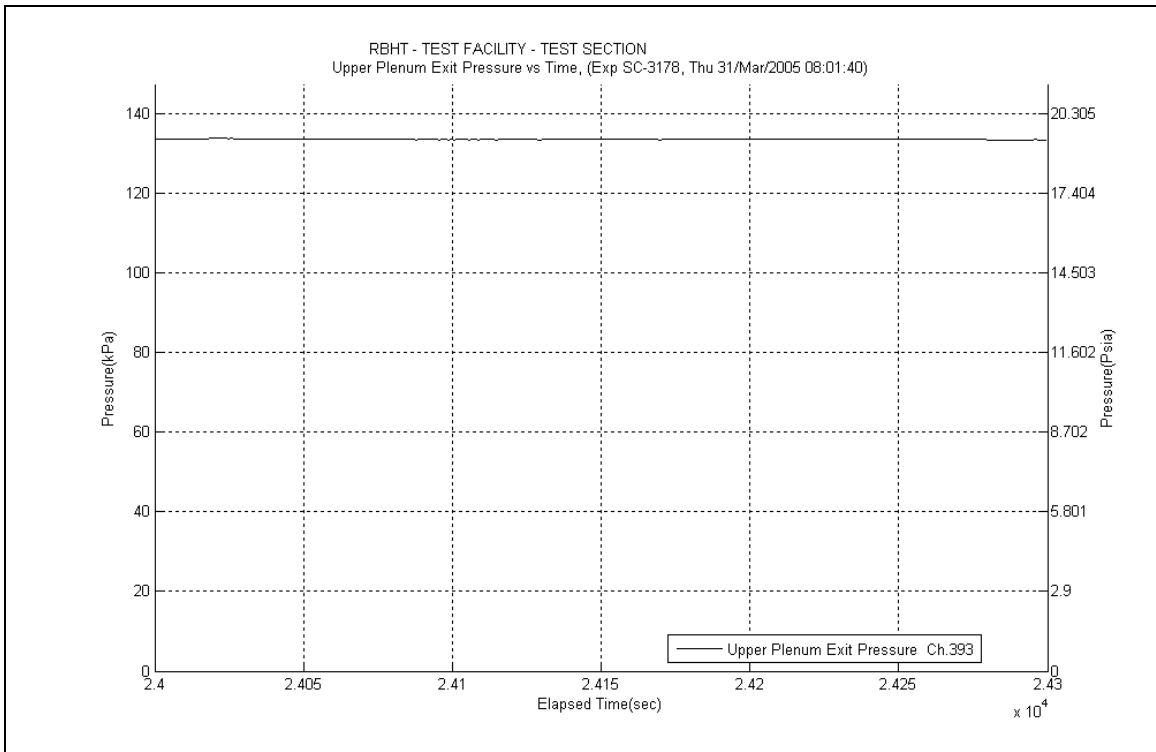
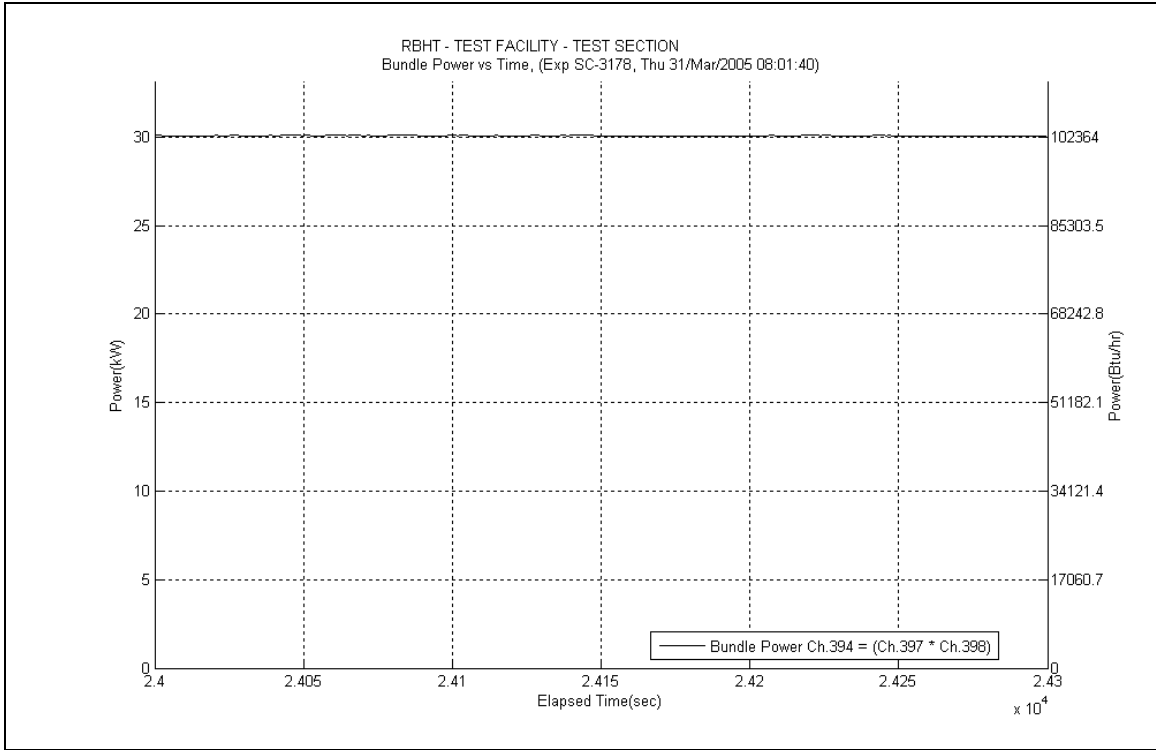
$$T_{cl} = -13.526x^3 + 86.131x^2 - 29.021x + 432.39$$

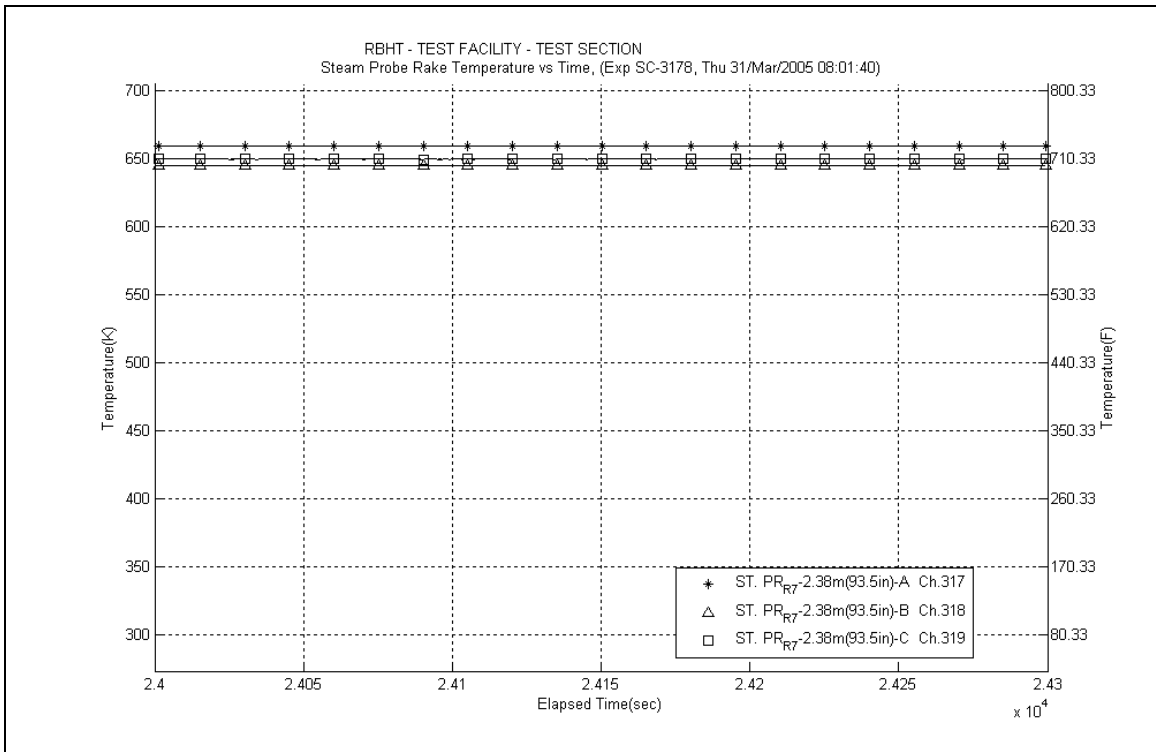
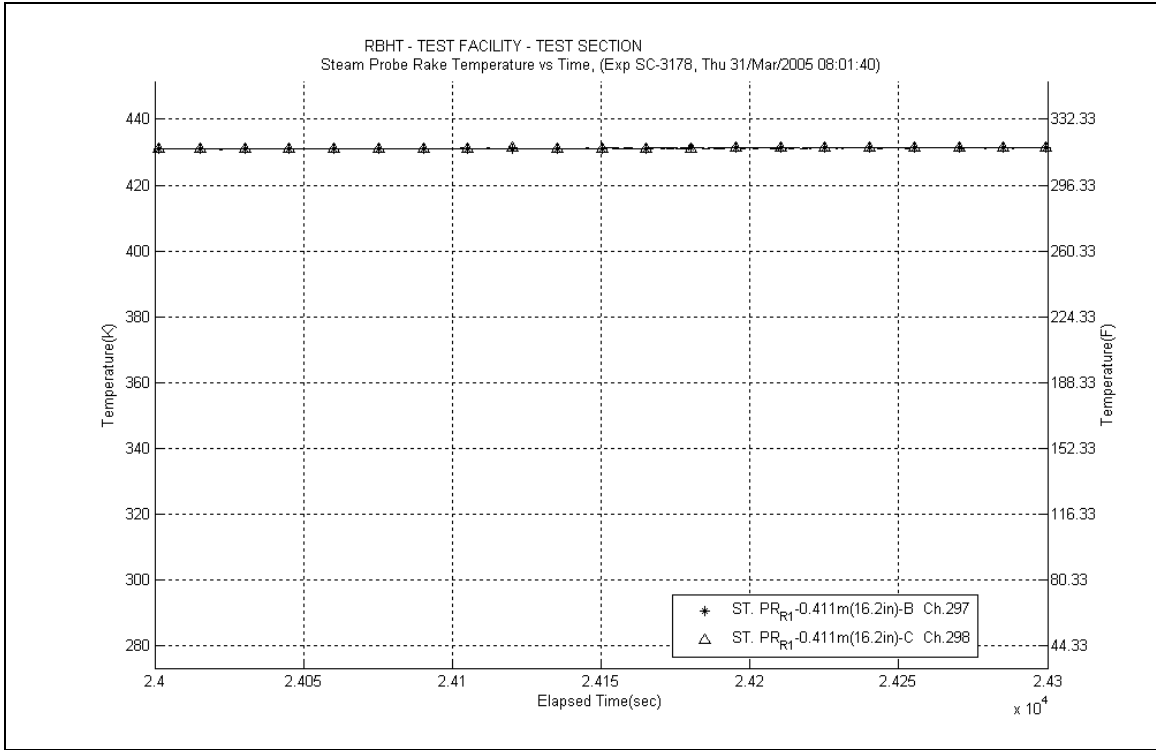
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

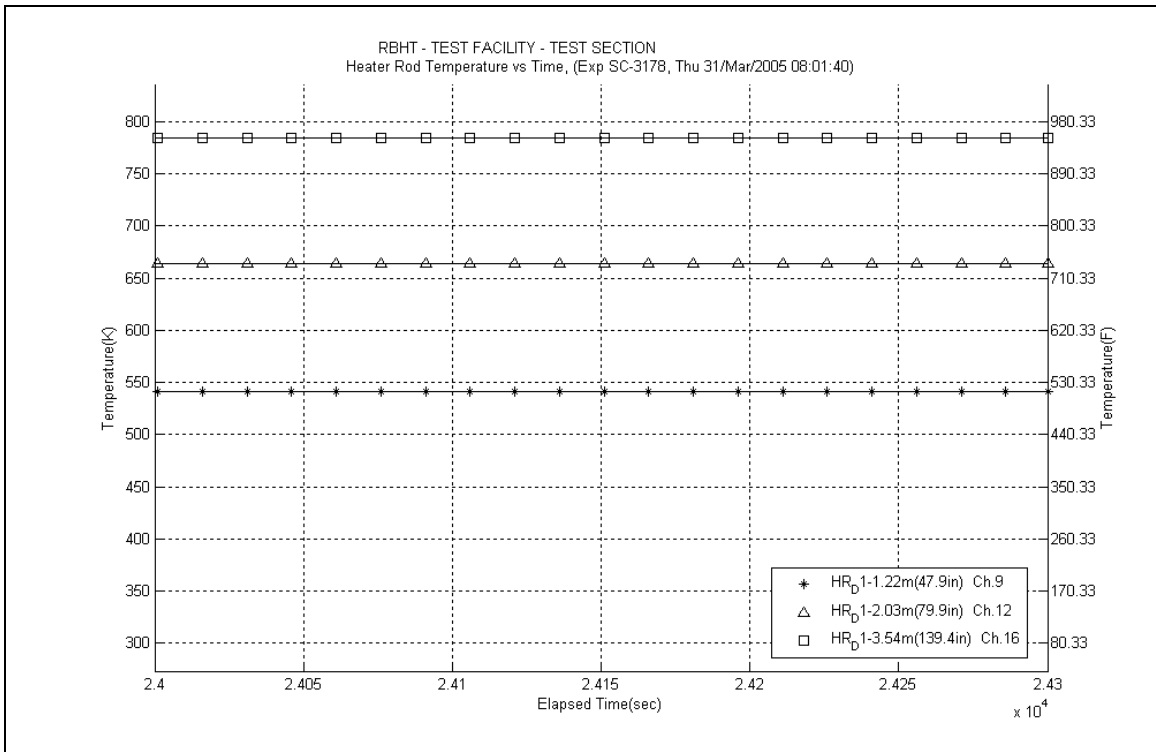
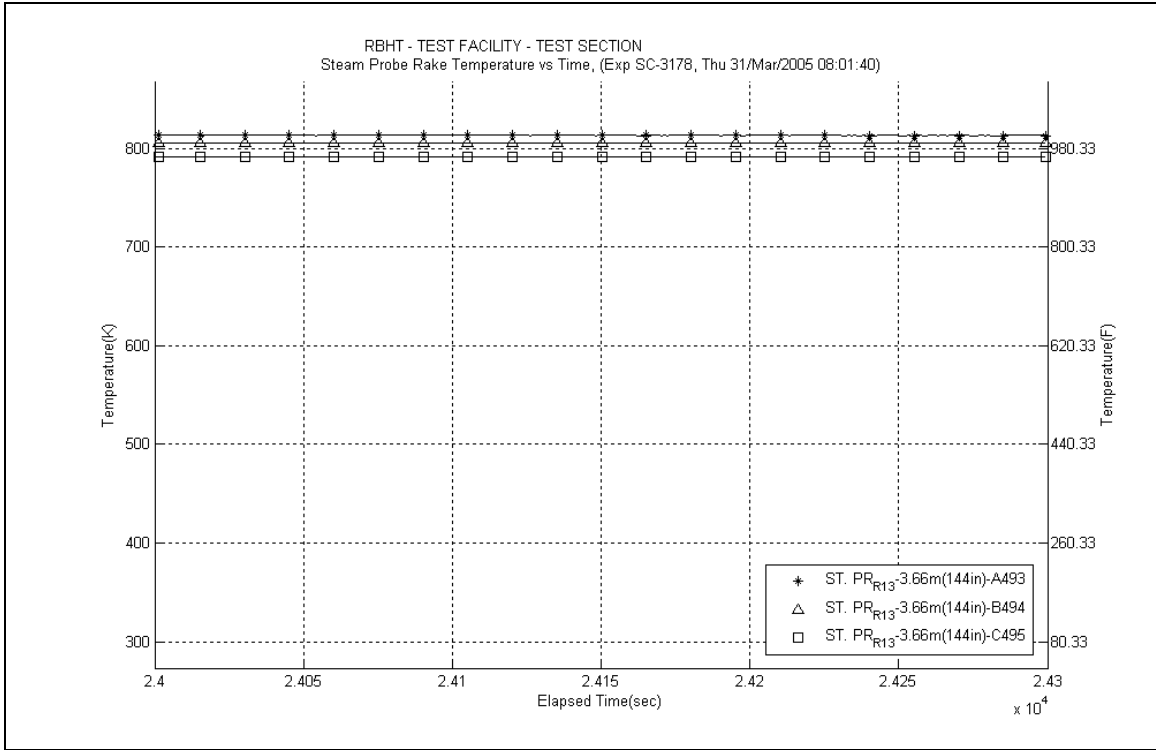
$$T_{cl} = -10.085x^3 + 66.105x^2 - 5.3139x + 425.12$$

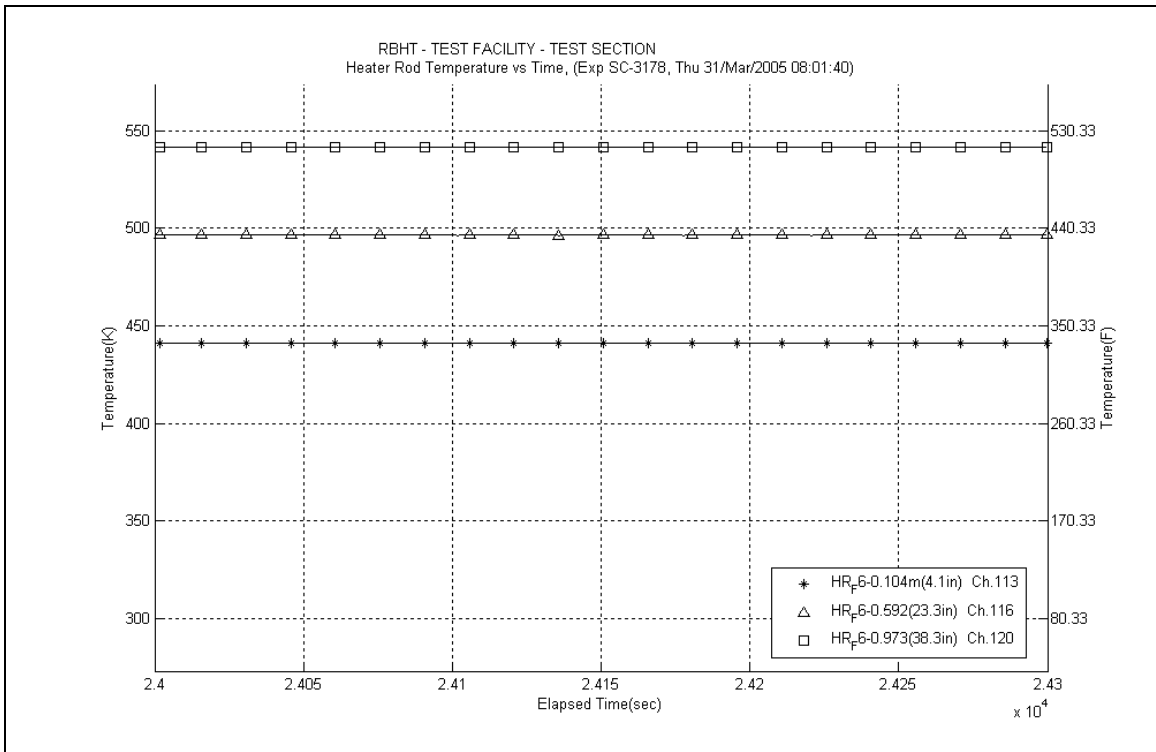
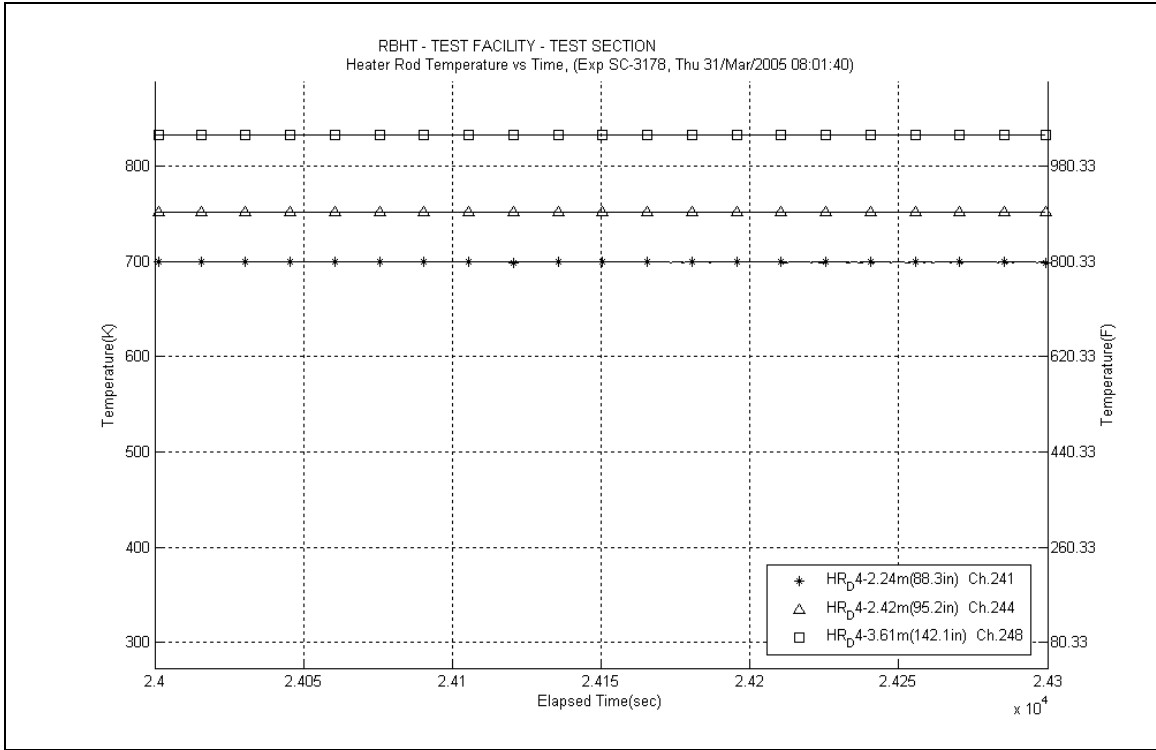
where x is the elevation (m) and T_{cl} is in (K)











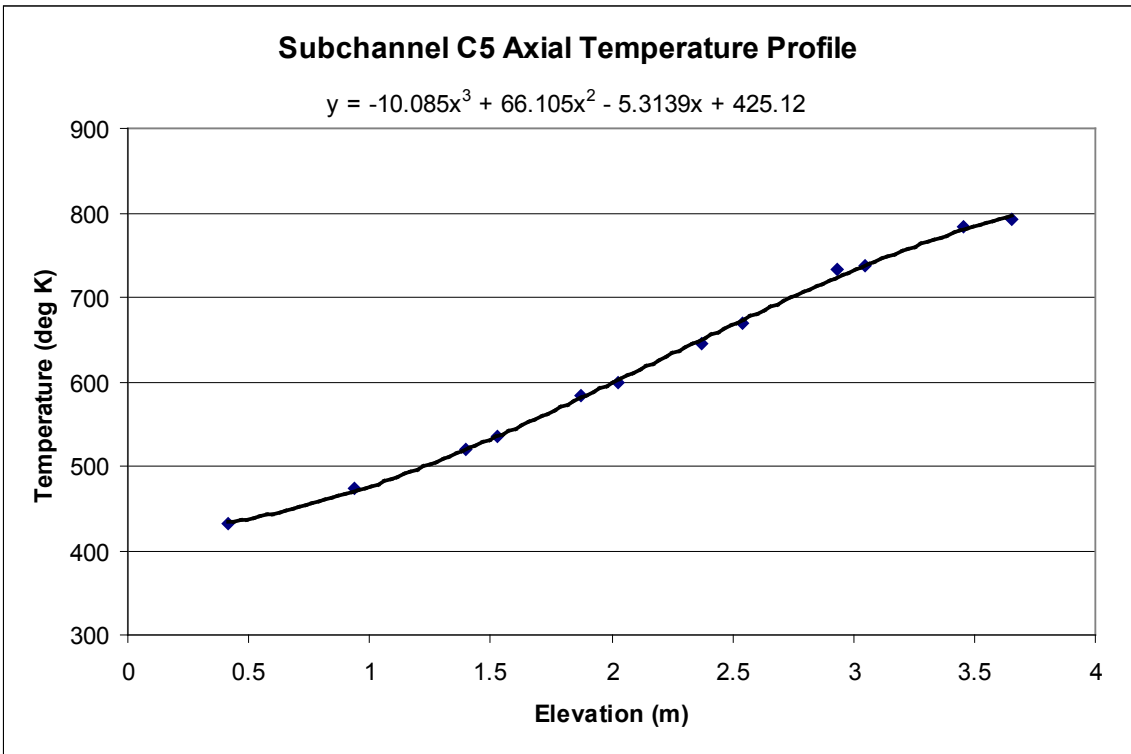
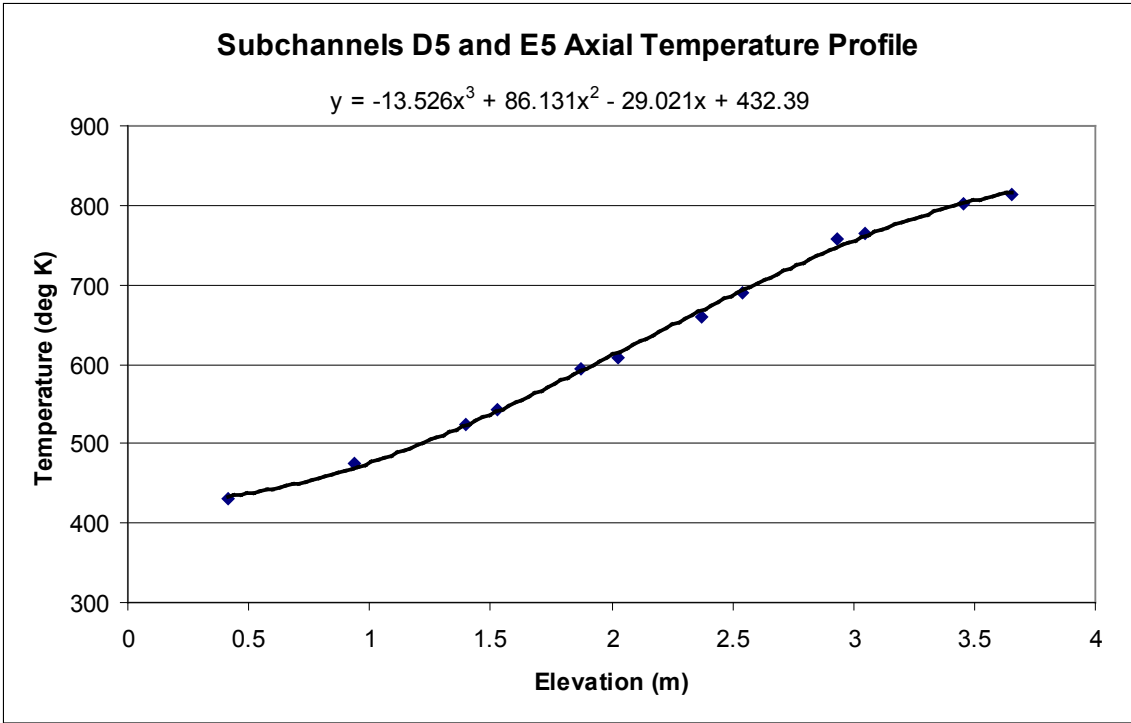


Table SC-3178-B.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohfc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	692.4	8049.9	648.0	1.27	657.5	3536	230.26	17.01	7.39%	51.16
RodD3_91.3	186	2.319	0.071	723.0	8218.1	659.6	1.27	673.2	3441	165.01	11.38	6.90%	35.43
RodD3_93.1	187	2.365	0.117	737.2	8318.9	666.5	1.27	681.7	3392	149.74	10.18	6.80%	31.57
RodD3_95.3	188	2.421	0.173	752.0	8443.4	675.0	1.27	691.5	3338	139.50	9.39	6.73%	28.81
RodD3_100.1	189	2.543	0.295	776.3	8723.3	693.1	1.27	710.9	3234	133.31	8.91	6.68%	26.44
RodD3_106.1	190	2.695	0.447	798.6	9066.5	715.0	1.27	732.9	3125	138.02	9.22	6.68%	26.19
RodD3_110	191	2.794	0.546	789.8	8955.8	728.7	1.27	741.8	3084	186.25	12.82	6.88%	34.73
RodD3_142.1	192	3.609	0.218	823.9	3117.1	813.7	1.27	815.9	2776	389.91	68.50	17.57%	63.33
RodC4_88.4	233	2.245	-0.003	693.3	8139.2	648.4	1.27	658.0	3533	230.60	16.93	7.34%	51.18
RodC4_91.1	234	2.314	0.066	719.6	8296.6	658.8	1.27	671.8	3449	173.76	12.01	6.91%	37.42
RodC4_93.4	235	2.372	0.124	734.3	8430.5	667.7	1.27	682.0	3391	161.13	10.99	6.82%	33.95
RodC4_95.3	236	2.421	0.173	748.2	8541.6	675.0	1.27	690.7	3342	148.45	10.00	6.74%	30.71
RodC4_100.1	237	2.543	0.295	772.4	8823.1	693.1	1.27	710.1	3239	141.54	9.46	6.68%	28.13
RodC4_106.1	238	2.695	0.447	795.9	9172.6	715.0	1.27	732.3	3128	144.20	9.61	6.67%	27.40
RodC4_110	239	2.794	0.546	784.9	8878.2	728.7	1.27	740.7	3088	200.88	14.07	7.00%	37.54
RodC4_142.2	240	3.612	0.221	833.0	3383.1	813.9	1.27	817.9	2768	225.34	24.23	10.75%	36.46
RodD4_88.3	241	2.243	-0.005	698.6	8110.3	648.0	1.27	658.8	3527	203.84	14.58	7.15%	45.16
RodD4_91.3	242	2.319	0.071	725.3	8285.0	659.6	1.27	673.7	3438	160.57	10.98	6.84%	34.44
RodD4_93.2	243	2.367	0.119	739.4	8394.1	666.9	1.27	682.4	3388	147.38	9.96	6.76%	31.02
RodD4_95.2	244	2.418	0.170	751.3	8507.9	674.6	1.27	691.0	3340	141.18	9.48	6.71%	29.19
RodD4_100.1	245	2.543	0.295	774.8	8793.7	693.1	1.27	710.6	3236	136.97	9.14	6.67%	27.19
RodD4_106.1	246	2.695	0.447	795.4	9141.2	715.0	1.27	732.2	3129	144.60	9.66	6.68%	27.48
RodD4_110	247	2.794	0.546	783.7	8830.0	728.7	1.27	740.4	3090	204.17	14.38	7.04%	38.18
RodD4_142.1	248	3.609	0.218	832.6	3268.8	813.7	1.27	817.7	2769	219.92	23.95	10.89%	35.60
RodE4_88.4	201	2.245	-0.003	691.8	7989.0	648.4	1.27	657.7	3535	233.88	17.43	7.45%	51.94
RodE4_91.2	202	2.316	0.069	717.7	8143.1	659.2	1.27	671.7	3450	177.04	12.40	7.00%	38.13
RodE4_95.3	204	2.421	0.173	745.9	8370.9	675.0	1.27	690.2	3345	150.07	10.23	6.82%	31.08
RodE4_100.9	205	2.563	0.315	770.5	8682.5	696.1	1.27	712.0	3229	148.47	10.07	6.78%	29.39
RodE4_142.3	208	3.614	0.224	825.5	3305.4	814.0	1.27	816.5	2773	367.39	58.11	15.82%	59.61
RodE3_63.4	193	1.610	0.417	632.9	6615.7	552.5	1.27	569.7	4177	104.79	7.03	6.71%	28.60
RodE3_113.6	194	2.885	0.022	792.8	8157.7	740.8	1.27	752.0	3037	199.48	14.24	7.14%	36.47
RodE3_115.5	195	2.934	0.070	804.7	7852.5	747.0	1.27	759.4	3004	173.36	12.14	7.00%	31.25
RodE3_118.5	196	3.010	0.146	816.2	7374.8	756.5	1.27	769.3	2961	157.29	10.94	6.95%	27.82
RodE3_122.7	197	3.117	0.253	824.9	6702.5	769.1	1.27	781.0	2912	152.75	10.72	7.02%	26.43
RodE3_126.5	198	3.213	0.349	827.1	6098.1	779.7	1.27	789.8	2876	163.72	11.85	7.24%	27.87
RodE3_131.7	199	3.345	-0.046	812.7	5268.9	792.8	1.27	797.1	2847	337.04	35.19	10.44%	56.62
RodE3_135.6	200	3.444	0.053	817.5	4645.9	801.5	1.27	805.0	2817	369.25	44.66	12.09%	61.15

Table SC-3178-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohhc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	637.0	6487.0	553.6	1.27	571.5	4162	98.98	6.68	6.75%	26.89
RodC5_113.6	226	2.885	0.022	787.0	7955.4	740.8	1.27	750.7	3043	219.14	16.20	7.39%	40.16
RodC5_115.7	227	2.939	0.075	801.9	7635.8	747.7	1.27	759.3	3004	179.26	12.81	7.14%	32.32
RodC5_122.7	229	3.117	0.253	822.9	6575.4	769.1	1.27	780.6	2913	155.33	11.05	7.12%	26.90
RodC5_126.7	230	3.218	0.354	826.2	5969.1	780.2	1.27	790.1	2875	165.15	12.11	7.33%	28.10
RodC5_131.6	231	3.343	-0.048	813.5	5229.5	792.6	1.27	797.0	2847	318.02	32.24	10.14%	53.43
RodC5_135.7	232	3.447	0.056	820.7	4604.7	801.7	1.27	805.8	2814	309.67	33.37	10.78%	51.21
RodE5_63.6	209	1.615	0.422	628.7	6647.9	553.3	1.27	569.4	4180	112.09	7.55	6.74%	30.61
RodE5_113.6	210	2.885	0.022	781.6	8205.2	740.8	1.27	749.6	3048	255.69	19.32	7.56%	46.97
RodE5_115.4	211	2.931	0.067	791.7	7920.8	746.7	1.27	756.3	3017	224.18	16.49	7.36%	40.65
RodE5_118.7	212	3.015	0.151	802.2	7403.3	757.1	1.27	766.8	2972	209.21	15.36	7.34%	37.18
RodE5_122.6	213	3.114	0.250	811.4	6790.8	768.8	1.27	777.9	2925	202.99	15.08	7.43%	35.33
RodE5_126.6	214	3.216	0.352	816.3	6162.8	779.9	1.27	787.7	2885	215.59	16.76	7.78%	36.85
RodE5_131.6	215	3.343	-0.048	804.8	5378.9	792.6	1.27	795.2	2855	560.84	83.76	14.93%	94.55
RodE5_135.6	216	3.444	0.053	812.1	4749.1	801.5	1.27	803.8	2821	571.81	96.34	16.85%	94.90
RodC3_79.8	177	2.027	0.227	677.2	7522.5	614.8	1.27	628.2	3727	153.35	10.62	6.93%	36.39
RodC3_85.6	178	2.174	0.374	685.3	7851.6	637.4	1.27	647.7	3597	208.73	15.18	7.27%	47.39
RodC3_88.5	179	2.248	0.000	689.4	8013.3	648.7	1.27	657.4	3536	250.91	19.03	7.58%	55.75
RodC3_92.4	180	2.347	0.099	723.6	8233.1	663.8	1.27	676.6	3421	175.45	12.23	6.97%	37.39
RodC3_94.4	181	2.398	0.150	735.0	8347.6	671.5	1.27	685.1	3373	167.34	11.56	6.91%	35.03
RodC3_97.2	182	2.469	0.221	754.6	8504.4	682.2	1.27	697.7	3304	149.38	10.15	6.79%	30.45
RodC3_108.8	183	2.764	0.516	792.8	8967.5	724.5	1.27	739.1	3096	167.16	11.43	6.84%	31.34
RodD5_50	217	1.270	0.076	576.2	5872.2	506.8	1.27	521.6	4636	107.63	7.32	6.80%	33.24
RodD5_54.1	218	1.374	0.180	599.4	6103.2	520.1	1.27	537.0	4479	97.93	6.57	6.71%	29.04
RodD5_56.9	219	1.445	0.251	612.4	6262.4	529.5	1.27	547.3	4380	96.16	6.42	6.68%	27.77
RodD5_60	220	1.524	0.330	624.8	6438.3	540.3	1.27	558.4	4277	96.99	6.47	6.67%	27.23
RodD5_66.1	221	1.679	0.485	638.9	6783.1	562.4	1.27	578.8	4100	112.91	7.60	6.73%	30.13
RodD5_69.9	222	1.775	-0.025	620.3	6999.1	576.7	1.27	586.0	4041	204.38	15.12	7.40%	53.59
RodD5_72.9	223	1.852	0.051	649.0	7166.1	588.1	1.27	601.1	3922	149.62	10.38	6.94%	37.82
RodD5_74.9	224	1.902	0.102	664.8	7279.5	595.8	1.27	610.6	3852	134.28	9.16	6.82%	33.20

Table SC-3178-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	557.8	5339.6	479.9	1.27	496.6	4915	87.25	5.87	6.73%	28.81
RodB5_52.9	154	1.344	0.150	590.5	6014.2	512.9	1.27	529.5	4554	98.60	6.64	6.73%	29.82
RodB5_55	155	1.397	0.203	598.7	6135.6	519.2	1.27	536.2	4487	98.20	6.59	6.71%	29.18
RodB5_57.8	156	1.468	0.274	611.3	6294.7	527.9	1.27	545.7	4394	96.08	6.42	6.69%	27.86
RodB5_64	157	1.626	0.432	629.6	6649.9	547.8	1.27	565.4	4215	103.45	6.93	6.69%	28.54
RodB5_73.9	158	1.877	0.077	651.4	7213.2	581.4	1.27	596.3	3959	131.13	8.93	6.81%	33.53
RodB5_75.9	159	1.928	0.128	664.3	7325.7	588.3	1.27	604.6	3896	122.57	8.27	6.75%	30.74
RodB5_76.9	160	1.953	0.153	669.6	7385.7	591.8	1.27	608.5	3867	120.74	8.13	6.73%	30.00
RodF5_41	105	1.041	0.343	553.9	5301.3	479.9	1.27	495.7	4924	91.15	6.19	6.79%	30.17
RodF5_53.1	106	1.349	0.155	585.5	5991.6	513.5	1.27	528.9	4561	105.87	7.20	6.80%	32.07
RodF5_55	107	1.397	0.203	594.9	6101.5	519.2	1.27	535.4	4495	102.52	6.93	6.76%	30.53
RodF5_57.8	108	1.468	0.274	606.4	6260.5	527.9	1.27	544.7	4404	101.42	6.83	6.74%	29.49
RodF5_64	109	1.626	0.432	623.1	6615.6	547.8	1.27	564.0	4227	111.90	7.57	6.76%	30.98
RodF5_73.8	110	1.875	0.074	639.2	7173.7	581.0	1.27	593.5	3982	156.81	10.96	6.99%	40.38
RodF5_75.8	111	1.925	0.125	652.3	7288.3	588.0	1.27	601.7	3918	144.07	9.94	6.90%	36.37
RodF5_76.8	112	1.951	0.150	657.8	7346.3	591.4	1.27	605.6	3888	140.92	9.68	6.87%	35.25
RodC2_41	57	1.041	0.343	551.9	5325.5	479.9	1.27	495.3	4929	94.08	6.39	6.79%	31.17
RodC2_53.1	58	1.349	0.155	593.1	6016.8	513.5	1.27	530.5	4544	96.14	6.46	6.72%	29.00
RodC2_55	59	1.397	0.203	601.4	6125.8	519.2	1.27	536.8	4481	94.80	6.35	6.70%	28.13
RodC2_57.8	60	1.468	0.274	613.1	6286.8	527.9	1.27	546.1	4391	93.91	6.27	6.68%	27.20
RodC2_63.9	61	1.623	0.429	628.5	6637.1	547.5	1.27	564.8	4220	104.32	6.99	6.70%	28.82
RodC2_73.8	62	1.875	0.074	641.5	7199.3	581.0	1.27	594.0	3978	151.41	10.50	6.94%	38.94
RodC2_75.8	63	1.925	0.125	653.3	7312.4	588.0	1.27	602.0	3916	142.28	9.78	6.88%	35.90
RodC2_76.8	64	1.951	0.150	658.2	7370.9	591.4	1.27	605.7	3888	140.53	9.64	6.86%	35.14
RodC6_40.9	137	1.039	0.340	558.3	5298.5	479.6	1.27	496.5	4916	85.75	5.78	6.74%	28.32
RodC6_52.8	138	1.341	0.147	592.6	6010.6	512.6	1.27	529.7	4552	95.61	6.42	6.71%	28.90
RodC6_54.8	139	1.392	0.198	602.4	6129.3	518.6	1.27	536.5	4484	93.11	6.22	6.68%	27.65
RodC6_57.8	140	1.468	0.274	615.5	6307.8	527.9	1.27	546.7	4386	91.57	6.09	6.65%	26.49
RodC6_63.8	141	1.621	0.427	634.3	6664.5	547.2	1.27	565.8	4211	97.38	6.47	6.65%	26.84
RodC6_73.7	142	1.872	0.072	653.8	7254.6	580.7	1.27	596.3	3959	126.23	8.53	6.76%	32.28
RodC6_75.8	143	1.925	0.125	665.7	7377.8	588.0	1.27	604.6	3896	120.70	8.10	6.71%	30.26
RodC6_76.8	144	1.951	0.150	672.2	7436.1	591.4	1.27	608.7	3865	117.12	7.83	6.69%	29.08

Table SC-3178-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohhc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	687.5	7979.3	632.3	1.27	644.1	3620	184.04	13.02	7.08%	42.12
RodB4_91.3	162	2.319	0.071	716.0	8138.6	642.5	1.27	658.3	3531	140.90	9.57	6.79%	31.25
RodB4_93.3	163	2.370	0.122	729.6	8250.8	649.6	1.27	666.7	3480	131.21	8.84	6.74%	28.57
RodB4_95.1	164	2.416	0.168	741.3	8349.4	655.9	1.27	674.1	3436	124.36	8.33	6.70%	26.65
RodB4_100	165	2.540	0.292	761.4	8618.0	672.8	1.27	691.8	3336	123.79	8.27	6.68%	25.55
RodB4_106	166	2.692	0.445	784.1	8951.3	693.2	1.27	712.6	3225	125.27	8.35	6.67%	24.76
RodB4_109.9	167	2.791	0.544	775.1	8665.5	706.0	1.27	720.8	3184	159.69	10.96	6.86%	31.05
RodB4_142.3	168	3.614	0.224	824.7	3353.9	793.3	1.27	800.0	2836	136.16	11.28	8.28%	22.75
RodF4_85.6	98	2.174	0.374	680.2	7878.8	622.4	1.27	634.8	3682	173.50	12.15	7.00%	40.56
RodF4_88.4	99	2.245	-0.003	681.9	8034.8	632.3	1.27	642.9	3628	206.33	14.87	7.21%	47.35
RodF4_92.4	100	2.347	0.099	717.0	8262.2	646.4	1.27	661.5	3511	148.88	10.13	6.80%	32.79
RodF4_94.3	101	2.395	0.147	730.6	8369.0	653.1	1.27	669.7	3462	137.37	9.25	6.74%	29.72
RodF4_97.2	102	2.469	0.221	747.8	8529.6	663.2	1.27	681.3	3395	128.25	8.57	6.68%	27.06
RodF4_108.8	103	2.764	0.516	774.7	9011.7	702.4	1.27	717.9	3199	158.62	10.75	6.78%	31.02
RodF4_111	104	2.819	-0.044	767.2	8644.4	709.6	1.27	721.9	3179	190.81	13.34	6.99%	37.02
RodD2_103.2	65	2.621	0.373	767.3	8916.4	683.8	1.27	701.6	3283	135.81	9.06	6.67%	27.46
RodD2_106	66	2.692	0.445	777.3	9075.7	693.2	1.27	711.2	3233	137.36	9.16	6.67%	27.23
RodD2_112.6	67	2.860	-0.004	768.0	8328.7	714.7	1.27	726.1	3158	199.05	14.15	7.11%	38.29
RodD2_114.9	68	2.918	0.055	785.3	7936.6	722.0	1.27	735.5	3113	159.34	11.01	6.91%	30.08
RodD2_117.4	69	2.982	0.118	793.6	7518.1	729.7	1.27	743.4	3076	149.66	10.32	6.90%	27.83
RodD2_120.8	70	3.068	0.204	804.7	6945.9	739.8	1.27	753.7	3029	136.28	9.38	6.88%	24.83
RodD2_124.8	71	3.170	0.306	810.3	6272.5	751.3	1.27	763.9	2984	135.34	9.45	6.98%	24.18
RodD2_128.6	72	3.266	0.403	810.5	5634.0	761.6	1.27	772.1	2949	146.53	10.60	7.24%	25.78
RodD6_103.1	129	2.619	0.371	767.2	8926.8	683.4	1.27	701.4	3284	135.64	9.04	6.67%	27.44
RodD6_106	130	2.692	0.445	775.6	9093.4	693.2	1.27	710.8	3235	140.38	9.37	6.68%	27.85
RodD6_112.9	131	2.868	0.004	766.9	8298.2	715.7	1.27	726.6	3156	205.92	14.73	7.15%	39.57
RodD6_114.9	132	2.918	0.055	782.4	7956.7	722.0	1.27	734.9	3116	167.41	11.63	6.95%	31.65
RodD6_116.8	133	2.967	0.103	792.5	7634.2	727.8	1.27	741.7	3084	150.31	10.34	6.88%	28.04
RodD6_120.9	134	3.071	0.207	801.5	6934.9	740.1	1.27	753.3	3031	143.69	9.97	6.94%	26.20
RodD6_124.8	135	3.170	0.306	806.8	6268.4	751.3	1.27	763.2	2987	143.57	10.13	7.06%	25.69
RodD6_128.7	136	3.269	0.405	807.9	5609.9	761.9	1.27	771.7	2951	154.92	11.37	7.34%	27.28

Table SC-3178-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	571.4	5887.3	504.6	1.27	518.9	4664	112.12	7.66	6.83%	34.87
RodE2_54	74	1.372	0.178	593.7	6113.2	516.2	1.27	532.8	4521	100.36	6.74	6.72%	30.10
RodE2_56.9	75	1.445	0.251	606.4	6279.9	525.1	1.27	542.5	4425	98.25	6.57	6.68%	28.73
RodE2_59.9	76	1.521	0.328	619.5	6452.9	534.5	1.27	552.7	4329	96.60	6.43	6.66%	27.51
RodE2_66	77	1.676	0.483	633.2	6805.5	554.5	1.27	571.3	4163	110.05	7.37	6.70%	29.91
RodE2_69.8	78	1.773	-0.027	612.4	7024.8	567.3	1.27	576.9	4116	197.95	14.49	7.32%	53.07
RodE2_72.9	79	1.852	0.051	636.8	7202.8	577.9	1.27	590.5	4005	155.51	10.80	6.94%	40.33
RodE2_74.9	80	1.902	0.102	648.9	7318.1	584.8	1.27	598.5	3942	145.31	9.99	6.87%	36.96
RodB3_50.2	169	1.275	0.081	565.9	5854.5	504.9	1.27	518.0	4674	122.07	8.46	6.93%	38.06
RodB3_54.1	170	1.374	0.180	582.1	6076.7	516.5	1.27	530.5	4544	117.87	8.09	6.86%	35.55
RodB3_56.9	171	1.445	0.251	592.0	6238.6	525.1	1.27	539.4	4455	118.54	8.11	6.84%	34.94
RodB3_60.1	172	1.527	0.333	601.3	6419.3	535.2	1.27	549.3	4360	123.48	8.46	6.85%	35.48
RodB3_66.1	173	1.679	0.485	622.2	6761.5	554.8	1.27	569.2	4181	127.57	8.72	6.83%	34.86
RodB3_69.9	174	1.775	-0.025	608.6	6979.1	567.6	1.27	576.4	4120	216.68	16.30	7.52%	58.16
RodB3_73	175	1.854	0.054	634.0	7154.2	578.2	1.27	590.2	4008	163.34	11.48	7.03%	42.40
RodB3_75	176	1.905	0.105	647.5	7268.5	585.2	1.27	598.5	3943	148.39	10.25	6.90%	37.75
RodF3_50.1	89	1.273	0.079	574.4	5854.7	504.6	1.27	519.6	4657	106.69	7.26	6.81%	33.12
RodF3_54	90	1.372	0.178	596.3	6081.7	516.2	1.27	533.3	4516	96.62	6.48	6.71%	28.93
RodF3_57	91	1.448	0.254	608.9	6256.9	525.4	1.27	543.3	4418	95.34	6.37	6.68%	27.82
RodF3_60	92	1.524	0.330	620.5	6433.6	534.9	1.27	553.2	4325	95.64	6.37	6.66%	27.21
RodF3_66.1	93	1.679	0.485	627.0	6789.3	554.8	1.27	570.3	4172	119.64	8.10	6.77%	32.61
RodF3_70	94	1.778	-0.022	612.8	7012.7	568.0	1.27	577.6	4111	198.91	14.60	7.34%	53.24
RodF3_73	95	1.854	0.054	638.0	7187.8	578.2	1.27	591.0	4001	153.13	10.62	6.94%	39.66
RodF3_75	96	1.905	0.105	652.6	7305.3	585.2	1.27	599.6	3934	137.90	9.42	6.83%	34.99
RodE6_50.2	121	1.275	0.081	568.8	5855.0	504.9	1.27	518.6	4668	116.57	8.03	6.89%	36.28
RodE6_54.1	122	1.374	0.180	588.8	6074.9	516.5	1.27	532.0	4529	106.93	7.25	6.78%	32.13
RodE6_57	123	1.448	0.254	599.6	6238.5	525.4	1.27	541.3	4437	106.97	7.24	6.76%	31.38
RodE6_60.2	124	1.529	0.335	611.1	6420.4	535.5	1.27	551.7	4338	108.06	7.30	6.75%	30.86
RodE6_66.1	125	1.679	0.485	624.1	6753.5	554.8	1.27	569.6	4178	123.97	8.45	6.82%	33.84
RodE6_70	126	1.778	-0.022	609.2	6971.9	568.0	1.27	576.8	4117	215.08	16.17	7.52%	57.68
RodE6_73.1	127	1.857	0.056	636.0	7146.5	578.6	1.27	590.9	4002	158.45	11.09	7.00%	41.06
RodE6_75	128	1.905	0.105	650.3	7256.8	585.2	1.27	599.1	3938	141.70	9.75	6.88%	36.00

RBHT Steam Cooling Test SC-3178-C

Matrix test # 6

Test date – 3/31/2005

Steady state time window: 28100 - 28500 sec

Inlet flow: 2.26 m³/min (79.9 ft³/min)

Inlet steam temperature: 413 K (284 °F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 49.9 kW

Outlet steam temperature: 825 K (1026 °F)

Bundle inlet Reynolds number: 8820

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

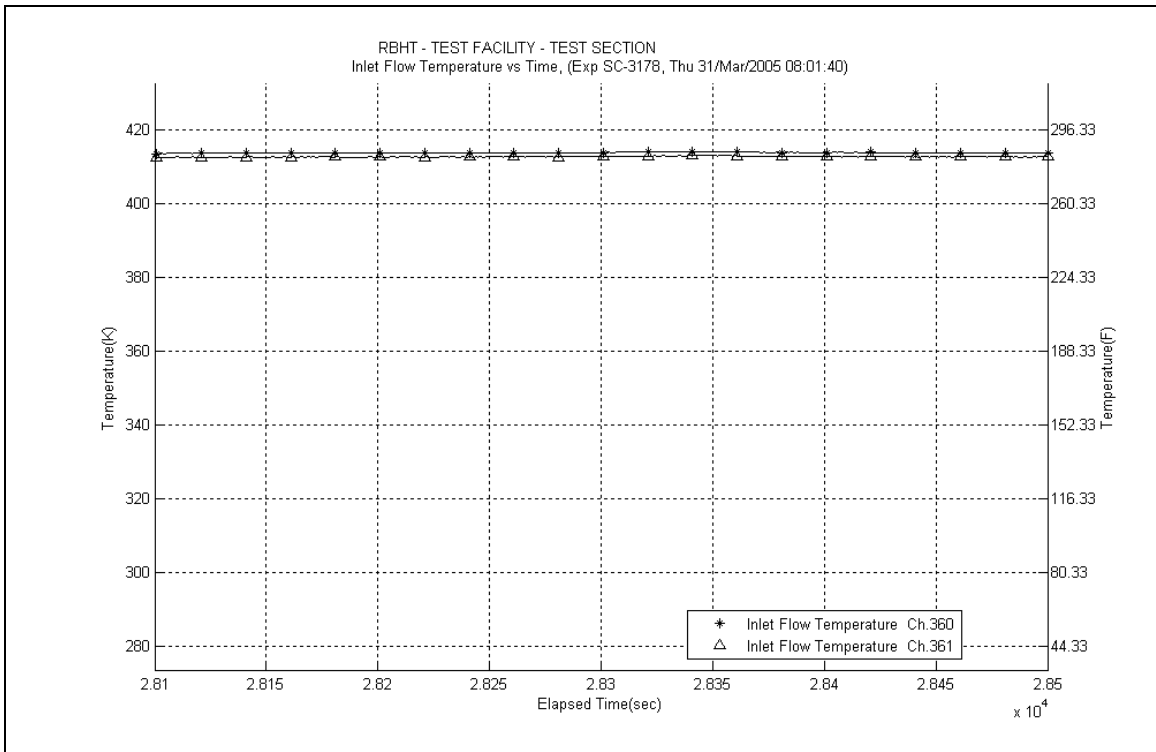
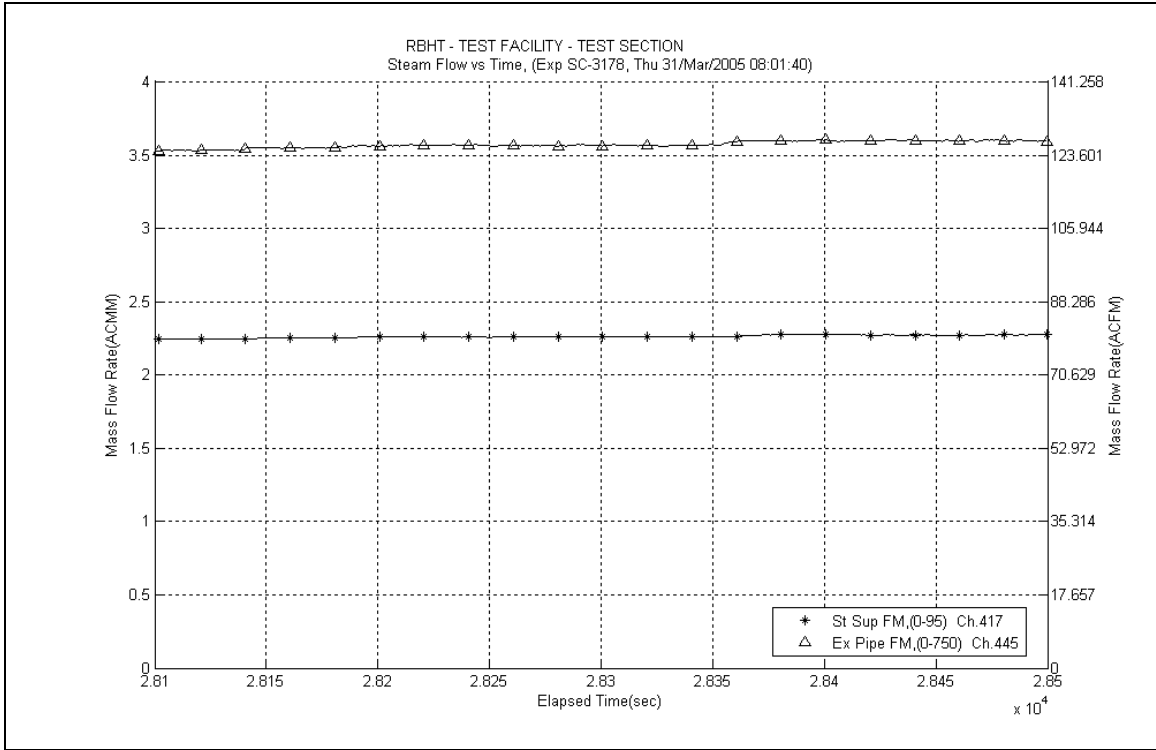
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

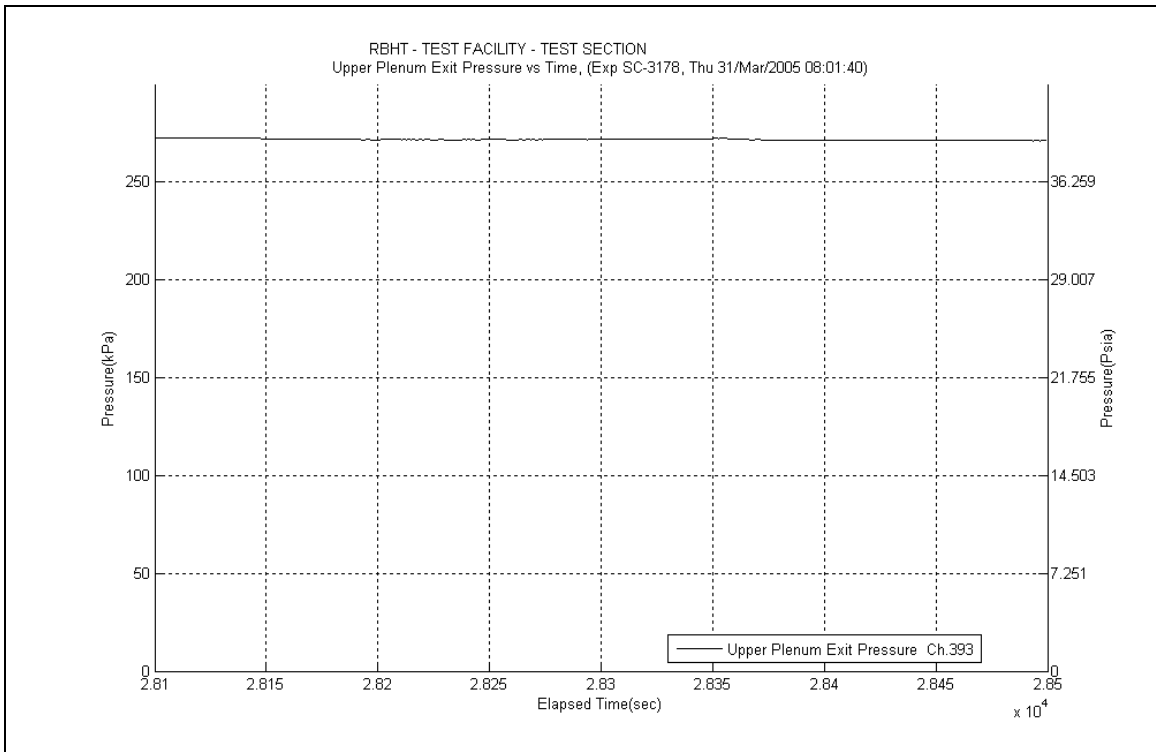
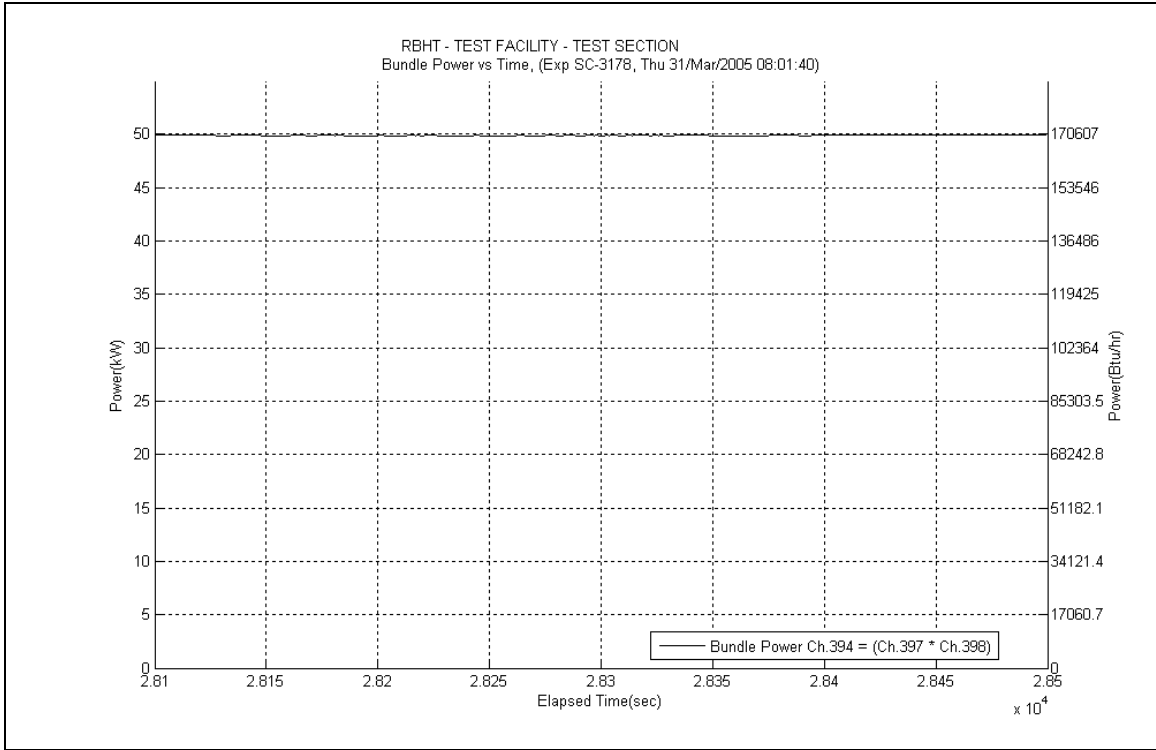
$$T_{cl} = -14.71x^3 + 93.998x^2 - 37.575x + 438.03$$

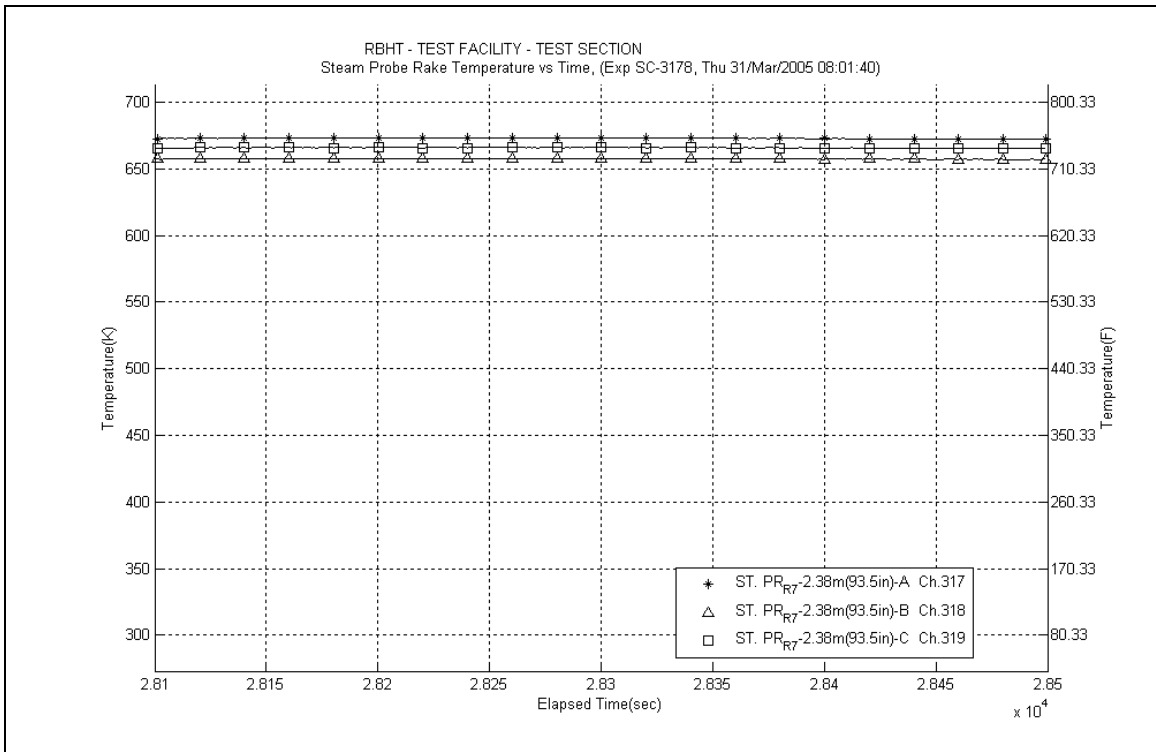
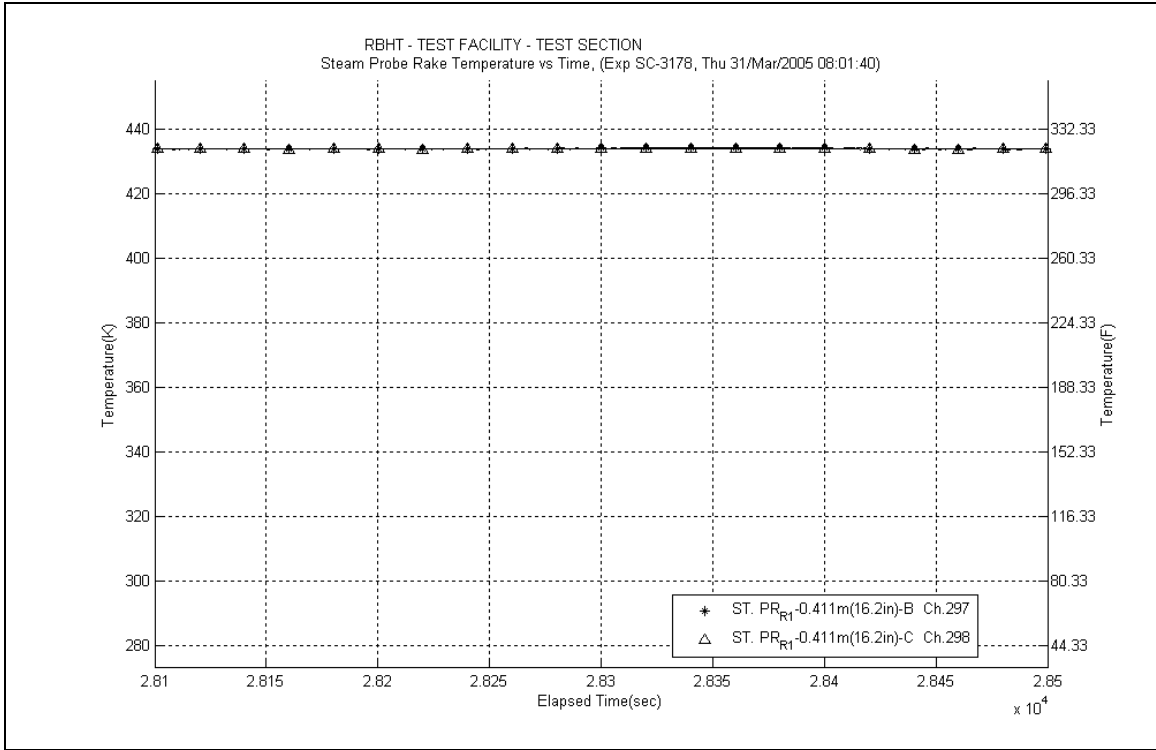
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

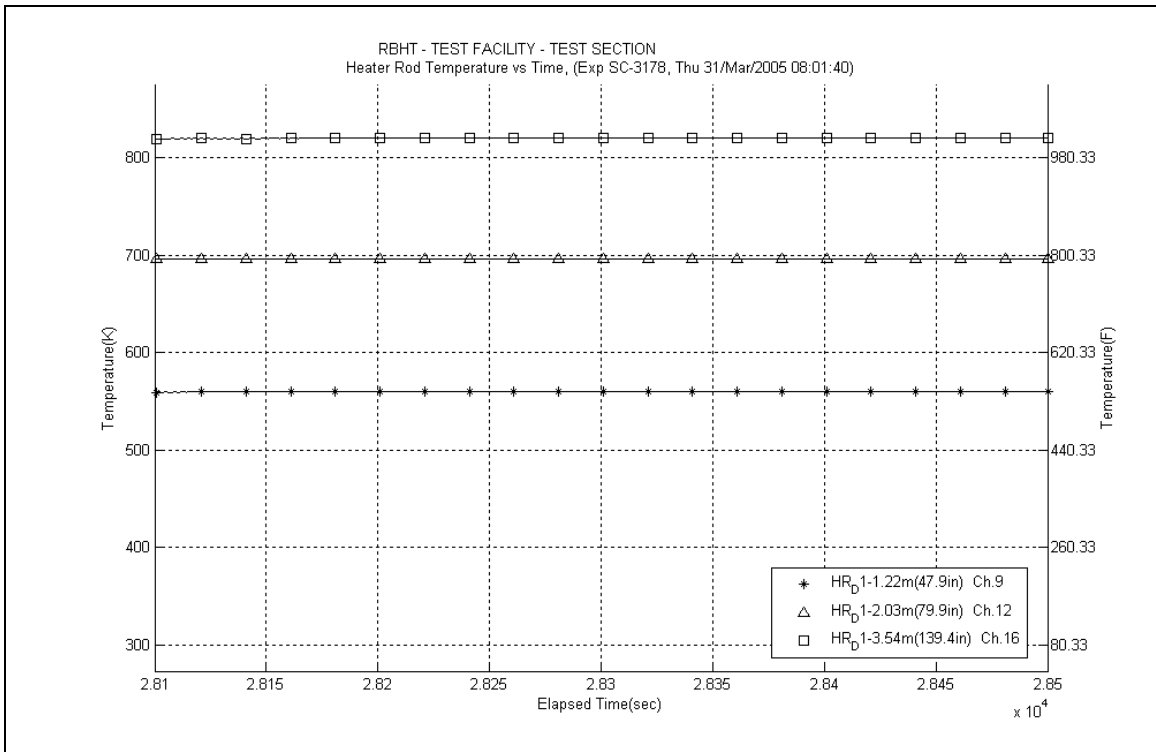
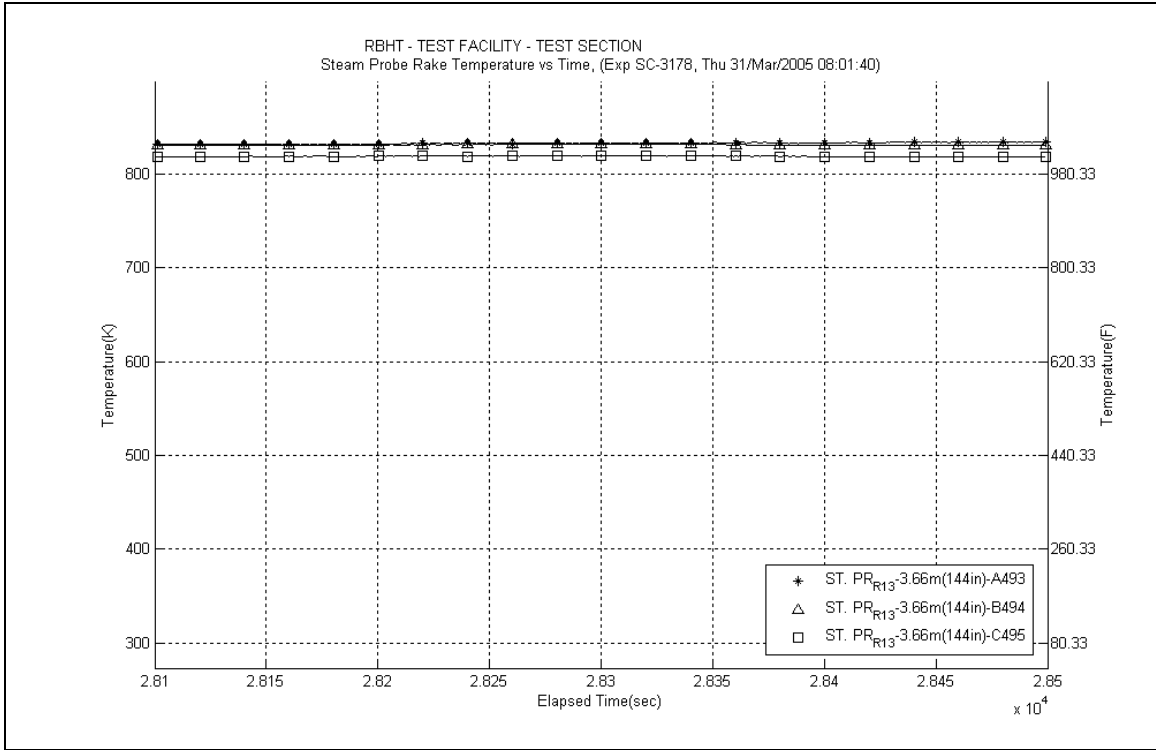
$$T_{cl} = -10.559x^3 + 70.797x^2 - 9.6599x + 429.36$$

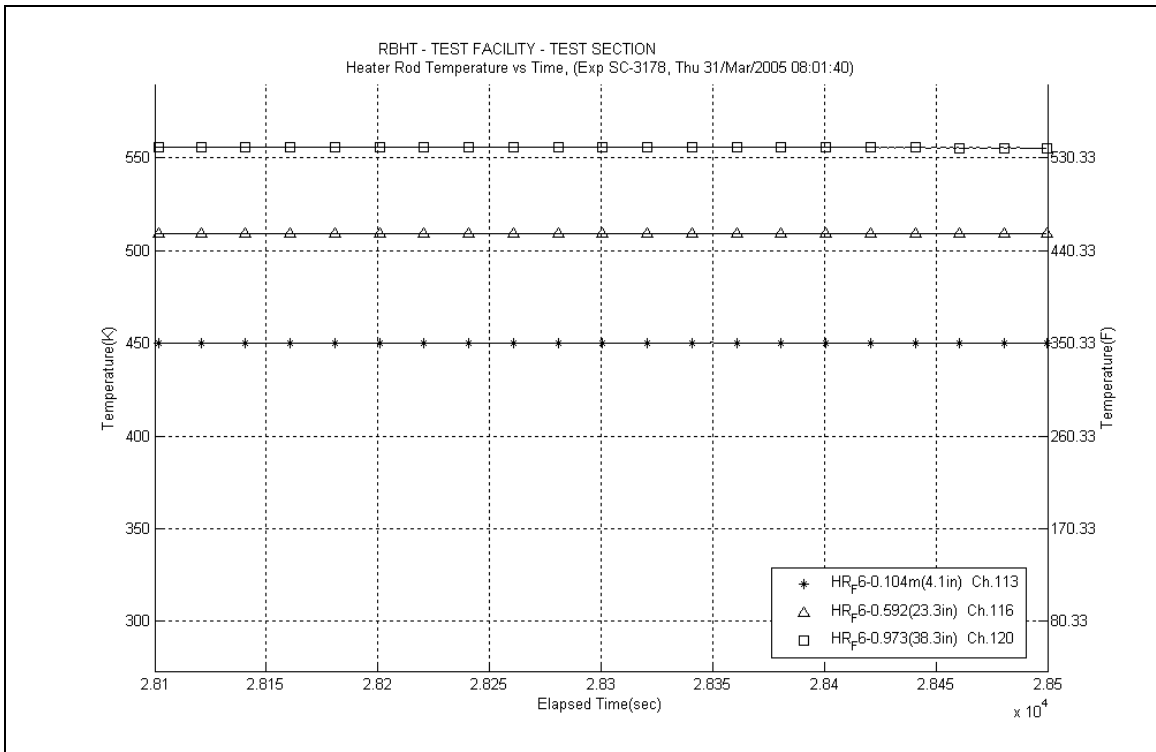
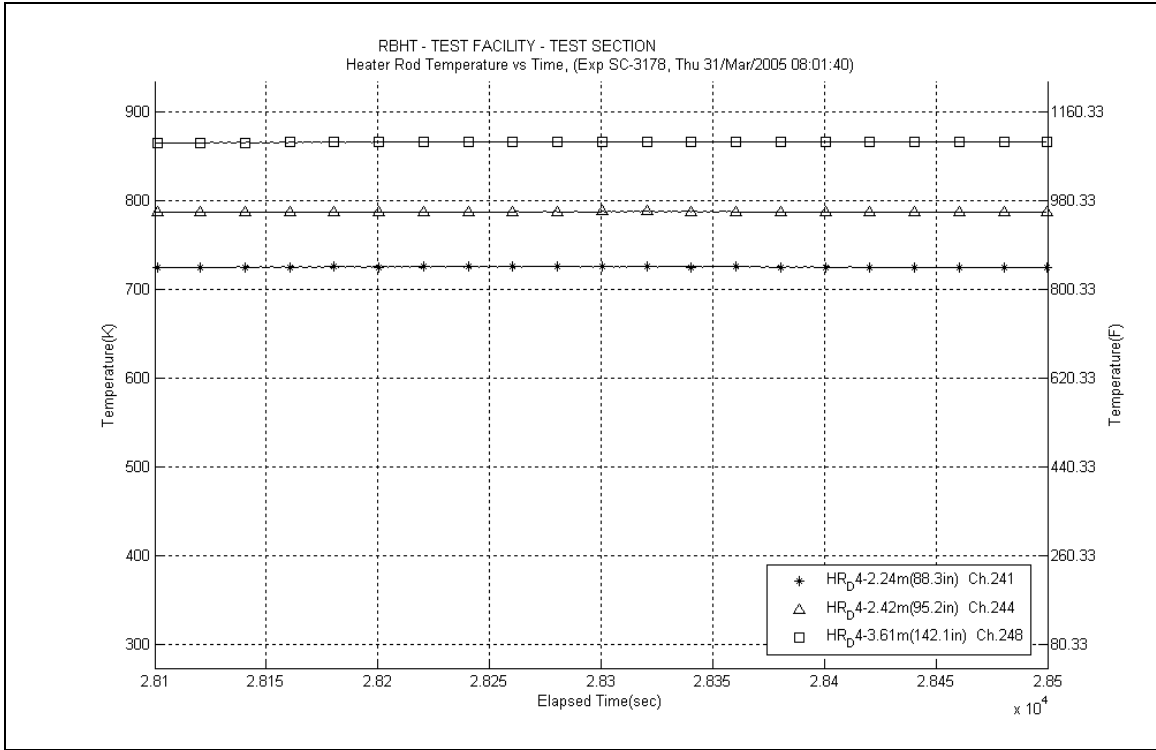
where x is the elevation (m) and T_{cl} is in (K)











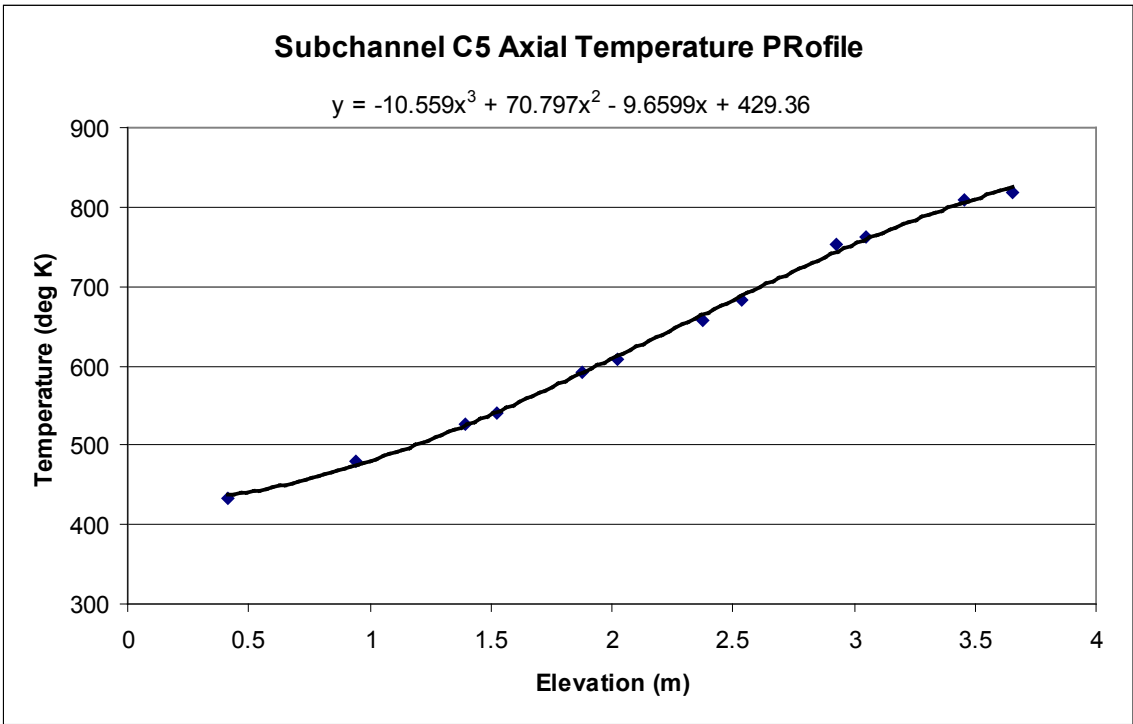
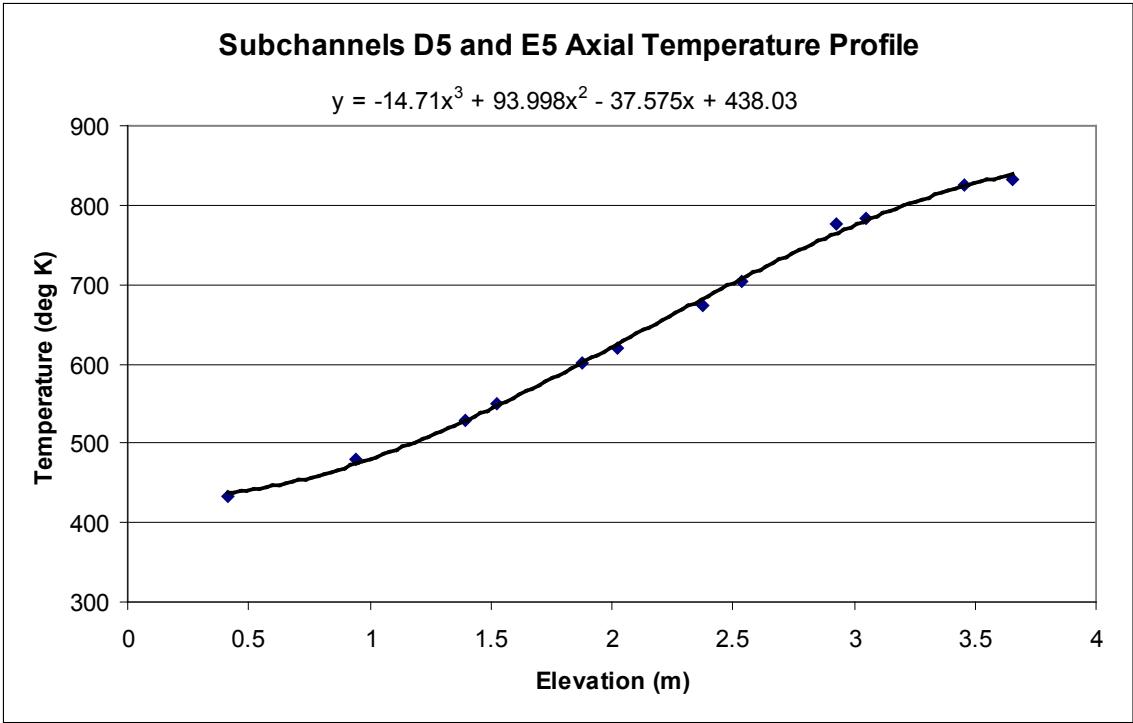


Table SC-3178-C.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	718.2	13345.8	660.6	1.20	670.2	5732	278.31	14.22	5.11%	60.00
RodD3_91.3	186	2.319	0.071	757.0	13626.8	672.9	1.20	686.9	5572	194.63	9.07	4.66%	40.49
RodD3_93.1	187	2.365	0.117	773.3	13801.4	680.3	1.20	695.8	5492	178.11	8.16	4.58%	36.38
RodD3_95.3	188	2.421	0.173	789.2	14005.2	689.2	1.20	705.9	5403	168.14	7.63	4.54%	33.64
RodD3_100.1	189	2.543	0.295	813.2	14461.1	708.4	1.20	725.8	5235	165.57	7.46	4.51%	31.81
RodD3_106.1	190	2.695	0.447	837.5	15027.5	731.5	1.20	749.2	5052	170.12	7.66	4.50%	31.22
RodD3_110	191	2.794	0.546	822.2	14840.1	746.0	1.27	762.3	4955	247.70	14.32	5.78%	44.33
RodD3_142.1	192	3.609	0.218	857.0	5164.6	835.3	1.27	839.9	4455	302.62	28.43	9.39%	47.07
RodC4_88.4	233	2.245	-0.003	720.5	13497.8	661.0	1.20	670.9	5724	272.57	13.75	5.04%	58.67
RodC4_91.1	234	2.314	0.066	753.3	13757.0	672.1	1.20	685.7	5584	203.40	9.51	4.67%	42.43
RodC4_93.4	235	2.372	0.124	768.0	13974.9	681.5	1.20	695.9	5490	193.85	8.96	4.62%	39.58
RodC4_95.3	236	2.421	0.173	783.3	14160.6	689.2	1.20	704.9	5411	180.55	8.23	4.56%	36.19
RodC4_100.1	237	2.543	0.295	807.4	14626.2	708.4	1.20	724.9	5243	177.14	8.01	4.52%	34.10
RodC4_106.1	238	2.695	0.447	833.9	15206.9	731.5	1.20	748.6	5057	178.18	8.02	4.50%	32.74
RodC4_110	239	2.794	0.546	816.5	14723.3	746.0	1.27	761.1	4964	265.58	15.56	5.86%	47.64
RodC4_142.2	240	3.612	0.221	869.1	5600.3	835.4	1.27	842.7	4440	211.63	15.42	7.29%	32.76
RodD4_88.3	241	2.243	-0.005	724.3	13446.9	660.6	1.20	671.2	5721	253.23	12.53	4.95%	54.47
RodD4_91.3	242	2.319	0.071	758.3	13736.7	672.9	1.20	687.2	5570	193.04	8.95	4.64%	40.14
RodD4_93.2	243	2.367	0.119	773.7	13914.7	680.7	1.20	696.2	5488	179.48	8.20	4.57%	36.63
RodD4_95.2	244	2.418	0.170	786.5	14104.5	688.8	1.20	705.1	5409	173.19	7.86	4.54%	34.70
RodD4_100.1	245	2.543	0.295	809.3	14576.9	708.4	1.20	725.2	5240	173.31	7.83	4.52%	33.34
RodD4_106.1	246	2.695	0.447	832.1	15148.0	731.5	1.20	748.3	5059	180.69	8.17	4.52%	33.22
RodD4_110	247	2.794	0.546	814.1	14635.1	746.0	1.27	760.6	4968	273.26	16.12	5.90%	49.07
RodD4_142.1	248	3.609	0.218	865.6	5411.6	835.3	1.27	841.8	4445	227.10	17.48	7.70%	35.21
RodE4_88.4	201	2.245	-0.003	716.5	13248.7	661.0	1.20	670.3	5731	286.58	14.85	5.18%	61.77
RodE4_91.2	202	2.316	0.069	749.6	13501.7	672.5	1.20	685.4	5587	210.19	9.98	4.75%	43.87
RodE4_95.3	204	2.421	0.173	781.8	13875.8	689.2	1.20	704.6	5413	179.92	8.28	4.60%	36.08
RodE4_100.9	205	2.563	0.315	808.9	14387.6	711.5	1.20	727.7	5219	177.23	8.09	4.57%	33.92
RodE4_142.3	208	3.614	0.224	856.7	5471.5	835.6	1.27	840.1	4454	330.87	31.56	9.54%	51.45
RodE3_63.4	193	1.610	0.417	657.0	10970.8	559.8	1.20	576.0	6837	135.56	6.18	4.56%	36.24
RodE3_113.6	194	2.885	0.022	827.8	13523.8	758.8	1.27	773.6	4875	249.56	14.72	5.90%	43.72
RodE3_115.5	195	2.934	0.070	842.4	13016.0	765.4	1.27	781.9	4818	214.98	12.46	5.80%	37.09
RodE3_118.5	196	3.010	0.146	854.6	12217.0	775.4	1.27	792.4	4748	196.13	11.32	5.77%	33.19
RodE3_122.7	197	3.117	0.253	862.2	11110.3	788.6	1.27	804.4	4670	192.10	11.19	5.82%	31.81
RodE3_126.5	198	3.213	0.349	862.2	10103.6	799.8	1.27	813.1	4615	206.00	12.33	5.98%	33.58
RodE3_131.7	199	3.345	-0.046	839.6	8736.1	813.5	1.27	819.1	4579	427.37	35.53	8.31%	68.93
RodE3_135.6	200	3.444	0.053	849.6	7695.8	822.7	1.27	828.4	4523	364.12	29.66	8.15%	57.78

Table SC-3178-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	656.9	10761.9	561.0	1.20	577.0	6824	134.69	6.20	4.60%	35.92
RodC5_113.6	226	2.885	0.022	824.0	13188.5	758.8	1.27	772.8	4881	257.37	15.40	5.98%	45.16
RodC5_115.7	227	2.939	0.075	842.4	12656.2	766.1	1.27	782.4	4815	210.99	12.31	5.83%	36.36
RodC5_122.7	229	3.117	0.253	864.6	10895.3	788.6	1.27	804.9	4667	182.39	10.62	5.82%	30.17
RodC5_126.7	230	3.218	0.354	865.2	9891.2	800.3	1.27	814.2	4609	193.98	11.56	5.96%	31.56
RodC5_131.6	231	3.343	-0.048	842.7	8664.1	813.3	1.27	819.6	4576	374.62	29.11	7.77%	60.37
RodC5_135.7	232	3.447	0.056	855.4	7628.6	822.9	1.27	829.9	4514	298.14	21.99	7.38%	47.19
RodE5_63.6	209	1.615	0.422	650.3	11031.9	560.6	1.20	575.6	6844	147.64	6.80	4.61%	39.51
RodE5_113.6	210	2.885	0.022	819.9	13603.5	758.8	1.27	771.9	4887	283.27	17.06	6.02%	49.79
RodE5_115.4	211	2.931	0.067	830.9	13131.8	765.0	1.27	779.1	4837	253.62	15.05	5.93%	43.98
RodE5_118.7	212	3.015	0.151	839.3	12277.5	776.0	1.27	789.6	4766	247.15	14.76	5.97%	42.04
RodE5_122.6	213	3.114	0.250	848.0	11257.4	788.3	1.27	801.1	4691	239.96	14.48	6.03%	39.97
RodE5_126.6	214	3.216	0.352	850.8	10214.7	800.0	1.27	810.9	4629	255.97	16.03	6.26%	41.89
RodE5_131.6	215	3.343	-0.048	831.1	8918.9	813.3	1.27	817.1	4591	636.75	68.16	10.71%	103.06
RodE5_135.6	216	3.444	0.053	845.5	7870.4	822.7	1.27	827.5	4528	438.50	39.40	8.98%	69.68
RodC3_79.8	177	2.027	0.227	701.7	12478.8	625.6	1.20	638.2	6064	196.63	9.35	4.76%	45.47
RodC3_85.6	178	2.174	0.374	709.2	13020.3	649.5	1.20	659.4	5839	261.57	13.23	5.06%	57.72
RodC3_88.5	179	2.248	0.000	715.8	13293.6	661.5	1.20	670.5	5729	293.40	15.29	5.21%	63.21
RodC3_92.4	180	2.347	0.099	758.3	13654.1	677.4	1.20	690.9	5536	202.56	9.52	4.70%	41.79
RodC3_94.4	181	2.398	0.150	767.8	13841.9	685.6	1.20	699.3	5460	202.04	9.47	4.69%	40.97
RodC3_97.2	182	2.469	0.221	790.2	14102.6	696.8	1.20	712.4	5347	181.36	8.32	4.59%	35.80
RodC3_108.8	183	2.764	0.516	830.7	14869.3	741.6	1.27	760.7	4967	212.40	12.10	5.70%	38.13
RodD5_50	217	1.270	0.076	598.0	9741.7	511.8	1.20	526.2	7613	135.55	6.27	4.63%	41.00
RodD5_54.1	218	1.374	0.180	623.3	10124.6	525.7	1.20	542.0	7349	124.49	5.65	4.54%	36.19
RodD5_56.9	219	1.445	0.251	637.0	10390.0	535.7	1.20	552.6	7182	123.00	5.56	4.52%	34.83
RodD5_60	220	1.524	0.330	647.2	10683.7	547.0	1.20	563.7	7014	127.93	5.79	4.53%	35.24
RodD5_66.1	221	1.679	0.485	661.8	11249.5	570.3	1.20	585.5	6707	147.59	6.78	4.60%	38.56
RodD5_69.9	222	1.775	-0.025	638.5	11605.4	585.3	1.20	594.2	6592	261.69	13.65	5.21%	66.98
RodD5_72.9	223	1.852	0.051	674.1	11884.8	597.3	1.20	610.1	6390	185.78	8.81	4.74%	45.80
RodD5_74.9	224	1.902	0.102	692.5	12070.0	605.5	1.20	620.0	6272	166.44	7.71	4.63%	40.12

Table SC-3178-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	575.1	8863.1	484.2	1.20	499.3	8105	116.91	5.37	4.59%	37.87
RodB5_52.9	154	1.344	0.150	616.2	9983.7	518.6	1.20	534.8	7466	122.79	5.58	4.56%	36.34
RodB5_55	155	1.397	0.203	625.3	10179.8	525.2	1.20	541.9	7350	122.14	5.54	4.53%	35.51
RodB5_57.8	156	1.468	0.274	637.5	10444.4	534.4	1.20	551.5	7198	121.55	5.49	4.51%	34.50
RodB5_64	157	1.626	0.432	652.4	11030.4	555.4	1.20	571.6	6900	136.41	6.22	4.56%	36.86
RodB5_73.9	158	1.877	0.077	680.4	11966.0	590.8	1.20	605.8	6444	160.25	7.39	4.61%	39.91
RodB5_75.9	159	1.928	0.128	695.6	12155.7	598.2	1.20	614.4	6338	149.76	6.82	4.56%	36.56
RodB5_76.9	160	1.953	0.153	701.9	12250.2	601.9	1.20	618.6	6289	146.95	6.67	4.54%	35.53
RodF5_41	105	1.041	0.343	568.2	8805.2	484.2	1.20	498.2	8128	125.73	5.86	4.66%	40.84
RodF5_53.1	106	1.349	0.155	607.8	9948.1	519.2	1.20	534.0	7480	134.75	6.22	4.62%	39.96
RodF5_55	107	1.397	0.203	616.8	10126.8	525.2	1.20	540.5	7373	132.67	6.10	4.60%	38.71
RodF5_57.8	108	1.468	0.274	627.3	10392.3	534.4	1.20	549.8	7224	134.24	6.16	4.59%	38.26
RodF5_64	109	1.626	0.432	642.6	10978.4	555.4	1.20	569.9	6924	151.11	6.99	4.63%	41.00
RodF5_73.8	110	1.875	0.074	665.7	11902.5	590.5	1.20	603.0	6479	189.88	9.06	4.77%	47.60
RodF5_75.8	111	1.925	0.125	680.1	12092.8	597.8	1.20	611.6	6373	176.30	8.26	4.69%	43.33
RodF5_76.8	112	1.951	0.150	685.7	12186.3	601.5	1.20	615.6	6324	173.68	8.11	4.67%	42.29
RodC2_41	57	1.041	0.343	568.2	8839.0	484.2	1.20	498.2	8128	126.24	5.88	4.66%	41.01
RodC2_53.1	58	1.349	0.155	612.9	9982.6	519.2	1.20	534.8	7466	127.80	5.85	4.57%	37.82
RodC2_55	59	1.397	0.203	621.0	10162.3	525.2	1.20	541.2	7362	127.30	5.81	4.56%	37.08
RodC2_57.8	60	1.468	0.274	632.9	10428.9	534.4	1.20	550.8	7210	126.99	5.77	4.54%	36.11
RodC2_63.9	61	1.623	0.429	646.2	11003.2	555.0	1.20	570.2	6919	144.86	6.65	4.59%	39.27
RodC2_73.8	62	1.875	0.074	669.5	11936.5	590.5	1.20	603.6	6471	181.35	8.56	4.72%	45.40
RodC2_75.8	63	1.925	0.125	682.8	12129.8	597.8	1.20	612.0	6368	171.28	7.97	4.66%	42.05
RodC2_76.8	64	1.951	0.150	688.1	12220.8	601.5	1.20	616.0	6320	169.39	7.86	4.64%	41.20
RodC6_40.9	137	1.039	0.340	573.4	8801.2	483.9	1.20	498.8	8115	117.95	5.44	4.61%	38.25
RodC6_52.8	138	1.341	0.147	616.6	9974.6	518.3	1.20	534.7	7469	121.73	5.53	4.54%	36.04
RodC6_54.8	139	1.392	0.198	626.6	10172.1	524.6	1.20	541.6	7355	119.69	5.41	4.52%	34.82
RodC6_57.8	140	1.468	0.274	639.9	10469.0	534.4	1.20	552.0	7191	118.98	5.35	4.50%	33.74
RodC6_63.8	141	1.621	0.427	656.2	11060.2	554.7	1.20	571.6	6900	130.74	5.92	4.53%	35.33
RodC6_73.7	142	1.872	0.072	682.5	12035.4	590.1	1.20	605.5	6448	156.34	7.16	4.58%	38.96
RodC6_75.8	143	1.925	0.125	694.6	12243.3	597.8	1.20	614.0	6344	151.80	6.90	4.55%	37.10
RodC6_76.8	144	1.951	0.150	701.7	12340.5	601.5	1.20	618.2	6293	147.89	6.69	4.53%	35.79

Table SC-3178-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	714.9	13239.3	645.1	1.20	656.7	5867	227.65	11.05	4.86%	50.54
RodB4_91.3	162	2.319	0.071	750.2	13503.1	656.0	1.20	671.7	5717	172.11	7.90	4.59%	36.99
RodB4_93.3	163	2.370	0.122	763.1	13686.2	663.5	1.20	680.1	5636	165.00	7.51	4.55%	34.83
RodB4_95.1	164	2.416	0.168	776.7	13850.5	670.3	1.20	688.0	5562	156.23	7.05	4.52%	32.43
RodB4_100	165	2.540	0.292	800.0	14300.8	688.5	1.20	707.1	5392	154.00	6.92	4.49%	30.73
RodB4_106	166	2.692	0.445	824.4	14847.4	710.5	1.20	729.5	5206	156.35	7.01	4.48%	29.82
RodB4_109.9	167	2.791	0.544	805.5	14377.2	724.4	1.20	737.9	5139	212.60	10.02	4.71%	39.89
RodB4_142.3	168	3.614	0.224	863.5	5562.6	820.7	1.27	829.9	4514	165.56	10.97	6.63%	26.20
RodF4_85.6	98	2.174	0.374	705.3	13066.4	634.5	1.20	646.3	5976	221.51	10.70	4.83%	50.31
RodF4_88.4	99	2.245	-0.003	708.9	13327.4	645.1	1.20	655.7	5878	250.49	12.42	4.96%	55.72
RodF4_92.4	100	2.347	0.099	751.5	13698.5	660.1	1.20	675.4	5681	179.95	8.28	4.60%	38.37
RodF4_94.3	101	2.395	0.147	766.4	13876.9	667.3	1.20	683.8	5601	167.99	7.63	4.54%	35.18
RodF4_97.2	102	2.469	0.221	784.5	14147.8	678.1	1.20	695.9	5491	159.57	7.19	4.50%	32.59
RodF4_108.8	103	2.764	0.516	811.2	14941.5	720.5	1.20	735.6	5157	197.60	9.09	4.60%	37.24
RodF4_111	104	2.819	-0.044	794.8	14338.5	728.2	1.20	739.3	5128	258.46	12.66	4.90%	48.35
RodD2_103.2	65	2.621	0.373	807.0	14784.8	700.3	1.20	718.1	5299	166.28	7.47	4.50%	32.45
RodD2_106	66	2.692	0.445	815.1	15051.6	710.5	1.20	727.9	5218	172.58	7.78	4.51%	33.02
RodD2_112.6	67	2.860	-0.004	802.2	13805.3	733.8	1.20	745.2	5082	242.34	11.81	4.87%	44.82
RodD2_114.9	68	2.918	0.055	822.9	13169.3	741.7	1.20	755.2	5007	194.57	9.13	4.69%	35.30
RodD2_117.4	69	2.982	0.118	832.2	12466.4	750.1	1.27	767.7	4917	193.18	11.11	5.75%	34.22
RodD2_120.8	70	3.068	0.204	843.4	11513.9	761.2	1.27	778.8	4839	178.18	10.25	5.75%	30.92
RodD2_124.8	71	3.170	0.306	846.8	10400.8	773.8	1.27	789.4	4767	181.30	10.60	5.84%	30.85
RodD2_128.6	72	3.266	0.403	845.5	9342.5	785.2	1.27	798.1	4711	197.22	11.93	6.05%	33.03
RodD6_103.1	129	2.619	0.371	804.2	14811.6	699.9	1.20	717.3	5305	170.43	7.68	4.50%	33.31
RodD6_106	130	2.692	0.445	810.9	15084.2	710.5	1.20	727.2	5224	180.16	8.15	4.53%	34.52
RodD6_112.9	131	2.868	0.004	800.2	13770.0	734.8	1.20	745.7	5078	252.89	12.46	4.93%	46.72
RodD6_114.9	132	2.918	0.055	819.6	13194.8	741.7	1.20	754.7	5011	203.30	9.62	4.73%	36.92
RodD6_116.8	133	2.967	0.103	830.3	12659.4	748.1	1.27	765.7	4931	195.85	11.26	5.75%	34.83
RodD6_120.9	134	3.071	0.207	839.1	11502.8	761.5	1.27	778.1	4844	188.75	10.93	5.79%	32.79
RodD6_124.8	135	3.170	0.306	842.4	10403.9	773.8	1.27	788.5	4774	192.98	11.39	5.90%	32.89
RodD6_128.7	136	3.269	0.405	842.1	9309.7	785.5	1.27	797.6	4714	209.07	12.81	6.13%	35.04

Table SC-3178-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	590.7	9773.6	510.0	1.20	523.4	7661	145.20	6.79	4.68%	44.23
RodE2_54	74	1.372	0.178	615.1	10145.3	522.1	1.20	537.6	7421	130.90	5.98	4.57%	38.47
RodE2_56.9	75	1.445	0.251	629.2	10420.6	531.4	1.20	547.7	7258	127.81	5.80	4.54%	36.62
RodE2_59.9	76	1.521	0.328	641.5	10709.7	541.4	1.20	558.0	7099	128.39	5.80	4.52%	35.86
RodE2_66	77	1.676	0.483	652.7	11292.3	562.4	1.20	577.4	6817	150.02	6.90	4.60%	39.97
RodE2_69.8	78	1.773	-0.027	628.0	11656.8	575.9	1.20	584.6	6719	268.59	14.09	5.25%	70.33
RodE2_72.9	79	1.852	0.051	661.1	11951.0	587.2	1.20	599.5	6523	194.07	9.27	4.77%	49.05
RodE2_74.9	80	1.902	0.102	675.5	12142.0	594.5	1.20	608.0	6417	179.98	8.43	4.69%	44.59
RodB3_50.2	169	1.275	0.081	588.8	9717.4	510.3	1.20	523.4	7662	148.46	6.99	4.71%	45.23
RodB3_54.1	170	1.374	0.180	605.0	10086.9	522.4	1.20	536.1	7444	146.53	6.84	4.67%	43.22
RodB3_56.9	171	1.445	0.251	615.8	10348.8	531.4	1.20	545.5	7293	147.21	6.84	4.65%	42.42
RodB3_60.1	172	1.527	0.333	622.3	10656.0	542.0	1.20	555.4	7139	159.37	7.48	4.69%	44.80
RodB3_66.1	173	1.679	0.485	647.3	11221.5	562.7	1.20	576.8	6826	159.22	7.40	4.65%	42.48
RodB3_69.9	174	1.775	-0.025	627.2	11583.2	576.3	1.20	584.8	6717	273.25	14.49	5.30%	71.53
RodB3_73	175	1.854	0.054	660.7	11873.1	587.5	1.20	599.7	6520	194.63	9.33	4.79%	49.17
RodB3_75	176	1.905	0.105	677.2	12061.1	594.9	1.20	608.6	6409	175.74	8.23	4.68%	43.48
RodF3_50.1	89	1.273	0.079	594.0	9719.9	510.0	1.20	524.0	7651	138.80	6.46	4.65%	42.22
RodF3_54	90	1.372	0.178	616.0	10093.2	522.1	1.20	537.7	7418	128.86	5.89	4.57%	37.86
RodF3_57	91	1.448	0.254	627.9	10386.1	531.7	1.20	547.8	7257	129.64	5.90	4.55%	37.14
RodF3_60	92	1.524	0.330	637.0	10675.4	541.7	1.20	557.6	7105	134.35	6.12	4.56%	37.57
RodF3_66.1	93	1.679	0.485	643.9	11265.4	562.7	1.20	576.3	6834	166.59	7.79	4.67%	44.51
RodF3_70	94	1.778	-0.022	629.5	11645.0	576.6	1.20	585.5	6708	264.28	13.80	5.22%	69.06
RodF3_73	95	1.854	0.054	663.1	11932.2	587.5	1.20	600.1	6515	189.44	9.01	4.75%	47.81
RodF3_75	96	1.905	0.105	680.5	12127.1	594.9	1.20	609.2	6402	169.96	7.89	4.64%	42.00
RodE6_50.2	121	1.275	0.081	591.0	9712.8	510.3	1.20	524.9	7634	146.95	6.76	4.60%	44.58
RodE6_54.1	122	1.374	0.180	612.9	10080.9	522.4	1.20	538.5	7406	135.46	6.14	4.54%	39.71
RodE6_57	123	1.448	0.254	624.8	10352.8	531.7	1.20	548.1	7252	134.97	6.11	4.53%	38.63
RodE6_60.2	124	1.529	0.335	634.6	10654.1	542.4	1.20	558.3	7094	139.67	6.35	4.55%	38.98
RodE6_66.1	125	1.679	0.485	649.2	11203.3	562.7	1.20	577.3	6820	155.68	7.22	4.64%	41.49
RodE6_73.1	127	1.857	0.056	663.4	11858.0	587.9	1.20	600.0	6517	187.12	8.98	4.80%	47.23
RodE6_75	128	1.905	0.105	679.8	12031.4	594.9	1.20	608.4	6411	168.66	7.93	4.70%	41.74

RBHT Steam Cooling Test SC-3180-A

Matrix test # 13

Test date – 4/6/2005

Steady state time window: 12840 - 13800 sec

Inlet flow: 0.35 m³/min (12.2 ft³/min)

Inlet steam temperature: 420 K (297 °F)

Upper plenum pressure: 409.5 kPa (59.4 psia)

Bundle power: 14.0 kW

Outlet steam temperature: 800 K (981 °F)

Bundle inlet Reynolds number: 1991

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

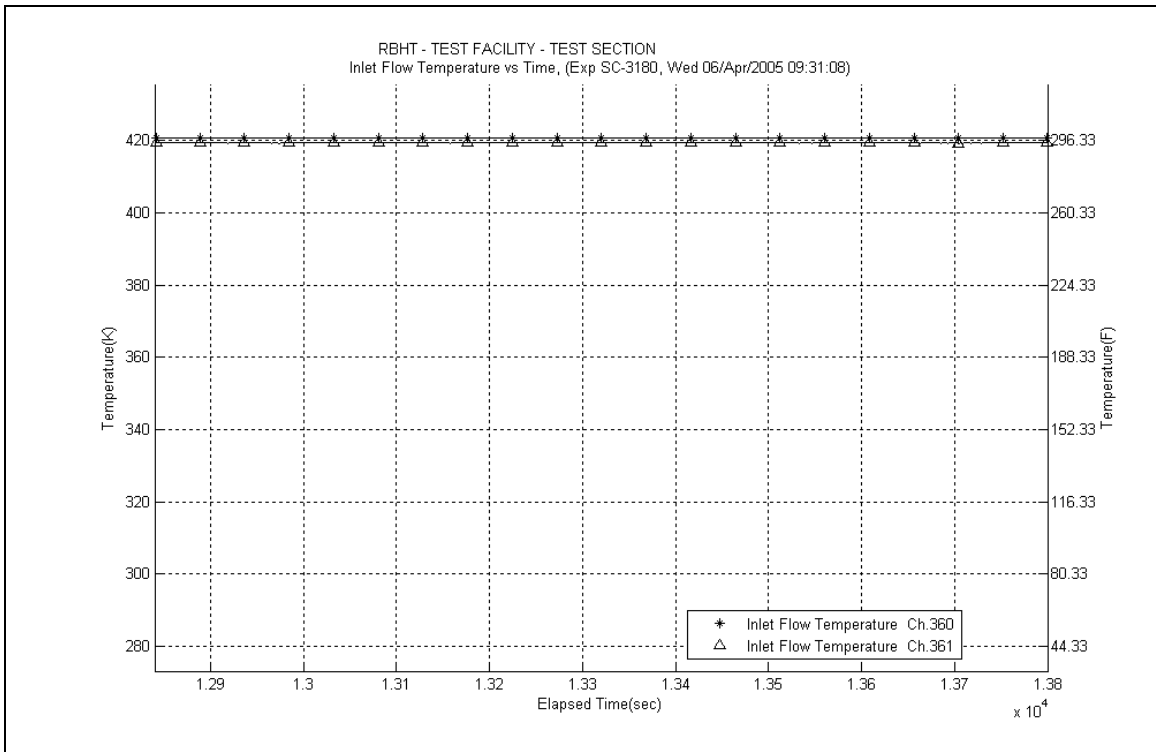
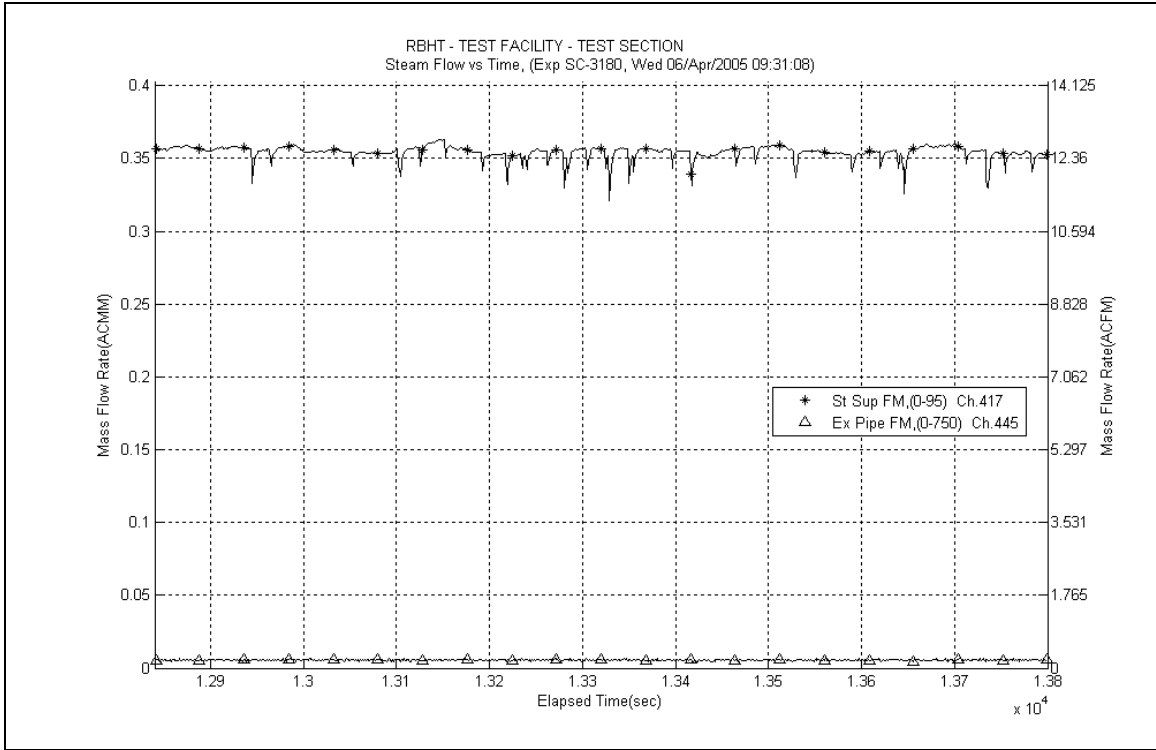
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

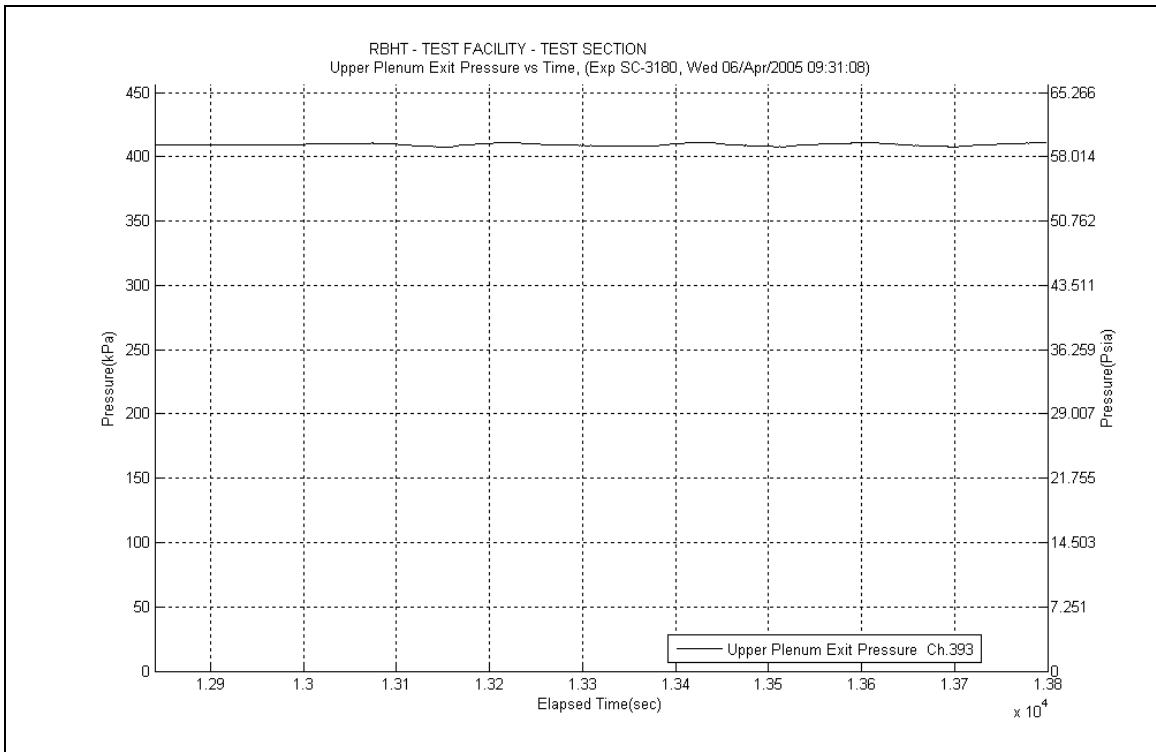
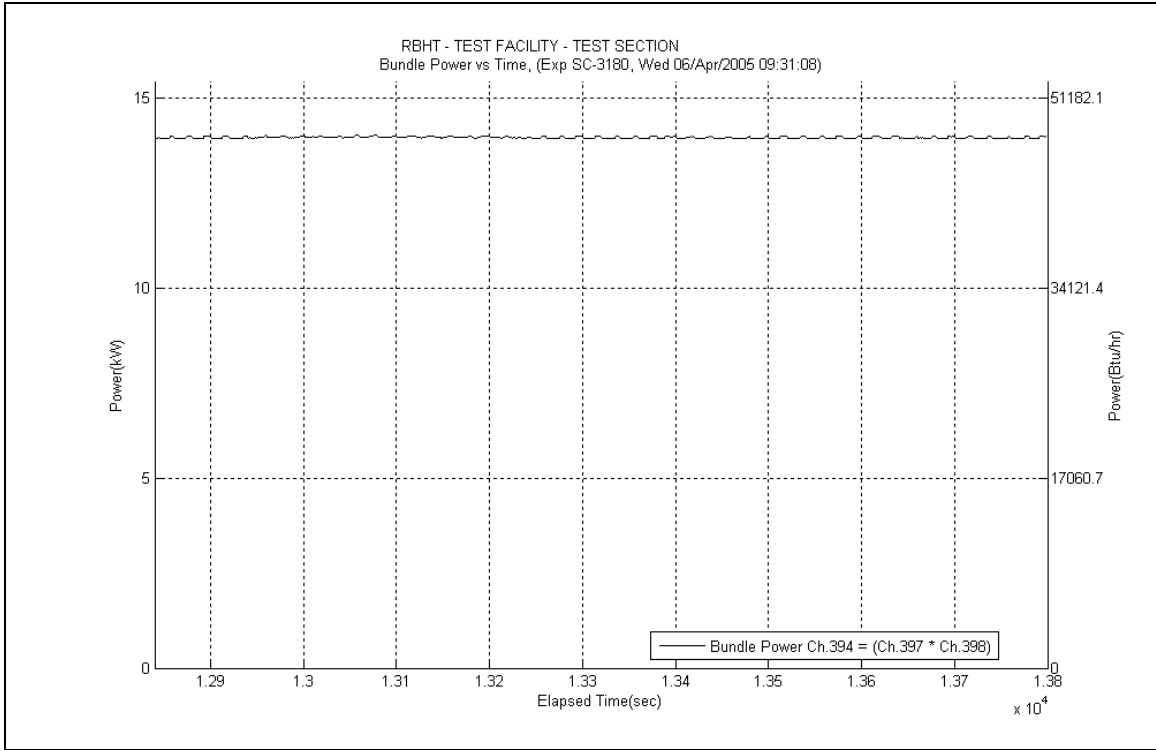
$$T_{cl} = -16.039x^3 + 96.018x^2 - 36.677x + 442.13$$

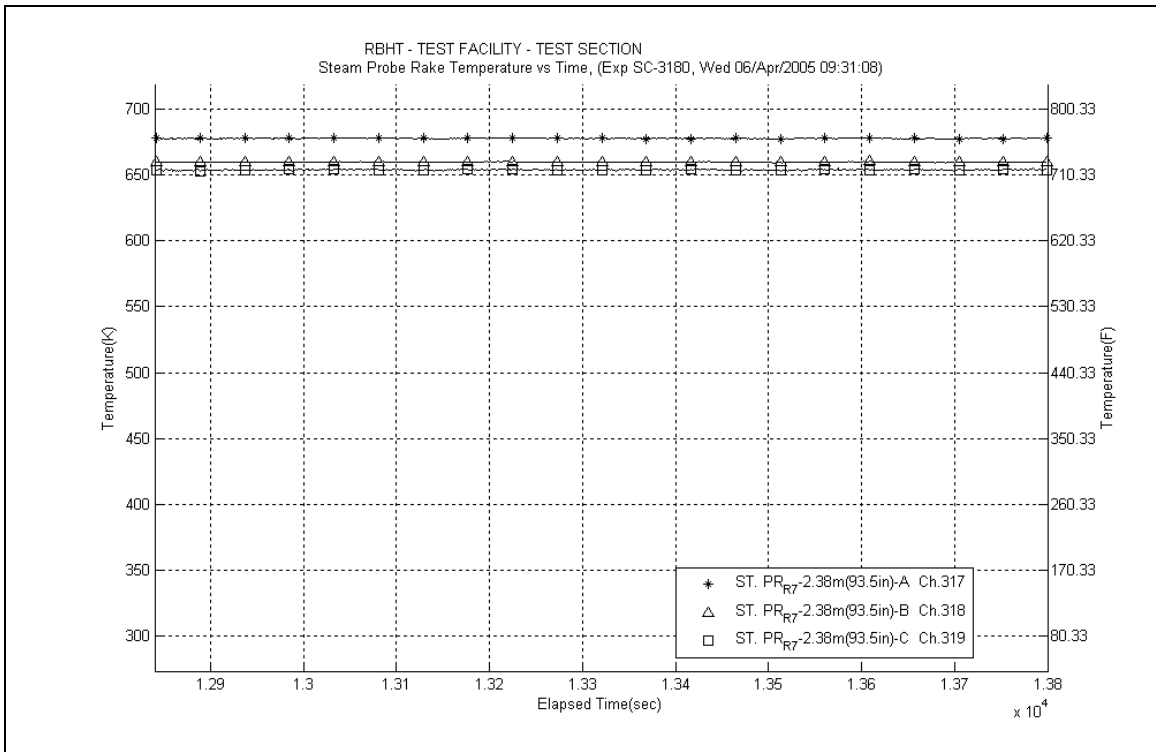
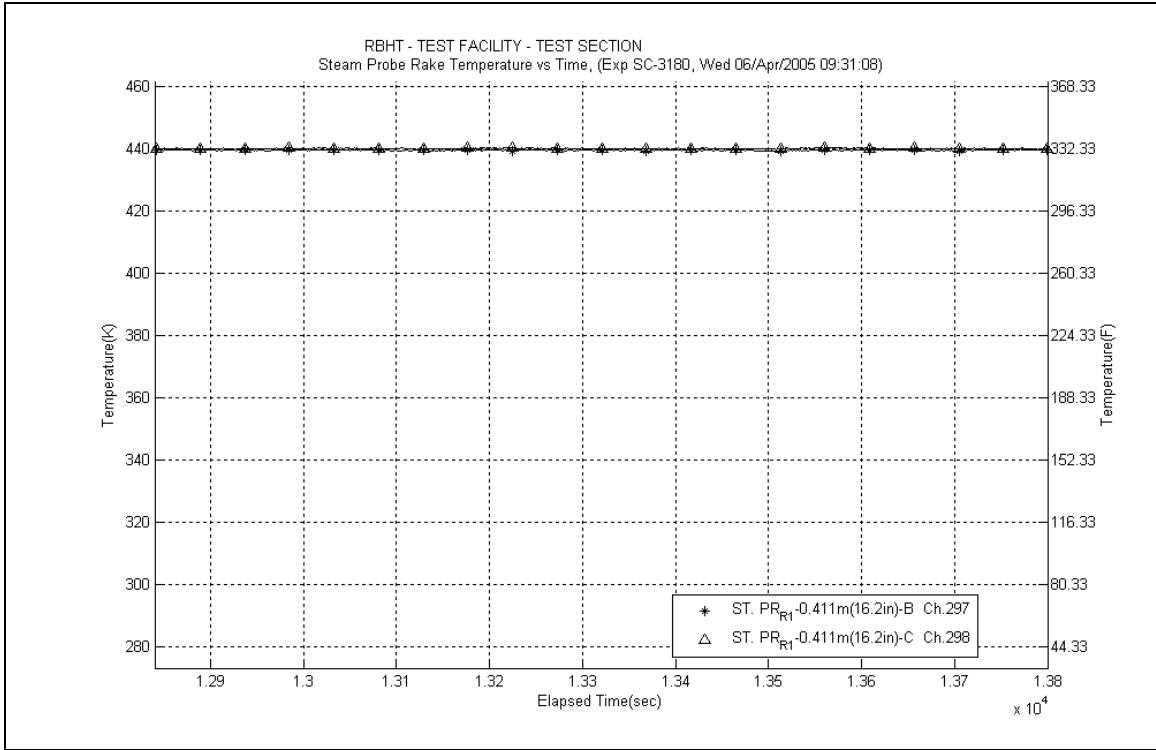
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

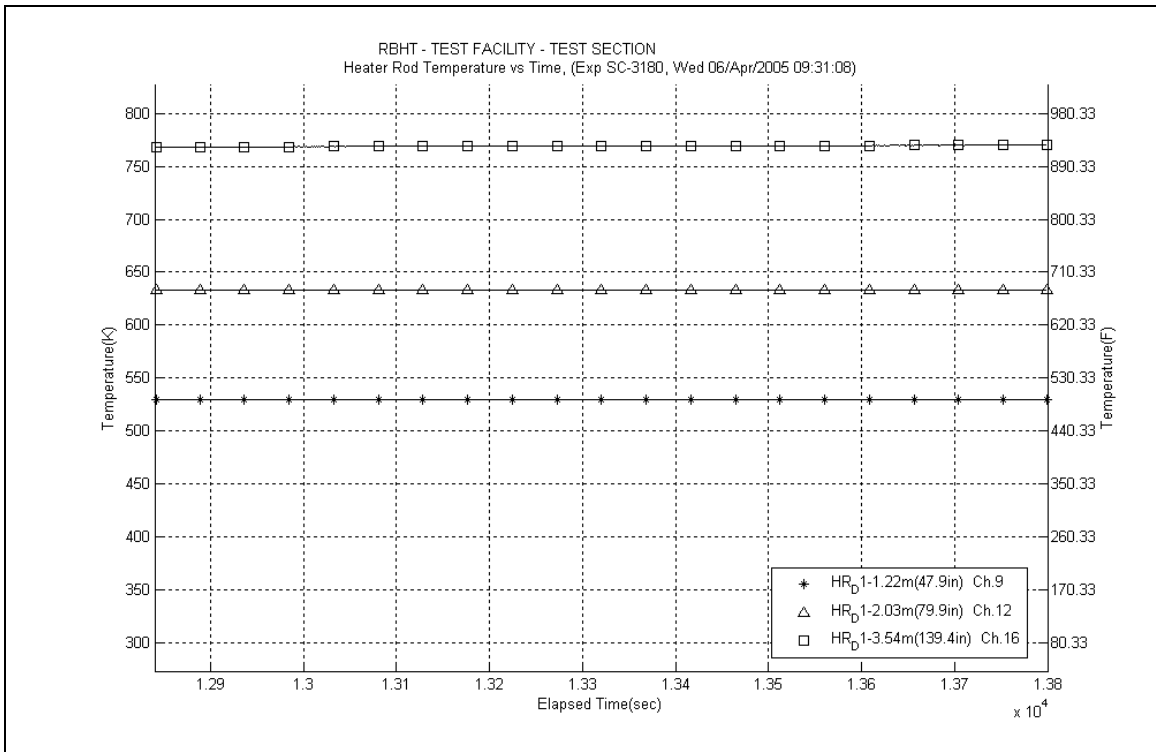
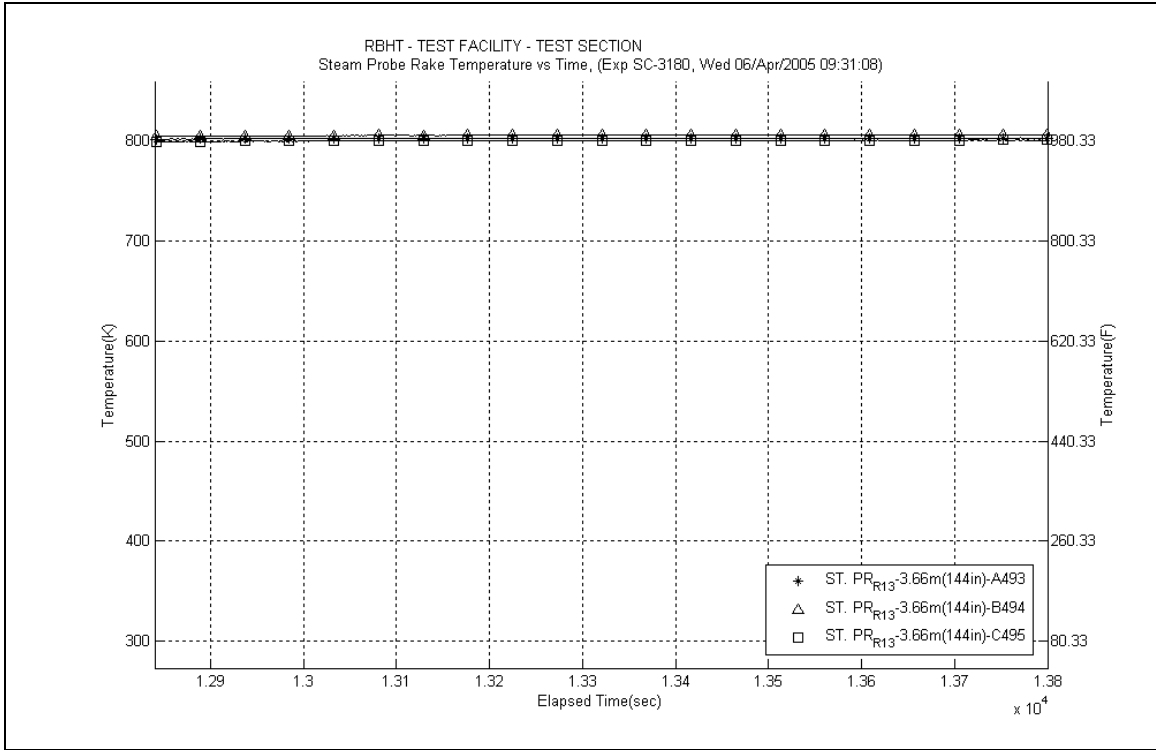
$$T_{cl} = -8.8333x^3 + 55.056x^2 + 20.513x + 423.98$$

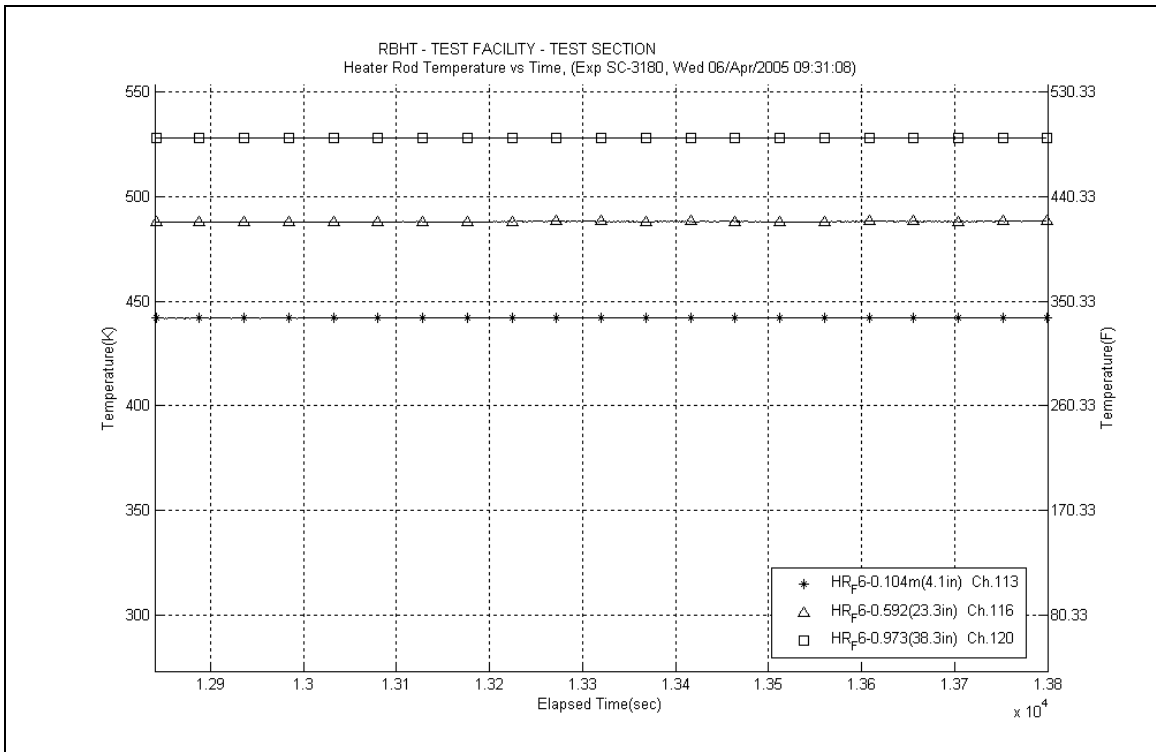
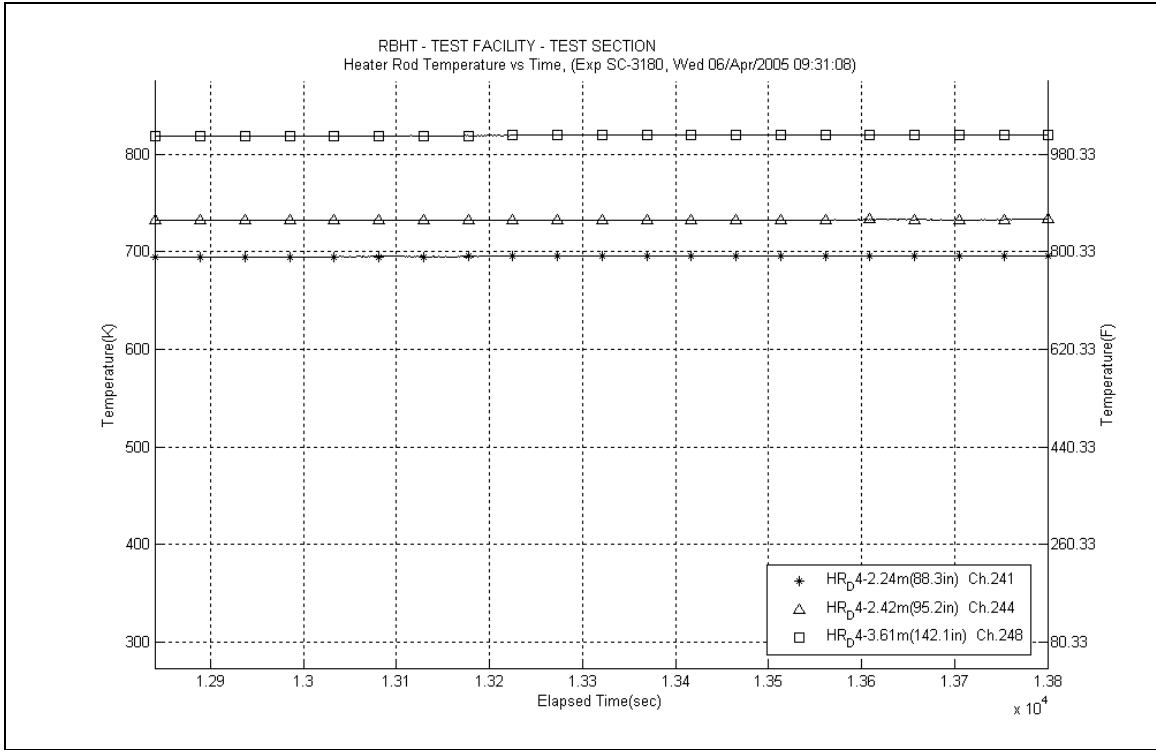
where x is the elevation (m) and T_{cl} is in (K)











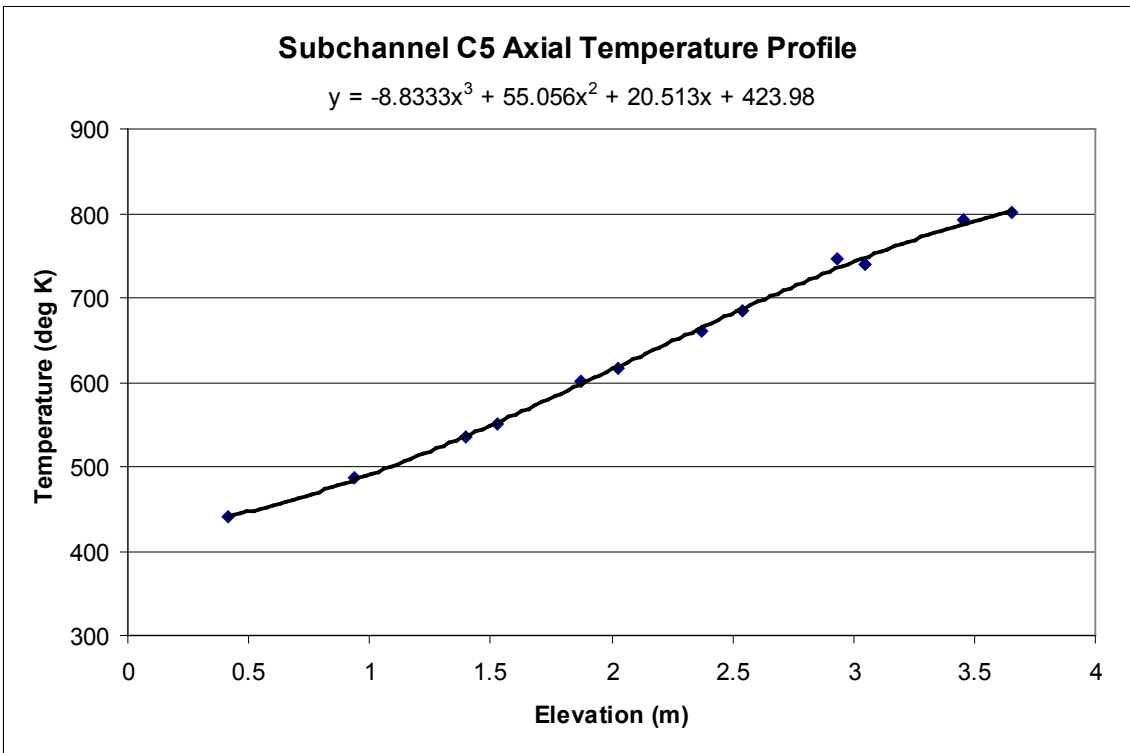
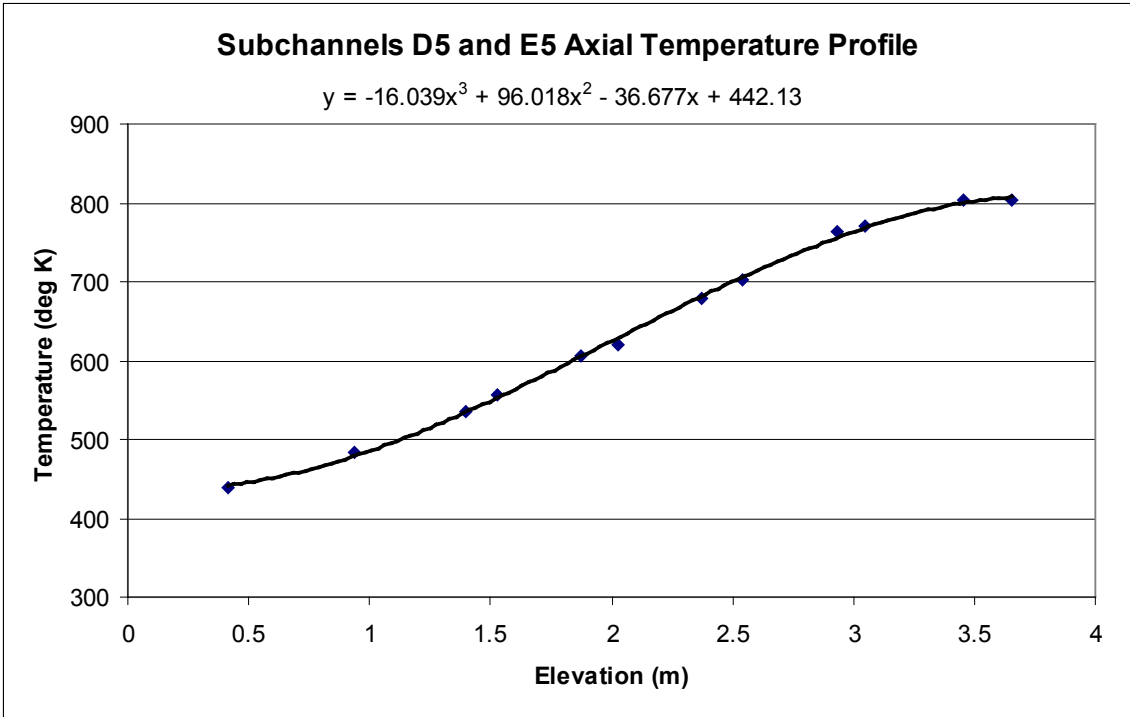


Table SC-3180-A.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	685.8	3731.8	661.9	1.50	669.9	1315	234.53	31.34	13.36%	50.48
RodD3_91.3	186	2.319	0.071	704.2	3811.0	673.4	1.50	683.7	1284	185.77	23.45	12.62%	38.83
RodD3_93.1	187	2.365	0.117	716.3	3858.3	680.2	1.50	692.3	1266	160.26	19.72	12.31%	32.90
RodD3_95.3	188	2.421	0.173	730.1	3916.4	688.5	1.50	702.3	1245	141.21	17.08	12.09%	28.40
RodD3_100.1	189	2.543	0.295	752.0	4041.8	706.0	1.50	721.3	1208	131.63	15.76	11.97%	25.47
RodD3_106.1	190	2.695	0.447	768.1	4200.1	726.7	1.50	740.5	1173	152.31	18.43	12.10%	28.38
RodD3_110	191	2.794	0.546	772.2	4147.4	739.4	1.50	750.3	1156	189.60	23.46	12.37%	34.67
RodD3_142.1	192	3.609	0.218	813.6	1434.3	806.5	1.50	808.8	1064	300.67	78.54	26.12%	49.33
RodC4_88.4	233	2.245	-0.003	693.3	3775.4	662.3	1.50	672.6	1308	182.89	22.93	12.54%	39.13
RodC4_91.1	234	2.314	0.066	708.7	3848.0	672.7	1.50	684.7	1282	160.00	19.57	12.23%	33.37
RodC4_93.4	235	2.372	0.124	721.1	3909.4	681.4	1.50	694.6	1261	147.52	17.82	12.08%	30.14
RodC4_95.3	236	2.421	0.173	732.3	3960.5	688.5	1.50	703.1	1244	135.48	16.19	11.95%	27.20
RodC4_100.1	237	2.543	0.295	754.7	4088.1	706.0	1.50	722.2	1207	125.89	14.90	11.84%	24.32
RodC4_106.1	238	2.695	0.447	769.8	4249.4	726.7	1.50	741.1	1172	147.96	17.71	11.97%	27.54
RodC4_110	239	2.794	0.546	772.2	4112.0	739.4	1.50	750.3	1156	188.11	23.39	12.43%	34.40
RodC4_142.2	240	3.612	0.221	819.1	1556.3	806.5	1.50	810.7	1061	185.73	32.41	17.45%	30.37
RodD4_88.3	241	2.243	-0.005	695.1	3758.0	661.9	1.50	673.0	1308	169.78	21.08	12.41%	36.30
RodD4_91.3	242	2.319	0.071	710.5	3837.2	673.4	1.50	685.8	1280	155.26	18.97	12.22%	32.31
RodD4_93.2	243	2.367	0.119	721.5	3887.9	680.6	1.50	694.2	1262	142.62	17.21	12.07%	29.16
RodD4_95.2	244	2.418	0.170	732.6	3940.8	688.1	1.50	702.9	1244	132.85	15.89	11.96%	26.68
RodD4_100.1	245	2.543	0.295	755.7	4069.6	706.0	1.50	722.5	1206	122.77	14.55	11.85%	23.70
RodD4_106.1	246	2.695	0.447	770.6	4229.2	726.7	1.50	741.3	1172	144.70	17.33	11.98%	26.92
RodD4_110	247	2.794	0.546	774.2	4084.2	739.4	1.50	751.0	1155	175.76	21.73	12.36%	32.10
RodD4_142.1	248	3.609	0.218	819.4	1501.2	806.5	1.50	810.8	1061	173.49	30.10	17.35%	28.36
RodE4_88.4	201	2.245	-0.003	687.8	3703.9	662.3	1.50	670.8	1313	218.09	28.78	13.19%	46.85
RodE4_91.2	202	2.316	0.069	702.7	3775.5	673.0	1.50	682.9	1286	191.19	24.42	12.77%	40.03
RodE4_95.3	204	2.421	0.173	725.1	3878.9	688.5	1.50	700.7	1249	158.91	19.63	12.35%	32.07
RodE4_100.9	205	2.563	0.315	747.3	4021.9	708.8	1.50	721.6	1208	156.70	19.24	12.28%	30.31
RodE4_142.3	208	3.614	0.224	814.1	1518.7	806.6	1.50	809.1	1063	303.48	75.60	24.91%	49.76
RodE3_63.4	193	1.610	0.417	612.2	3071.5	565.1	1.50	580.8	1553	97.69	11.67	11.95%	25.69
RodE3_113.6	194	2.885	0.022	779.7	3780.2	750.4	1.50	760.2	1139	193.34	24.69	12.77%	34.69
RodE3_115.5	195	2.934	0.070	786.6	3638.6	755.9	1.50	766.2	1129	178.08	22.53	12.65%	31.59
RodE3_118.5	196	3.010	0.146	794.7	3415.6	764.3	1.50	774.4	1116	168.41	21.30	12.65%	29.42
RodE3_122.7	197	3.117	0.253	801.4	3104.0	774.9	1.50	783.7	1101	176.08	22.87	12.99%	30.23
RodE3_126.5	198	3.213	0.349	804.4	2821.7	783.5	1.50	790.5	1091	202.59	28.02	13.83%	34.36
RodE3_131.7	199	3.345	-0.046	806.2	2435.3	793.5	1.50	797.7	1080	288.74	49.83	17.26%	48.32
RodE3_135.6	200	3.444	0.053	807.8	2144.2	799.5	1.50	802.3	1073	386.48	88.18	22.82%	64.15

Table SC-3180-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±chtc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	618.0	3011.3	566.2	1.50	583.5	1544	87.15	10.48	12.03%	22.77
RodC5_113.6	226	2.885	0.022	778.4	3683.4	750.4	1.50	759.7	1140	197.19	25.77	13.07%	35.41
RodC5_115.7	227	2.939	0.075	786.8	3536.4	756.5	1.50	766.6	1129	175.02	22.49	12.85%	31.02
RodC5_122.7	229	3.117	0.253	802.4	3042.0	774.9	1.50	784.1	1101	165.87	21.57	13.01%	28.46
RodC5_126.7	230	3.218	0.354	806.3	2759.9	783.9	1.50	791.4	1090	185.19	25.27	13.64%	31.35
RodC5_131.6	231	3.343	-0.048	808.2	2414.9	793.3	1.50	798.3	1079	243.55	38.71	15.89%	40.72
RodC5_135.7	232	3.447	0.056	812.4	2125.3	799.7	1.50	803.9	1071	251.10	43.20	17.20%	41.56
RodE5_63.6	209	1.615	0.422	610.0	3085.0	565.8	1.50	580.6	1554	104.69	12.56	12.00%	27.55
RodE5_113.6	210	2.885	0.022	772.9	3799.6	750.4	1.50	757.9	1143	253.49	34.43	13.58%	45.68
RodE5_115.4	211	2.931	0.067	780.3	3669.3	755.7	1.50	763.9	1133	222.99	29.49	13.22%	39.73
RodE5_118.7	212	3.015	0.151	788.6	3427.4	764.8	1.50	772.7	1119	215.61	28.70	13.31%	37.78
RodE5_122.6	213	3.114	0.250	795.2	3142.1	774.7	1.50	781.5	1105	230.01	31.96	13.90%	39.65
RodE5_126.6	214	3.216	0.352	799.2	2850.0	783.7	1.50	788.9	1093	276.49	42.92	15.52%	47.03
RodE5_131.6	215	3.343	-0.048	802.4	2484.8	793.3	1.50	796.4	1082	410.07	87.52	21.34%	68.80
RodE5_135.6	216	3.444	0.053	805.1	2191.7	799.5	1.50	801.4	1075	585.94	184.50	31.49%	97.42
RodC3_79.8	177	2.027	0.227	665.6	3491.0	628.7	1.50	641.0	1383	141.87	17.46	12.31%	32.51
RodC3_85.6	178	2.174	0.374	677.1	3641.9	651.4	1.50	660.0	1337	212.74	27.97	13.15%	46.77
RodC3_88.5	179	2.248	0.000	685.7	3717.7	662.7	1.50	670.3	1314	242.60	32.84	13.53%	52.16
RodC3_92.4	180	2.347	0.099	708.0	3818.3	677.6	1.50	687.7	1276	188.51	23.93	12.69%	39.07
RodC3_94.4	181	2.398	0.150	719.7	3871.0	685.1	1.50	696.6	1257	168.10	20.88	12.42%	34.20
RodC3_97.2	182	2.469	0.221	734.2	3943.9	695.5	1.50	708.4	1233	152.73	18.68	12.23%	30.34
RodC3_108.8	183	2.764	0.516	769.4	4156.0	735.6	1.50	746.8	1162	184.48	22.98	12.46%	33.96
RodD5_50	217	1.270	0.076	565.2	2726.1	517.6	1.50	533.4	1719	85.89	10.24	11.92%	25.30
RodD5_54.1	218	1.374	0.180	583.6	2832.9	531.4	1.50	548.8	1661	81.47	9.65	11.84%	23.12
RodD5_56.9	219	1.445	0.251	594.1	2905.9	541.3	1.50	558.9	1626	82.43	9.76	11.83%	22.84
RodD5_60	220	1.524	0.330	605.0	2987.1	552.5	1.50	570.0	1588	85.25	10.09	11.84%	23.00
RodD5_66.1	221	1.679	0.485	621.8	3145.9	575.3	1.50	590.8	1522	101.54	12.14	11.95%	26.08
RodD5_69.9	222	1.775	-0.025	621.7	3245.2	589.9	1.50	600.5	1493	153.05	19.17	12.52%	38.44
RodD5_72.9	223	1.852	0.051	637.6	3323.8	601.6	1.50	613.6	1456	138.37	17.01	12.29%	33.72
RodD5_74.9	224	1.902	0.102	648.8	3376.4	609.4	1.50	622.6	1431	128.65	15.67	12.18%	30.72

Table SC-3180-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±hc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	545.7	2479.6	495.1	1.50	511.9	1806	73.53	8.75	11.90%	22.83
RodB5_52.9	154	1.344	0.150	578.8	2795.0	529.5	1.50	546.0	1672	84.99	10.12	11.91%	24.29
RodB5_55	155	1.397	0.203	585.5	2850.6	536.0	1.50	552.5	1648	86.41	10.29	11.91%	24.31
RodB5_57.8	156	1.468	0.274	595.5	2924.4	544.8	1.50	561.7	1616	86.61	10.29	11.88%	23.83
RodB5_64	157	1.626	0.432	613.0	3087.6	564.9	1.50	580.9	1553	96.25	11.48	11.93%	25.30
RodB5_73.9	158	1.877	0.077	638.9	3348.8	598.0	1.50	611.7	1461	122.99	14.89	12.11%	30.11
RodB5_75.9	159	1.928	0.128	649.1	3401.0	604.9	1.50	619.6	1439	115.34	13.88	12.03%	27.73
RodB5_76.9	160	1.953	0.153	653.2	3427.0	608.3	1.50	623.3	1429	114.35	13.74	12.01%	27.26
RodF5_41	105	1.041	0.343	541.0	2463.5	495.1	1.50	510.4	1813	80.51	9.69	12.04%	25.09
RodF5_53.1	106	1.349	0.155	572.2	2783.3	530.1	1.50	544.2	1678	99.12	12.02	12.12%	28.45
RodF5_55	107	1.397	0.203	580.3	2833.4	536.0	1.50	550.8	1654	95.88	11.56	12.06%	27.09
RodF5_57.8	108	1.468	0.274	590.1	2907.4	544.8	1.50	559.9	1622	96.38	11.60	12.03%	26.64
RodF5_64	109	1.626	0.432	606.8	3070.8	564.9	1.50	578.8	1559	109.87	13.31	12.12%	29.03
RodF5_73.8	110	1.875	0.074	628.4	3329.7	597.7	1.50	607.9	1472	162.62	20.55	12.64%	40.15
RodF5_75.8	111	1.925	0.125	638.6	3382.4	604.5	1.50	615.9	1449	149.00	18.51	12.43%	36.12
RodF5_76.8	112	1.951	0.150	643.0	3408.7	607.9	1.50	619.6	1439	145.93	18.06	12.37%	35.08
RodC2_41	57	1.041	0.343	542.2	2474.6	495.1	1.50	510.8	1811	78.77	9.44	11.98%	24.52
RodC2_53.1	58	1.349	0.155	572.6	2795.6	530.1	1.50	544.3	1678	98.82	11.94	12.08%	28.36
RodC2_55	59	1.397	0.203	579.1	2845.9	536.0	1.50	550.4	1656	99.12	11.96	12.06%	28.03
RodC2_57.8	60	1.468	0.274	588.8	2919.6	544.8	1.50	559.5	1624	99.63	11.99	12.04%	27.57
RodC2_63.9	61	1.623	0.429	605.7	3080.2	564.5	1.50	578.3	1561	112.20	13.59	12.11%	29.68
RodC2_73.8	62	1.875	0.074	626.5	3342.3	597.7	1.50	607.3	1473	174.34	22.25	12.76%	43.10
RodC2_75.8	63	1.925	0.125	635.2	3395.4	604.5	1.50	614.8	1452	165.80	20.90	12.61%	40.30
RodC2_76.8	64	1.951	0.150	638.9	3421.9	607.9	1.50	618.3	1443	165.55	20.84	12.59%	39.92
RodC6_40.9	137	1.039	0.340	545.8	2463.0	494.8	1.50	511.8	1807	72.46	8.65	11.93%	22.50
RodC6_52.8	138	1.341	0.147	579.0	2791.5	529.2	1.50	545.8	1672	84.16	10.02	11.90%	24.06
RodC6_54.8	139	1.392	0.198	586.8	2845.8	535.4	1.50	552.5	1648	83.01	9.85	11.87%	23.35
RodC6_57.8	140	1.468	0.274	596.5	2928.7	544.8	1.50	562.0	1615	84.95	10.07	11.85%	23.36
RodC6_63.8	141	1.621	0.427	613.9	3093.5	564.2	1.50	580.8	1553	93.35	11.08	11.87%	24.55
RodC6_73.7	142	1.872	0.072	640.3	3366.6	597.4	1.50	611.7	1461	117.55	14.10	12.00%	28.77
RodC6_75.8	143	1.925	0.125	649.2	3424.4	604.5	1.50	619.4	1440	114.95	13.75	11.97%	27.64
RodC6_76.8	144	1.951	0.150	653.9	3451.4	607.9	1.50	623.3	1429	112.54	13.43	11.93%	26.83

Table SC-3180-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohhc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	684.5	3701.9	647.6	1.50	659.9	1338	150.63	18.58	12.33%	33.12
RodB4_91.3	162	2.319	0.071	702.7	3775.8	657.5	1.50	672.5	1309	125.30	15.11	12.06%	26.81
RodB4_93.3	163	2.370	0.122	712.3	3826.4	664.2	1.50	680.3	1292	119.29	14.31	12.00%	25.11
RodB4_95.1	164	2.416	0.168	720.6	3872.5	670.3	1.50	687.1	1277	115.35	13.79	11.96%	23.94
RodB4_100	165	2.540	0.292	738.1	3996.8	686.5	1.50	703.7	1243	116.28	13.89	11.94%	23.32
RodB4_106	166	2.692	0.445	757.3	4149.1	705.9	1.50	723.0	1205	121.09	14.47	11.95%	23.36
RodB4_109.9	167	2.791	0.544	761.6	4016.3	718.1	1.50	732.6	1187	138.62	16.86	12.17%	26.23
RodB4_142.3	168	3.614	0.224	807.7	1544.0	800.3	1.50	802.7	1073	313.25	78.79	25.15%	51.96
RodF4_85.6	98	2.174	0.374	670.6	3655.1	638.1	1.50	648.9	1364	168.56	21.10	12.52%	37.96
RodF4_88.4	99	2.245	-0.003	675.2	3728.5	647.6	1.50	656.8	1345	203.10	26.24	12.92%	44.96
RodF4_92.4	100	2.347	0.099	698.8	3832.7	661.2	1.50	673.7	1306	152.85	18.73	12.25%	32.63
RodF4_94.3	101	2.395	0.147	709.8	3882.2	667.6	1.50	681.7	1289	137.94	16.68	12.09%	28.95
RodF4_97.2	102	2.469	0.221	724.6	3956.6	677.3	1.50	693.0	1264	125.53	15.02	11.96%	25.73
RodF4_108.8	103	2.764	0.516	760.5	4176.1	714.7	1.50	730.0	1192	136.87	16.39	11.98%	26.04
RodF4_111	104	2.819	-0.044	764.7	4005.4	721.5	1.50	735.9	1181	138.89	16.72	12.04%	26.12
RodD2_103.2	65	2.621	0.373	733.9	4131.0	696.9	1.50	709.3	1232	167.47	20.52	12.25%	33.21
RodD2_106	66	2.692	0.445	743.2	4205.2	705.9	1.50	718.4	1214	168.94	20.67	12.24%	32.89
RodD2_112.6	67	2.860	-0.004	759.1	3857.0	726.3	1.50	737.3	1179	176.61	22.12	12.52%	33.12
RodD2_114.9	68	2.918	0.055	769.0	3677.5	733.2	1.50	745.1	1165	153.96	19.02	12.36%	28.43
RodD2_117.4	69	2.982	0.118	775.1	3482.1	740.5	1.50	752.0	1153	151.01	18.76	12.42%	27.52
RodD2_120.8	70	3.068	0.204	783.3	3216.3	750.1	1.50	761.2	1138	145.25	18.16	12.50%	26.01
RodD2_124.8	71	3.170	0.306	789.2	2902.6	760.9	1.50	770.3	1123	153.39	19.74	12.87%	27.00
RodD2_128.6	72	3.266	0.403	792.8	2606.1	770.6	1.50	778.0	1110	175.67	24.03	13.68%	30.48
RodD6_103.1	129	2.619	0.371	736.2	4136.7	696.6	1.50	710.5	1229	149.34	18.02	12.07%	29.54
RodD6_106	130	2.692	0.445	746.7	4212.2	705.9	1.50	719.5	1212	154.87	18.73	12.09%	30.08
RodD6_112.9	131	2.868	0.004	763.0	3843.4	727.2	1.50	739.2	1175	161.05	19.87	12.34%	30.09
RodD6_114.9	132	2.918	0.055	770.4	3686.8	733.2	1.50	745.6	1164	148.87	18.28	12.28%	27.47
RodD6_116.8	133	2.967	0.103	775.8	3536.1	738.8	1.50	751.1	1155	143.32	17.61	12.29%	26.17
RodD6_120.9	134	3.071	0.207	782.5	3209.8	750.4	1.50	761.1	1138	149.76	18.82	12.57%	26.83
RodD6_124.8	135	3.170	0.306	785.9	2901.1	760.9	1.50	769.2	1124	173.88	23.03	13.25%	30.67
RodD6_128.7	136	3.269	0.405	790.2	2592.9	770.8	1.50	777.3	1111	200.17	28.63	14.31%	34.78

Table SC-3180-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohhc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	557.3	2737.0	521.0	1.50	533.1	1720	113.09	13.85	12.25%	33.34
RodE2_54	74	1.372	0.178	575.2	2841.2	532.9	1.50	547.0	1668	100.84	12.13	12.03%	28.75
RodE2_56.9	75	1.445	0.251	585.2	2918.4	542.0	1.50	556.4	1634	101.35	12.16	12.00%	28.25
RodE2_59.9	76	1.521	0.328	595.7	2998.6	551.5	1.50	566.2	1600	101.89	12.20	11.97%	27.74
RodE2_66	77	1.676	0.483	609.8	3161.3	571.5	1.50	584.3	1542	123.72	15.04	12.15%	32.27
RodE2_69.8	78	1.773	-0.027	610.0	3262.9	584.2	1.50	592.8	1516	189.47	24.65	13.01%	48.44
RodE2_72.9	79	1.852	0.051	623.3	3345.7	594.7	1.50	604.2	1482	175.24	22.29	12.72%	43.63
RodE2_74.9	80	1.902	0.102	632.9	3399.1	601.5	1.50	611.9	1460	162.15	20.27	12.50%	39.67
RodB3_50.2	169	1.275	0.081	566.6	2719.9	521.3	1.50	533.1	1720	115.54	14.27	12.35%	34.07
RodB3_54.1	170	1.374	0.180	571.2	2822.9	533.2	1.50	545.9	1672	111.39	13.62	12.23%	31.84
RodB3_56.9	171	1.445	0.251	581.7	2897.8	542.0	1.50	555.2	1638	109.42	13.30	12.16%	30.58
RodB3_60.1	172	1.527	0.333	592.7	2982.0	552.2	1.50	565.7	1602	110.45	13.40	12.13%	30.11
RodB3_66.1	173	1.679	0.485	610.3	3140.1	571.8	1.50	584.6	1541	122.52	14.95	12.20%	31.93
RodB3_69.9	174	1.775	-0.025	611.3	3240.6	584.5	1.50	593.4	1514	181.48	23.51	12.95%	46.33
RodB3_73	175	1.854	0.054	624.7	3322.6	595.0	1.50	604.9	1480	167.88	21.29	12.68%	41.74
RodB3_75	176	1.905	0.105	635.6	3375.6	601.8	1.50	613.1	1457	149.75	18.58	12.41%	36.54
RodF3_50.1	89	1.273	0.079	562.8	2720.7	521.0	1.50	534.9	1713	97.83	11.83	12.09%	28.72
RodF3_54	90	1.372	0.178	580.1	2826.1	532.9	1.50	548.6	1662	89.82	10.73	11.95%	25.51
RodF3_57	91	1.448	0.254	590.1	2907.2	542.3	1.50	558.2	1628	91.26	10.88	11.93%	25.32
RodF3_60	92	1.524	0.330	599.2	2988.0	551.8	1.50	567.6	1596	94.71	11.30	11.93%	25.70
RodF3_66.1	93	1.679	0.485	611.9	3152.8	571.8	1.50	585.2	1539	118.10	14.31	12.12%	30.74
RodF3_70	94	1.778	-0.022	613.2	3257.8	584.9	1.50	594.3	1511	172.58	22.04	12.77%	43.97
RodF3_73	95	1.854	0.054	627.7	3339.0	595.0	1.50	605.9	1477	152.93	19.02	12.44%	37.93
RodF3_75	96	1.905	0.105	639.0	3392.9	601.8	1.50	614.2	1454	136.78	16.70	12.21%	33.29
RodE6_50.2	121	1.275	0.081	558.9	2718.7	521.3	1.50	533.9	1717	108.61	13.31	12.25%	31.97
RodE6_54.1	122	1.374	0.180	574.9	2820.6	533.2	1.50	547.1	1667	101.52	12.29	12.11%	28.94
RodE6_57	123	1.448	0.254	584.2	2896.4	542.3	1.50	556.3	1635	103.53	12.52	12.10%	28.86
RodE6_60.2	124	1.529	0.335	595.4	2979.7	552.5	1.50	566.8	1599	104.12	12.57	12.07%	28.30
RodE6_66.1	125	1.679	0.485	610.3	3133.8	571.8	1.50	584.6	1541	122.14	14.92	12.21%	31.83
RodE6_70	126	1.778	-0.022	609.9	3235.4	584.9	1.50	593.2	1515	193.84	25.54	13.17%	49.51
RodE6_73.1	127	1.857	0.056	623.9	3316.5	595.3	1.50	604.9	1480	174.19	22.29	12.80%	43.31
RodE6_75	128	1.905	0.105	634.3	3365.5	601.8	1.50	612.6	1458	155.49	19.45	12.51%	37.98

RBHT Steam Cooling Test SC-3180-B

Matrix test # 14

Test date – 4/6/2005

Steady state time window: 9960 - 10260 sec

Inlet flow: 1.01 m³/min (35.5 ft³/min)

Inlet steam temperature: 420 K (297 °F)

Upper plenum pressure: 409.5 kPa (59.4 psia)

Bundle power: 29.9 kW

Outlet steam temperature: 770 K (927 °F)

Bundle inlet Reynolds number: 5794

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

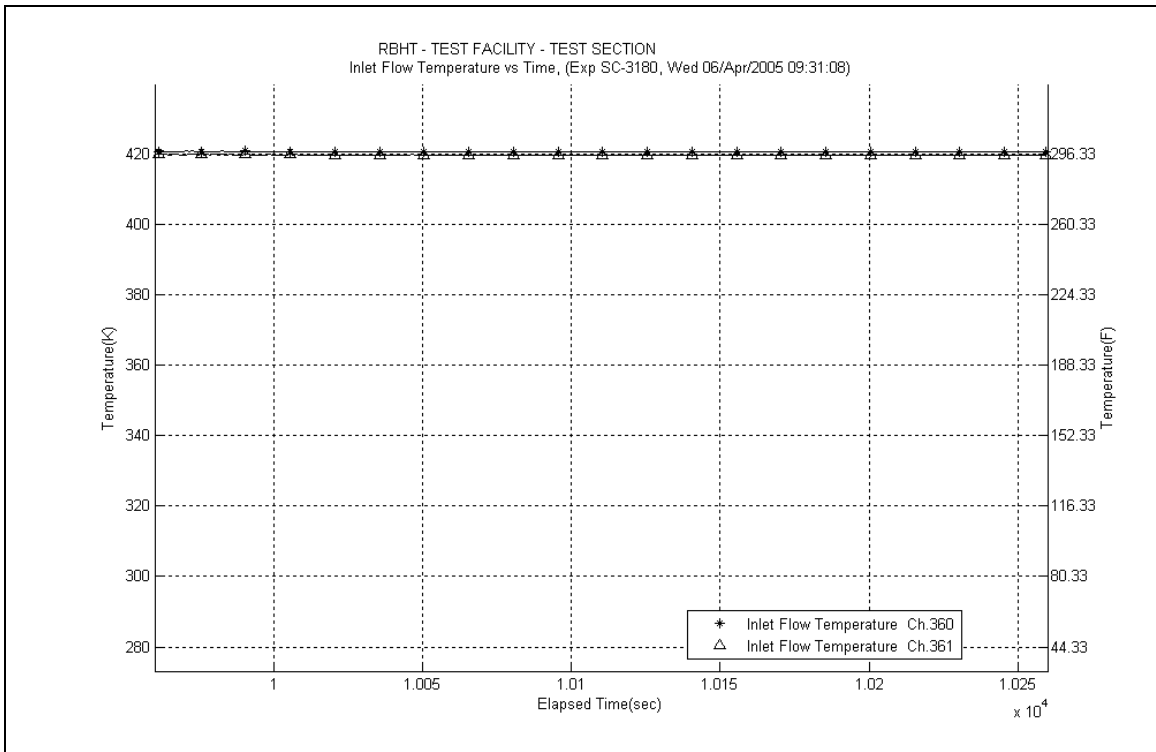
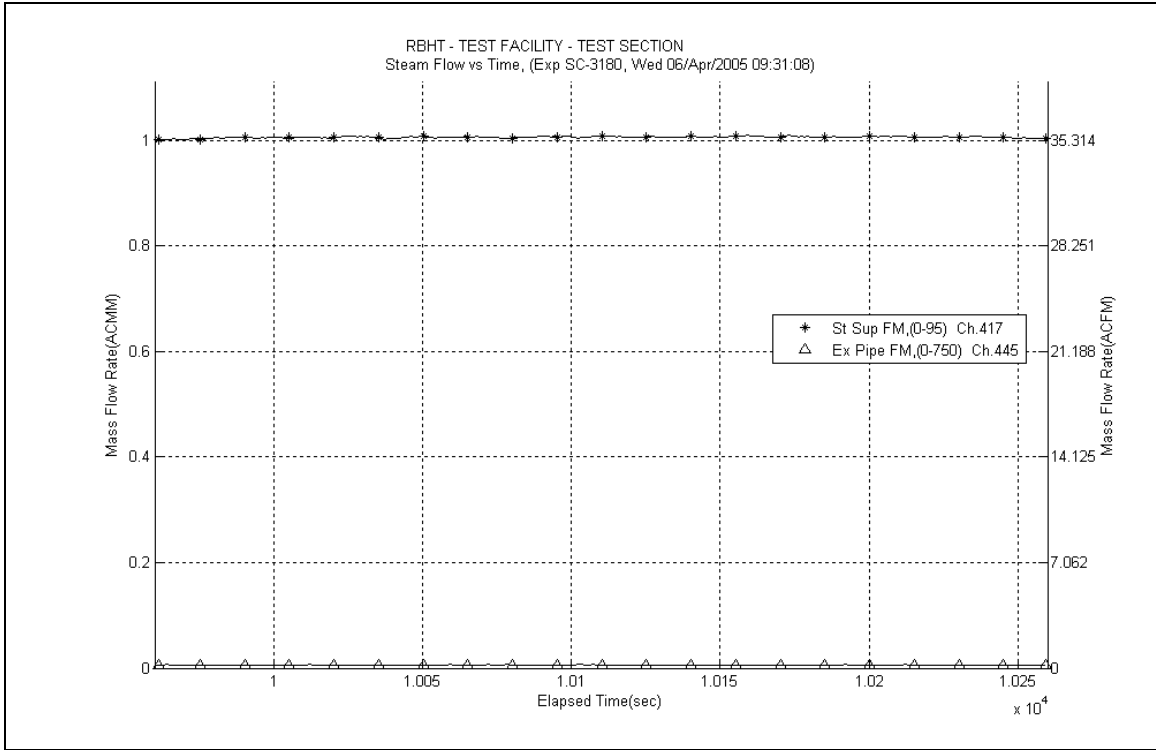
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

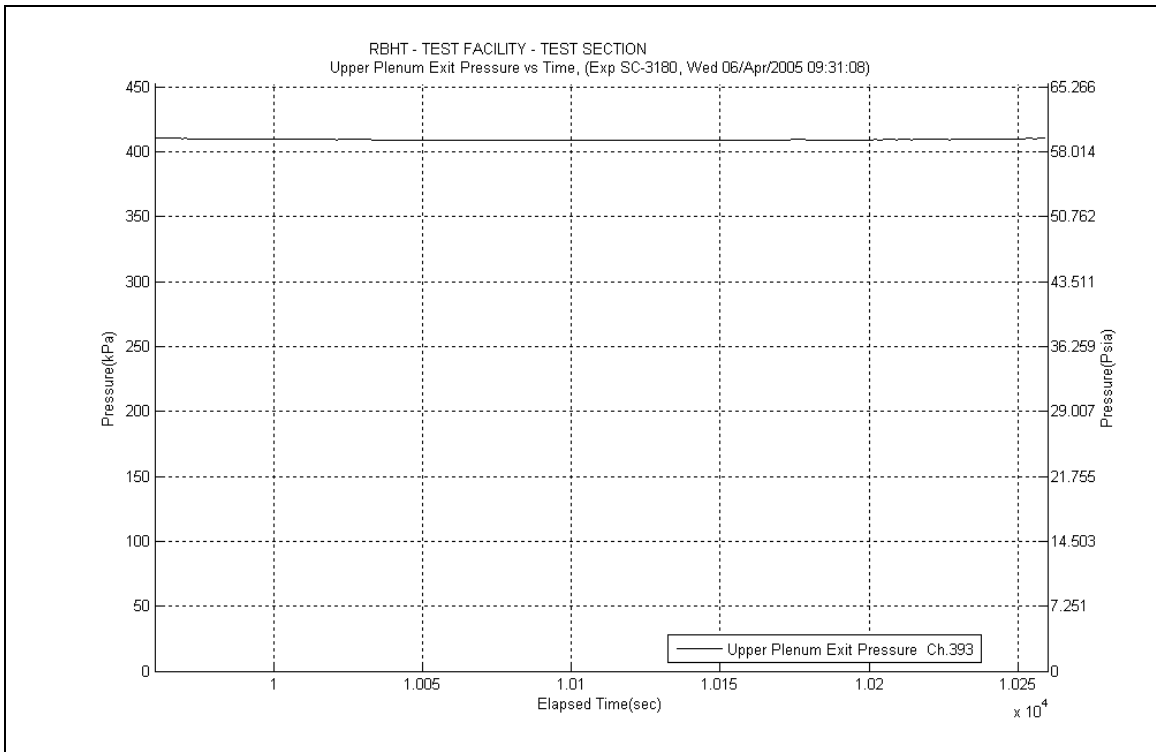
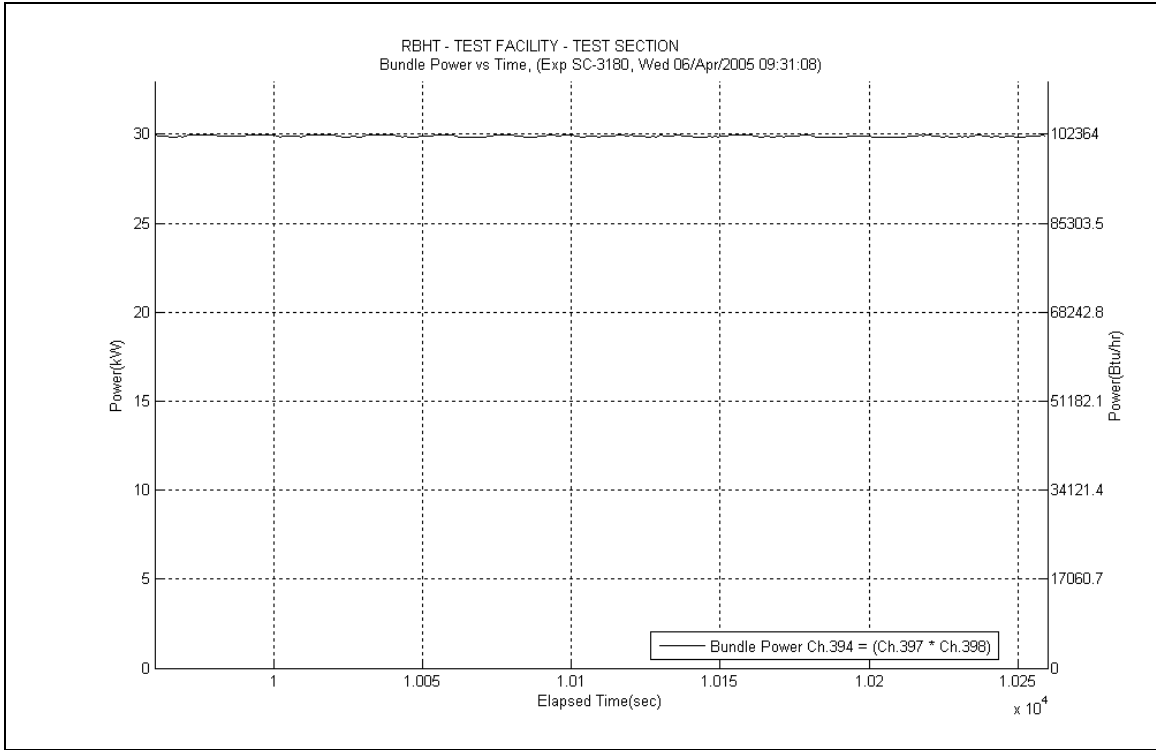
$$T_{cl} = -14.398x^3 + 90.388x^2 - 48.035x + 444.77$$

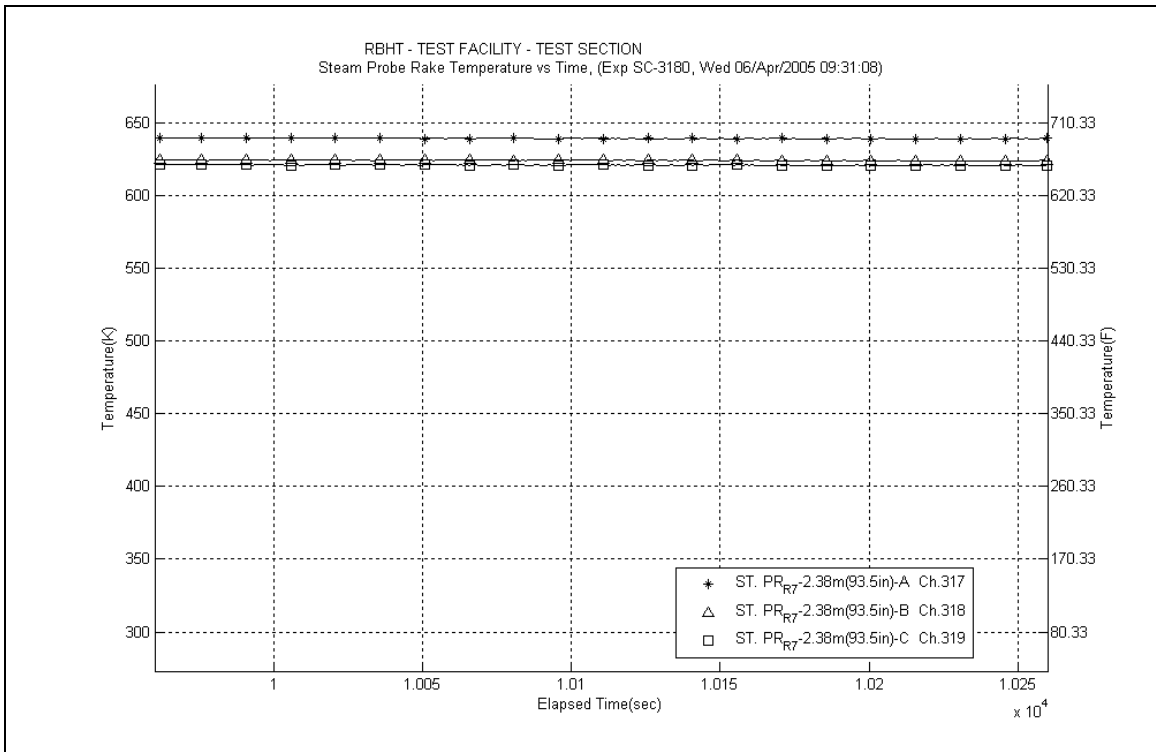
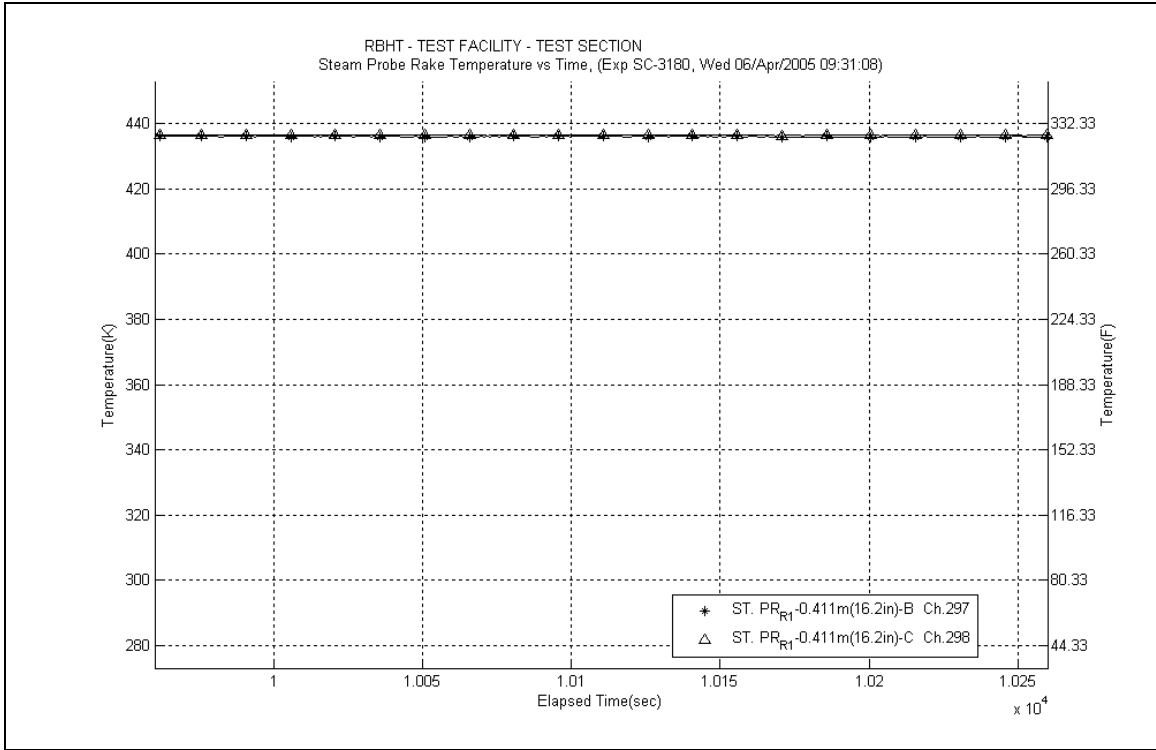
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

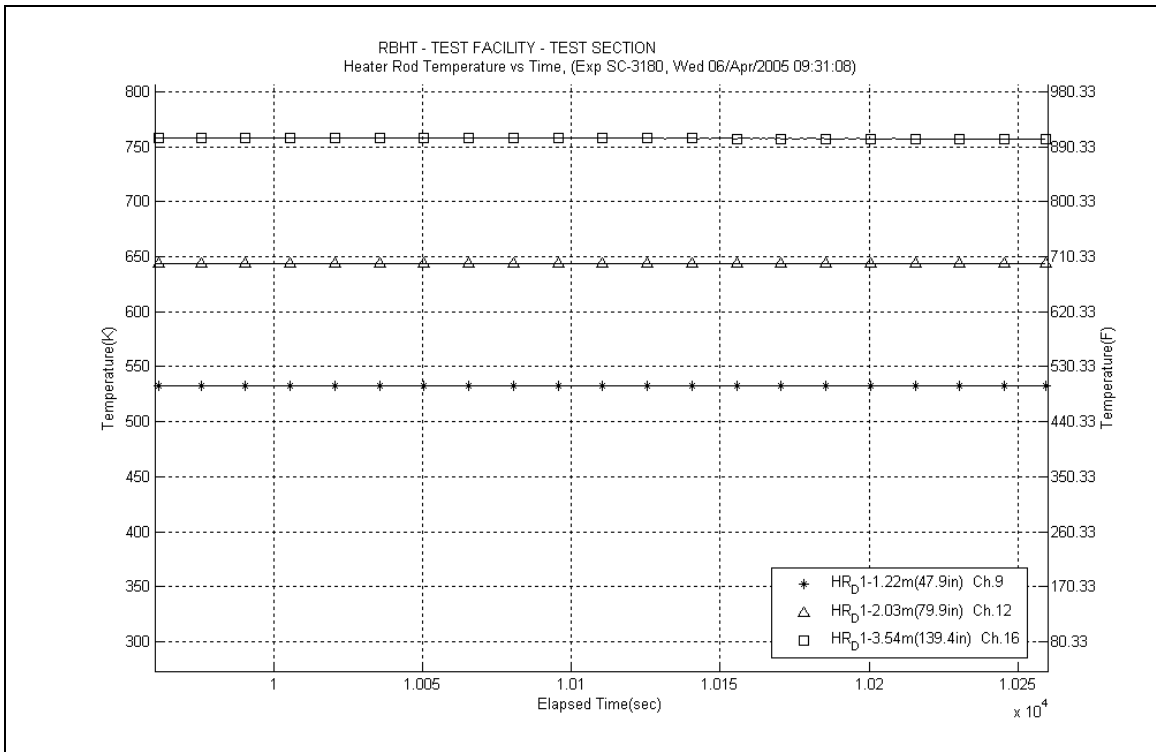
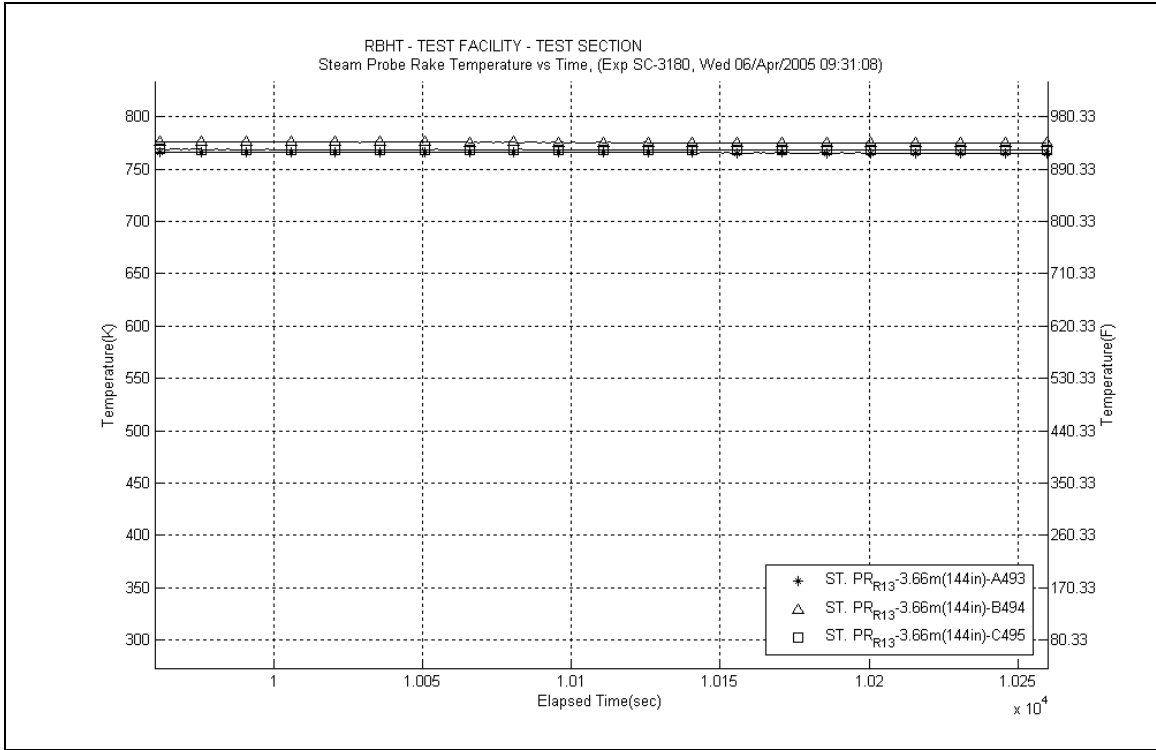
$$T_{cl} = -7.8945x^3 + 54.904x^2 - 1.1931x + 430.65$$

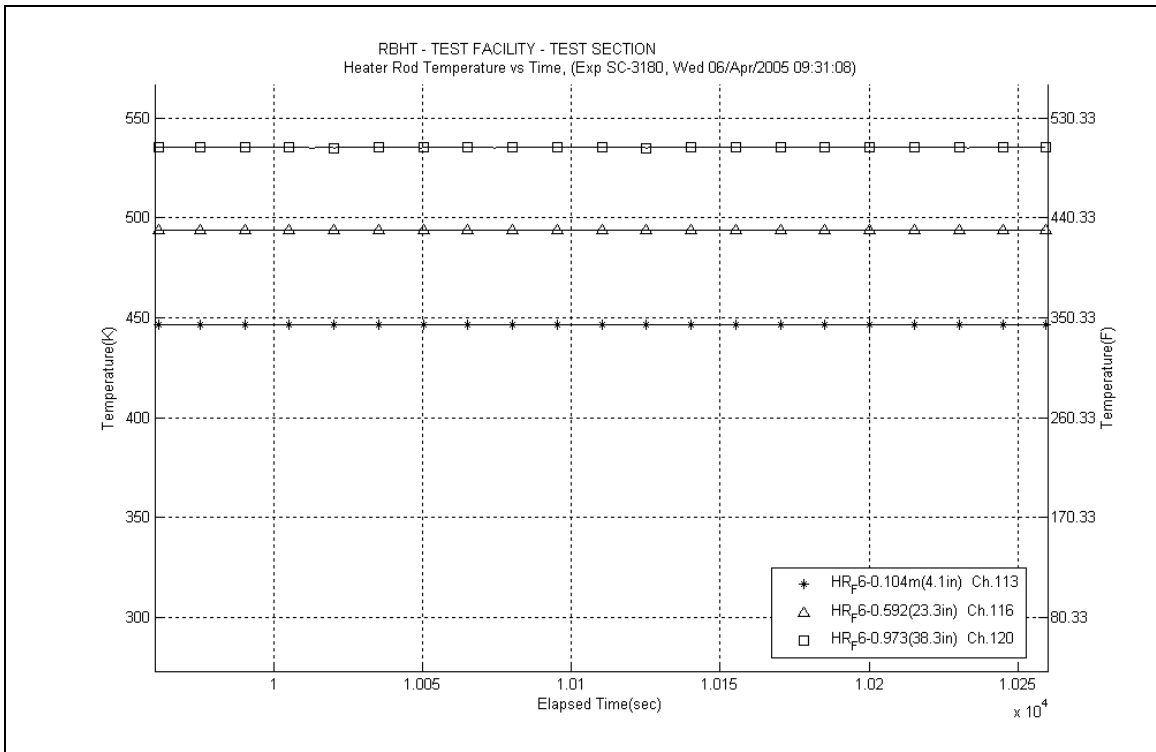
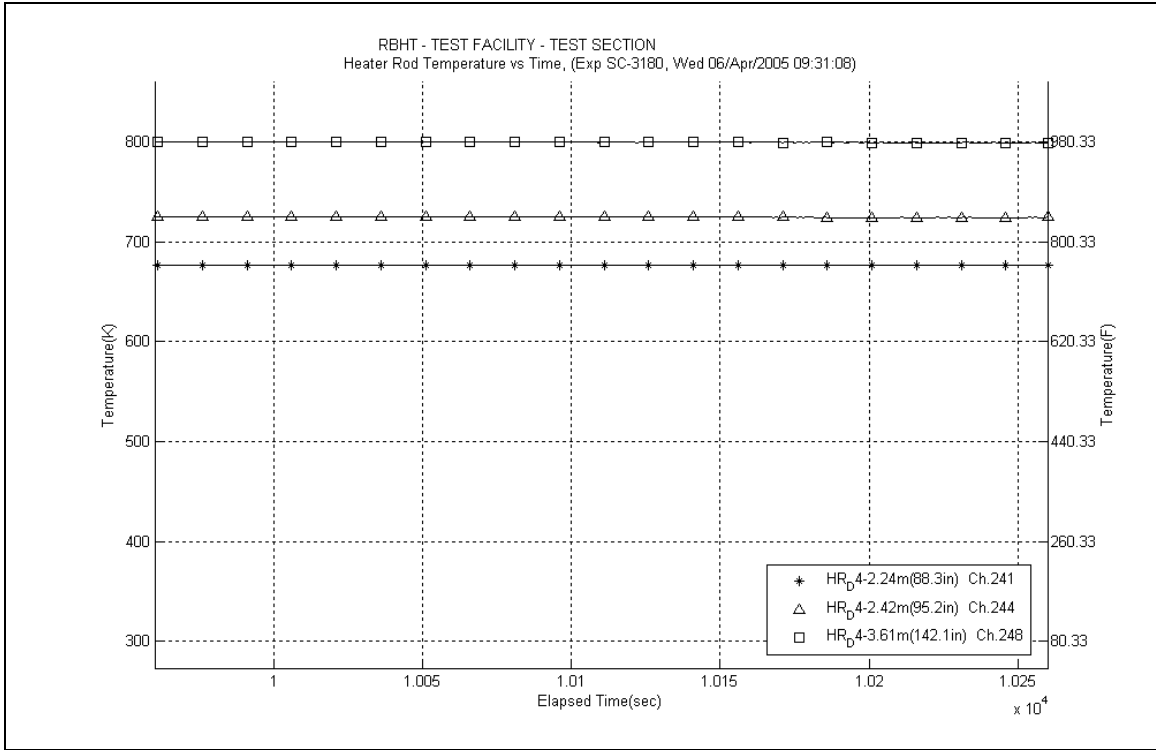
where x is the elevation (m) and T_{cl} is in (K)











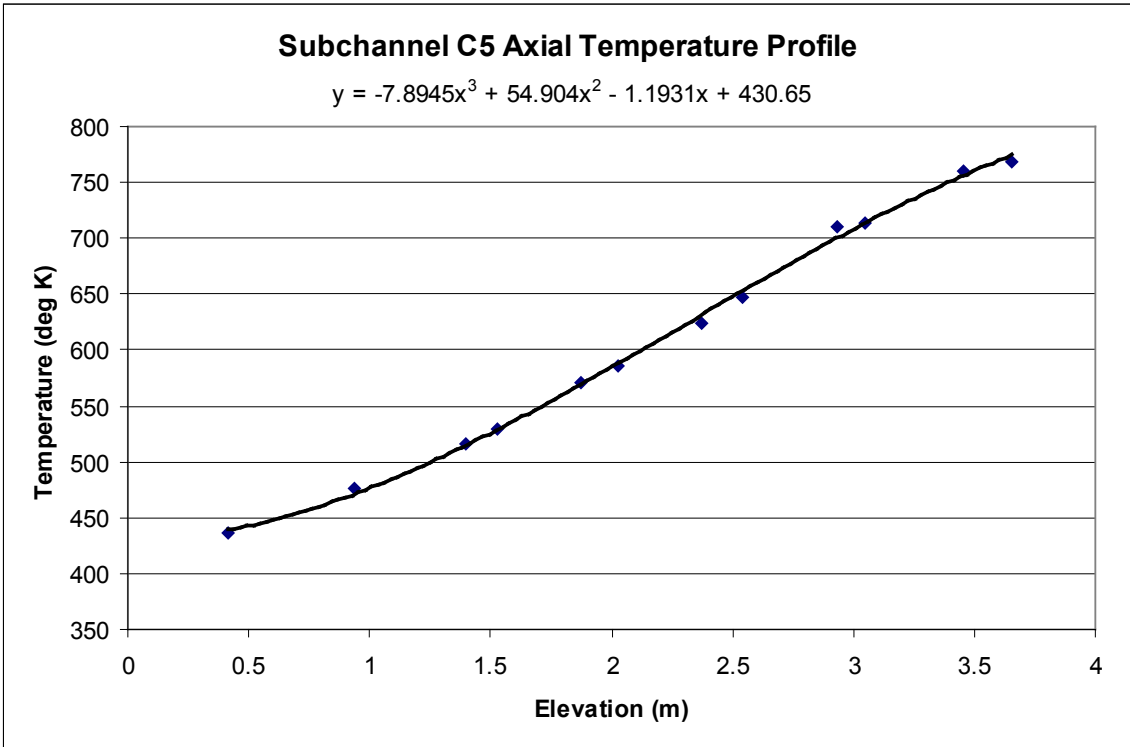
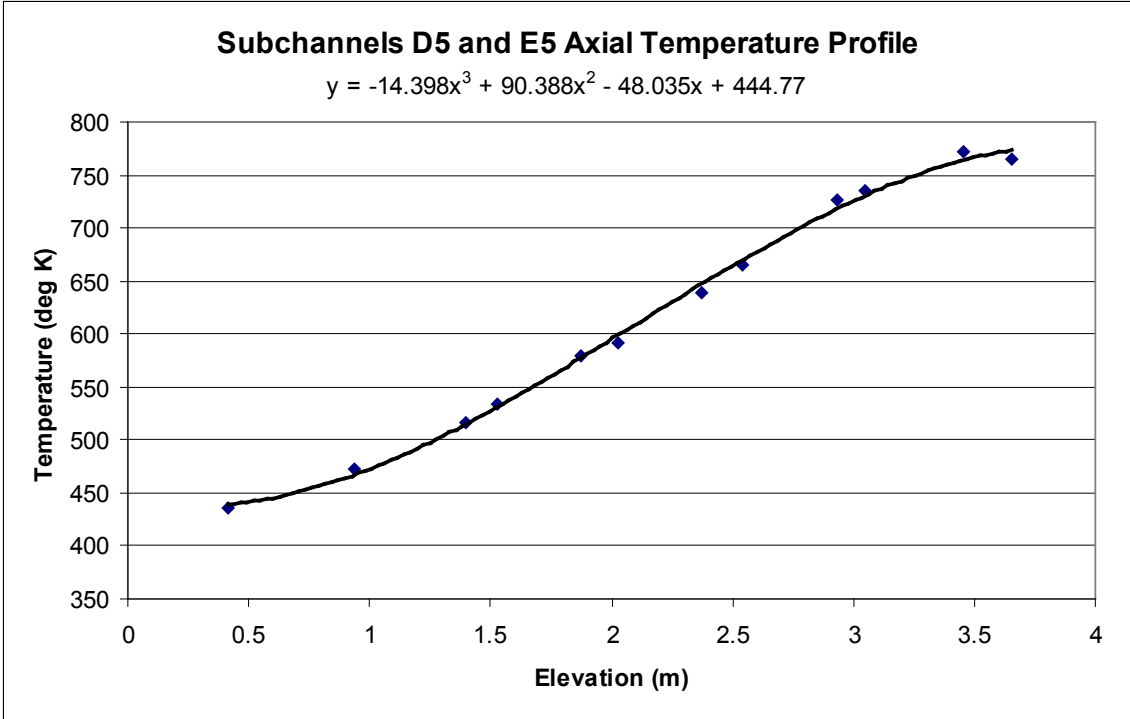


Table SC-3180-B.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±hctic (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	668.1	8009.5	629.3	1.27	637.6	4050	262.35	20.16	7.68%	60.57
RodD3_91.3	186	2.319	0.071	696.7	8180.9	639.9	1.27	652.1	3946	183.19	12.87	7.03%	40.97
RodD3_93.1	187	2.365	0.117	709.5	8283.1	646.2	1.27	659.8	3893	166.55	11.51	6.91%	36.63
RodD3_95.3	188	2.421	0.173	722.7	8410.8	653.9	1.27	668.6	3834	155.54	10.62	6.83%	33.56
RodD3_100.1	189	2.543	0.295	745.7	8684.7	670.3	1.27	686.4	3720	146.62	9.91	6.76%	30.47
RodD3_106.1	190	2.695	0.447	765.0	9022.9	690.0	1.27	706.0	3602	152.98	10.34	6.76%	30.53
RodD3_110	191	2.794	0.546	757.9	8913.8	702.1	1.27	713.9	3557	206.21	14.48	7.02%	40.51
RodD3_142.1	192	3.609	0.218	792.3	3126.3	771.9	1.27	776.3	3239	194.50	20.34	10.46%	33.86
RodC4_88.4	233	2.245	-0.003	674.8	8107.5	629.6	1.27	639.3	4038	228.10	16.74	7.34%	52.47
RodC4_91.1	234	2.314	0.066	697.9	8265.3	639.2	1.27	651.8	3948	179.17	12.47	6.96%	40.10
RodC4_93.4	235	2.372	0.124	710.9	8397.8	647.3	1.27	660.9	3885	167.91	11.54	6.87%	36.84
RodC4_95.3	236	2.421	0.173	723.3	8509.1	653.9	1.27	668.8	3833	156.01	10.60	6.79%	33.66
RodC4_100.1	237	2.543	0.295	744.0	8787.1	670.3	1.27	686.1	3722	151.65	10.23	6.74%	31.54
RodC4_106.1	238	2.695	0.447	767.7	9136.9	690.0	1.27	706.6	3599	149.64	10.03	6.70%	29.83
RodC4_110	239	2.794	0.546	757.9	8845.0	702.1	1.27	714.1	3556	201.81	14.17	7.02%	39.63
RodC4_142.2	240	3.612	0.221	804.5	3386.3	772.0	1.27	779.0	3226	132.56	10.81	8.15%	22.96
RodD4_88.3	241	2.243	-0.005	676.1	8077.2	629.3	1.27	639.3	4038	219.31	15.98	7.28%	50.44
RodD4_91.3	242	2.319	0.071	701.1	8247.6	639.9	1.27	653.0	3939	171.36	11.86	6.92%	38.24
RodD4_93.2	243	2.367	0.119	713.3	8356.9	646.6	1.27	660.9	3885	159.46	10.90	6.84%	34.99
RodD4_95.2	244	2.418	0.170	724.2	8472.0	653.5	1.27	668.7	3833	152.52	10.35	6.79%	32.91
RodD4_100.1	245	2.543	0.295	745.6	8756.0	670.3	1.27	686.4	3720	147.96	9.97	6.74%	30.75
RodD4_106.1	246	2.695	0.447	763.4	9098.3	690.0	1.27	705.7	3604	157.72	10.65	6.76%	31.50
RodD4_110	247	2.794	0.546	756.6	8787.0	702.1	1.27	713.8	3558	205.16	14.51	7.07%	40.31
RodD4_142.1	248	3.609	0.218	799.7	3270.3	771.9	1.27	777.8	3232	149.90	13.21	8.81%	26.02
RodE4_88.4	201	2.245	-0.003	669.4	7952.2	629.6	1.27	638.1	4046	254.25	19.45	7.65%	58.63
RodE4_91.2	202	2.316	0.069	694.3	8106.1	639.5	1.27	651.3	3952	188.44	13.37	7.10%	42.22
RodE4_95.3	204	2.421	0.173	720.3	8332.2	653.9	1.27	668.1	3837	159.54	10.99	6.89%	34.46
RodE4_100.9	205	2.563	0.315	743.4	8640.0	673.0	1.27	688.0	3710	156.22	10.68	6.84%	32.36
RodE4_142.3	208	3.614	0.224	791.1	3307.5	772.1	1.27	776.2	3239	221.80	24.02	10.83%	38.62
RodE3_63.4	193	1.610	0.417	615.0	6586.7	541.7	1.27	557.4	4745	114.30	7.75	6.78%	31.78
RodE3_113.6	194	2.885	0.022	762.6	8125.9	712.8	1.27	723.5	3504	207.86	15.00	7.22%	40.06
RodE3_115.5	195	2.934	0.070	773.5	7823.5	718.2	1.27	730.1	3468	180.19	12.73	7.07%	34.27
RodE3_118.5	196	3.010	0.146	784.0	7345.8	726.4	1.27	738.8	3423	162.47	11.38	7.01%	30.38
RodE3_122.7	197	3.117	0.253	792.4	6681.7	737.1	1.27	749.0	3370	153.99	10.84	7.04%	28.23
RodE3_126.5	198	3.213	0.349	794.3	6078.9	746.0	1.27	756.3	3334	160.08	11.55	7.22%	28.94
RodE3_131.7	199	3.345	-0.046	780.9	5258.7	756.6	1.27	761.8	3307	274.58	25.46	9.27%	49.12
RodE3_135.6	200	3.444	0.053	786.0	4641.3	763.3	1.27	768.2	3277	259.50	24.94	9.61%	45.87

Table SC-3180-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohhc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	620.8	6465.1	542.7	1.27	559.4	4725	105.29	7.15	6.80%	29.13
RodC5_113.6	226	2.885	0.022	760.4	7929.2	712.8	1.27	723.0	3507	211.92	15.58	7.35%	40.88
RodC5_115.7	227	2.939	0.075	774.3	7613.8	718.8	1.27	730.7	3465	174.51	12.43	7.12%	33.15
RodC5_122.7	229	3.117	0.253	793.1	6559.8	737.1	1.27	749.1	3370	149.20	10.55	7.07%	27.34
RodC5_126.7	230	3.218	0.354	795.6	5956.2	746.4	1.27	756.9	3331	154.20	11.14	7.23%	27.84
RodC5_131.6	231	3.343	-0.048	782.7	5222.2	756.4	1.27	762.0	3306	252.48	22.55	8.93%	45.15
RodC5_135.7	232	3.447	0.056	791.3	4604.5	763.4	1.27	769.4	3271	210.31	18.20	8.65%	37.08
RodE5_63.6	209	1.615	0.422	610.9	6618.9	542.3	1.27	557.0	4749	122.91	8.39	6.82%	34.20
RodE5_113.6	210	2.885	0.022	752.2	8176.3	712.8	1.27	721.2	3516	264.33	20.21	7.65%	51.17
RodE5_115.4	211	2.931	0.067	761.3	7896.2	717.9	1.27	727.2	3484	231.71	17.22	7.43%	44.32
RodE5_118.7	212	3.015	0.151	769.4	7379.6	727.0	1.27	736.1	3437	221.09	16.50	7.46%	41.56
RodE5_122.6	213	3.114	0.250	777.8	6772.0	736.9	1.27	745.7	3387	210.54	15.83	7.52%	38.84
RodE5_126.6	214	3.216	0.352	783.0	6148.4	746.2	1.27	754.1	3345	212.77	16.49	7.75%	38.62
RodE5_131.6	215	3.343	-0.048	771.2	5373.1	756.4	1.27	759.6	3318	459.76	58.71	12.77%	82.59
RodE5_135.6	216	3.444	0.053	778.9	4748.5	763.3	1.27	766.6	3284	387.50	47.67	12.30%	68.69
RodC3_79.8	177	2.027	0.227	657.2	7492.0	598.9	1.27	611.3	4254	163.51	11.46	7.01%	40.05
RodC3_85.6	178	2.174	0.374	664.5	7817.9	619.6	1.27	629.2	4113	221.74	16.40	7.40%	52.16
RodC3_88.5	179	2.248	0.000	668.6	7980.9	630.0	1.27	638.2	4045	262.86	20.27	7.71%	60.60
RodC3_92.4	180	2.347	0.099	700.1	8198.6	643.8	1.27	655.8	3920	185.16	13.06	7.05%	41.07
RodC3_94.4	181	2.398	0.150	708.8	8312.6	650.8	1.27	663.2	3870	182.19	12.78	7.02%	39.77
RodC3_97.2	182	2.469	0.221	725.0	8470.1	660.4	1.27	674.3	3797	167.06	11.53	6.90%	35.62
RodC3_108.8	183	2.764	0.516	764.9	8930.1	698.4	1.27	712.7	3564	170.85	11.74	6.87%	33.64
RodD5_50	217	1.270	0.076	566.7	5851.1	500.1	1.20	511.2	5265	105.38	6.30	5.98%	32.77
RodD5_54.1	218	1.374	0.180	587.4	6082.3	512.1	1.20	524.6	5102	96.89	5.69	5.87%	29.16
RodD5_56.9	219	1.445	0.251	598.7	6237.4	520.7	1.27	537.4	4957	101.66	6.84	6.73%	29.66
RodD5_60	220	1.524	0.330	609.1	6413.5	530.5	1.27	547.4	4849	103.87	6.98	6.72%	29.59
RodD5_66.1	221	1.679	0.485	621.2	6755.3	550.8	1.27	565.9	4661	122.02	8.30	6.80%	33.25
RodD5_69.9	222	1.775	-0.025	605.7	6972.2	563.8	1.27	572.8	4594	211.86	15.85	7.48%	56.78
RodD5_72.9	223	1.852	0.051	632.0	7141.2	574.3	1.27	586.7	4465	157.51	11.01	6.99%	40.85
RodD5_74.9	224	1.902	0.102	645.8	7253.3	581.4	1.27	595.2	4390	143.37	9.86	6.88%	36.45

Table SC-3180-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohic (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	551.1	5318.1	480.0	1.20	491.9	5515	89.78	5.33	5.93%	29.25
RodB5_52.9	154	1.344	0.150	582.2	5993.1	509.0	1.20	521.2	5143	98.28	5.80	5.91%	29.83
RodB5_55	155	1.397	0.203	589.7	6112.3	514.6	1.20	527.1	5073	97.75	5.75	5.88%	29.24
RodB5_57.8	156	1.468	0.274	600.7	6271.2	522.3	1.27	539.0	4939	101.79	6.85	6.73%	29.58
RodB5_64	157	1.626	0.432	617.2	6623.6	539.9	1.27	556.4	4755	109.04	7.35	6.74%	30.39
RodB5_73.9	158	1.877	0.077	639.1	7185.4	569.6	1.27	584.5	4485	131.66	8.97	6.82%	34.32
RodB5_75.9	159	1.928	0.128	651.3	7299.6	575.8	1.27	592.0	4418	123.13	8.33	6.77%	31.54
RodB5_76.9	160	1.953	0.153	656.2	7356.7	579.0	1.27	595.5	4387	121.18	8.18	6.75%	30.79
RodF5_41	105	1.041	0.343	547.0	5276.7	480.0	1.20	491.2	5525	94.55	5.69	6.01%	30.86
RodF5_53.1	106	1.349	0.155	576.6	5968.3	509.5	1.20	520.7	5148	106.86	6.42	6.00%	32.47
RodF5_55	107	1.397	0.203	584.7	6077.3	514.6	1.20	526.3	5083	104.05	6.20	5.96%	31.19
RodF5_57.8	108	1.468	0.274	594.3	6236.6	522.3	1.27	537.7	4954	110.15	7.50	6.81%	32.12
RodF5_64	109	1.626	0.432	608.4	6591.3	539.9	1.27	554.6	4774	122.37	8.37	6.84%	34.26
RodF5_73.8	110	1.875	0.074	624.0	7147.5	569.3	1.27	581.0	4517	166.54	11.78	7.07%	43.77
RodF5_75.8	111	1.925	0.125	635.8	7262.1	575.5	1.27	588.4	4450	153.41	10.68	6.96%	39.63
RodF5_76.8	112	1.951	0.150	640.7	7319.8	578.6	1.27	591.9	4419	150.15	10.40	6.93%	38.47
RodC2_41	57	1.041	0.343	546.4	5302.7	480.0	1.20	491.1	5526	95.88	5.76	6.01%	31.30
RodC2_53.1	58	1.349	0.155	581.3	5990.1	509.5	1.20	521.5	5139	100.16	5.94	5.93%	30.38
RodC2_55	59	1.397	0.203	589.1	6097.8	514.6	1.20	527.0	5074	98.26	5.80	5.90%	29.40
RodC2_57.8	60	1.468	0.274	600.3	6257.1	522.3	1.27	539.0	4940	102.06	6.88	6.74%	29.67
RodC2_63.9	61	1.623	0.429	614.8	6604.0	539.6	1.27	555.7	4762	111.76	7.56	6.77%	31.20
RodC2_73.8	62	1.875	0.074	625.5	7165.4	569.3	1.27	581.4	4514	162.39	11.42	7.03%	42.65
RodC2_75.8	63	1.925	0.125	635.3	7281.4	575.5	1.27	588.3	4451	155.07	10.79	6.96%	40.06
RodC2_76.8	64	1.951	0.150	639.2	7339.1	578.6	1.27	591.6	4421	154.13	10.70	6.94%	39.52
RodC6_40.9	137	1.039	0.340	551.8	5288.8	479.8	1.20	491.8	5516	88.21	5.24	5.94%	28.74
RodC6_52.8	138	1.341	0.147	583.7	5990.1	508.8	1.20	521.2	5142	95.98	5.65	5.88%	29.13
RodC6_54.8	139	1.392	0.198	592.2	6110.9	514.1	1.20	527.1	5074	93.91	5.49	5.85%	28.10
RodC6_57.8	140	1.468	0.274	603.6	6288.8	522.3	1.27	539.7	4932	98.37	6.59	6.70%	28.55
RodC6_63.8	141	1.621	0.427	619.6	6646.6	539.3	1.27	556.5	4754	105.28	7.06	6.70%	29.33
RodC6_73.7	142	1.872	0.072	639.9	7229.4	569.0	1.27	584.2	4488	129.72	8.79	6.78%	33.84
RodC6_75.8	143	1.925	0.125	650.5	7352.0	575.5	1.27	591.6	4422	124.85	8.43	6.75%	32.01
RodC6_76.8	144	1.951	0.150	656.3	7411.6	578.6	1.27	595.3	4389	121.47	8.17	6.72%	30.88

Table SC-3180-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ohic (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	670.6	7950.8	615.4	1.27	627.2	4128	183.23	12.98	7.08%	43.29
RodB4_91.3	162	2.319	0.071	697.6	8109.8	624.7	1.27	640.3	4030	141.50	9.64	6.81%	32.47
RodB4_93.3	163	2.370	0.122	708.4	8220.2	631.1	1.27	647.6	3977	135.36	9.16	6.77%	30.57
RodB4_95.1	164	2.416	0.168	718.4	8317.2	636.9	1.27	654.3	3930	129.82	8.74	6.74%	28.89
RodB4_100	165	2.540	0.292	736.8	8587.9	652.5	1.27	670.5	3821	129.64	8.71	6.72%	27.86
RodB4_106	166	2.692	0.445	760.0	8918.4	671.4	1.27	690.3	3696	128.05	8.57	6.69%	26.40
RodB4_109.9	167	2.791	0.544	750.1	8633.8	683.4	1.27	697.7	3651	164.72	11.37	6.90%	33.44
RodB4_142.3	168	3.614	0.224	800.0	3362.6	770.8	1.27	777.1	3235	146.54	12.50	8.53%	25.47
RodF4_85.6	98	2.174	0.374	657.6	7845.9	606.5	1.27	617.4	4205	195.22	14.00	7.17%	47.16
RodF4_88.4	99	2.245	-0.003	661.4	8003.3	615.4	1.27	625.3	4143	221.25	16.24	7.34%	52.51
RodF4_92.4	100	2.347	0.099	693.6	8227.3	628.2	1.27	642.2	4016	160.04	11.01	6.88%	36.57
RodF4_94.3	101	2.395	0.147	705.9	8335.1	634.3	1.27	649.6	3963	148.16	10.08	6.81%	33.31
RodF4_97.2	102	2.469	0.221	721.3	8496.1	643.6	1.27	660.2	3890	139.11	9.38	6.75%	30.57
RodF4_108.8	103	2.764	0.516	750.9	8974.4	680.0	1.27	695.2	3666	161.16	10.96	6.80%	32.89
RodF4_111	104	2.819	-0.044	740.0	8615.8	686.8	1.27	698.2	3648	205.87	14.62	7.10%	41.75
RodD2_103.2	65	2.621	0.373	739.0	8876.9	662.6	1.27	678.9	3767	147.90	9.97	6.74%	31.22
RodD2_106	66	2.692	0.445	747.3	9034.6	671.4	1.27	687.6	3712	151.33	10.21	6.75%	31.37
RodD2_112.6	67	2.860	-0.004	739.3	8293.8	691.7	1.27	701.9	3627	221.64	16.15	7.29%	44.62
RodD2_114.9	68	2.918	0.055	755.6	7909.9	698.6	1.27	710.8	3575	176.37	12.40	7.03%	34.86
RodD2_117.4	69	2.982	0.118	763.2	7493.9	706.0	1.27	718.2	3533	166.78	11.72	7.03%	32.48
RodD2_120.8	70	3.068	0.204	773.1	6925.7	715.8	1.27	728.1	3479	153.94	10.81	7.03%	29.39
RodD2_124.8	71	3.170	0.306	778.9	6261.6	727.1	1.27	738.2	3425	153.74	11.00	7.15%	28.78
RodD2_128.6	72	3.266	0.403	780.0	5625.9	737.4	1.27	746.5	3383	168.22	12.60	7.49%	30.98
RodD6_103.1	129	2.619	0.371	737.3	8926.8	662.3	1.27	678.3	3771	151.44	10.21	6.74%	32.01
RodD6_106	130	2.692	0.445	745.1	9093.9	671.4	1.27	687.2	3715	156.89	10.59	6.75%	32.56
RodD6_112.9	131	2.868	0.004	740.7	8299.0	692.6	1.27	702.9	3621	219.27	15.90	7.25%	44.05
RodD6_114.9	132	2.918	0.055	755.1	7959.3	698.6	1.27	710.7	3576	179.13	12.58	7.02%	35.42
RodD6_116.8	133	2.967	0.103	764.4	7638.0	704.2	1.27	717.1	3539	161.54	11.23	6.95%	31.53
RodD6_120.9	134	3.071	0.207	773.1	6944.3	716.1	1.27	728.3	3478	155.16	10.89	7.02%	29.61
RodD6_124.8	135	3.170	0.306	778.0	6282.2	727.1	1.27	738.0	3427	157.18	11.27	7.17%	29.43
RodD6_128.7	136	3.269	0.405	778.7	5622.3	737.7	1.27	746.5	3383	174.42	13.19	7.56%	32.13

Table SC-3180-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±hctic (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	560.2	5864.7	501.8	1.20	511.5	5260	120.39	7.37	6.12%	37.41
RodE2_54	74	1.372	0.178	580.6	6089.0	511.9	1.20	523.4	5117	106.46	6.33	5.94%	32.14
RodE2_56.9	75	1.445	0.251	591.8	6254.4	519.8	1.27	535.2	4981	110.50	7.49	6.78%	32.42
RodE2_59.9	76	1.521	0.328	603.5	6425.7	528.1	1.27	544.3	4882	108.50	7.32	6.74%	31.14
RodE2_66	77	1.676	0.483	614.8	6775.5	545.8	1.27	560.5	4713	124.84	8.50	6.81%	34.45
RodE2_69.8	78	1.773	-0.027	595.2	6995.1	557.1	1.27	565.3	4666	233.56	17.94	7.68%	63.72
RodE2_72.9	79	1.852	0.051	618.7	7174.1	566.6	1.27	577.7	4547	175.25	12.45	7.11%	46.42
RodE2_74.9	80	1.902	0.102	629.8	7290.0	572.7	1.27	585.0	4481	162.47	11.36	6.99%	42.31
RodB3_50.2	169	1.275	0.081	561.1	5833.4	502.0	1.20	511.9	5256	118.43	7.26	6.13%	36.77
RodB3_54.1	170	1.374	0.180	575.3	6054.3	512.2	1.20	522.7	5125	115.14	6.97	6.05%	34.82
RodB3_56.9	171	1.445	0.251	584.6	6211.7	519.8	1.27	533.7	4999	122.00	8.40	6.88%	35.92
RodB3_60.1	172	1.527	0.333	592.9	6395.6	528.7	1.27	542.4	4902	126.79	8.74	6.89%	36.55
RodB3_66.1	173	1.679	0.485	612.1	6733.1	546.1	1.27	560.2	4717	129.72	8.90	6.86%	35.83
RodB3_69.9	174	1.775	-0.025	598.3	6951.1	557.4	1.27	566.2	4658	216.25	16.30	7.54%	58.87
RodB3_73	175	1.854	0.054	621.9	7126.8	566.9	1.27	578.7	4539	164.82	11.63	7.05%	43.56
RodB3_75	176	1.905	0.105	634.1	7239.8	573.1	1.27	586.1	4470	150.95	10.47	6.94%	39.20
RodF3_50.1	89	1.273	0.079	563.9	5831.8	501.8	1.20	512.1	5253	112.65	6.83	6.07%	34.95
RodF3_54	90	1.372	0.178	583.1	6057.9	511.9	1.20	523.8	5112	102.12	6.05	5.93%	30.80
RodF3_57	91	1.448	0.254	594.4	6231.8	520.1	1.27	536.0	4973	106.72	7.22	6.77%	31.25
RodF3_60	92	1.524	0.330	604.3	6407.6	528.4	1.27	544.7	4878	107.37	7.25	6.75%	30.78
RodF3_66.1	93	1.679	0.485	609.8	6760.4	546.1	1.27	559.7	4722	135.01	9.30	6.89%	37.33
RodF3_70	94	1.778	-0.022	598.4	6986.2	557.7	1.27	566.4	4655	218.33	16.46	7.54%	59.40
RodF3_73	95	1.854	0.054	621.7	7161.1	566.9	1.27	578.6	4539	166.13	11.70	7.05%	43.91
RodF3_75	96	1.905	0.105	634.7	7276.1	573.1	1.27	586.3	4469	150.06	10.37	6.91%	38.96
RodE6_50.2	121	1.275	0.081	560.3	5834.7	502.0	1.20	511.7	5257	120.13	7.38	6.15%	37.31
RodE6_54.1	122	1.374	0.180	578.1	6057.9	512.2	1.20	523.2	5119	110.24	6.62	6.00%	33.30
RodE6_57	123	1.448	0.254	588.0	6223.2	520.1	1.27	534.6	4988	116.56	7.97	6.84%	34.24
RodE6_60.2	124	1.529	0.335	598.2	6404.7	529.0	1.27	543.8	4887	117.78	8.04	6.82%	33.84
RodE6_66.1	125	1.679	0.485	609.5	6737.1	546.1	1.27	559.6	4723	135.20	9.33	6.90%	37.39
RodE6_70	126	1.778	-0.022	596.1	6950.6	557.7	1.27	565.9	4660	230.46	17.71	7.68%	62.78
RodE6_73.1	127	1.857	0.056	620.0	7126.9	567.2	1.27	578.5	4540	171.56	12.19	7.11%	45.36
RodE6_75	128	1.905	0.105	632.5	7238.0	573.1	1.27	585.8	4473	154.91	10.79	6.96%	40.26

RBHT Steam Cooling Test SC-3180-C

Matrix test # 15

Test date – 4/6/2005

Steady state time window: 7100 - 7600 sec

Inlet flow: 2.43 m³/min (85.9 ft³/min)

Inlet steam temperature: 420 K (297 °F)

Upper plenum pressure: 409.5 kPa (59.4 psia)

Bundle power: 70.0 kW

Outlet steam temperature: 780 K (945 °F)

Bundle inlet Reynolds number: 14026

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

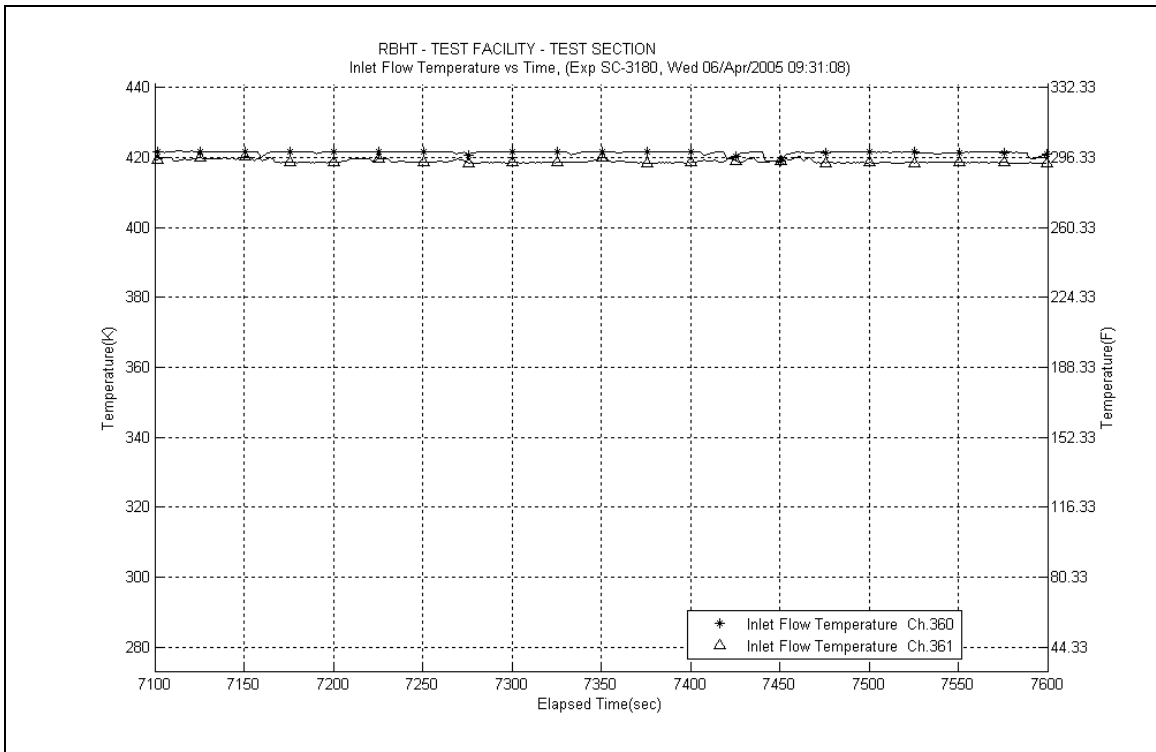
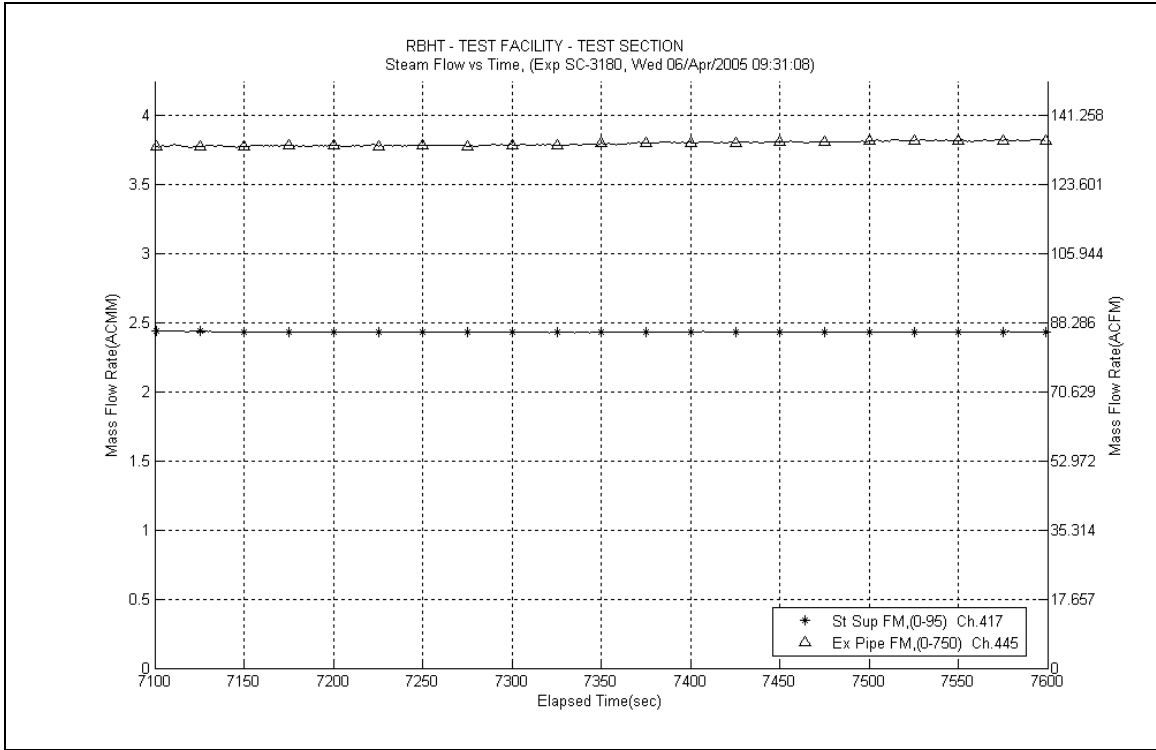
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

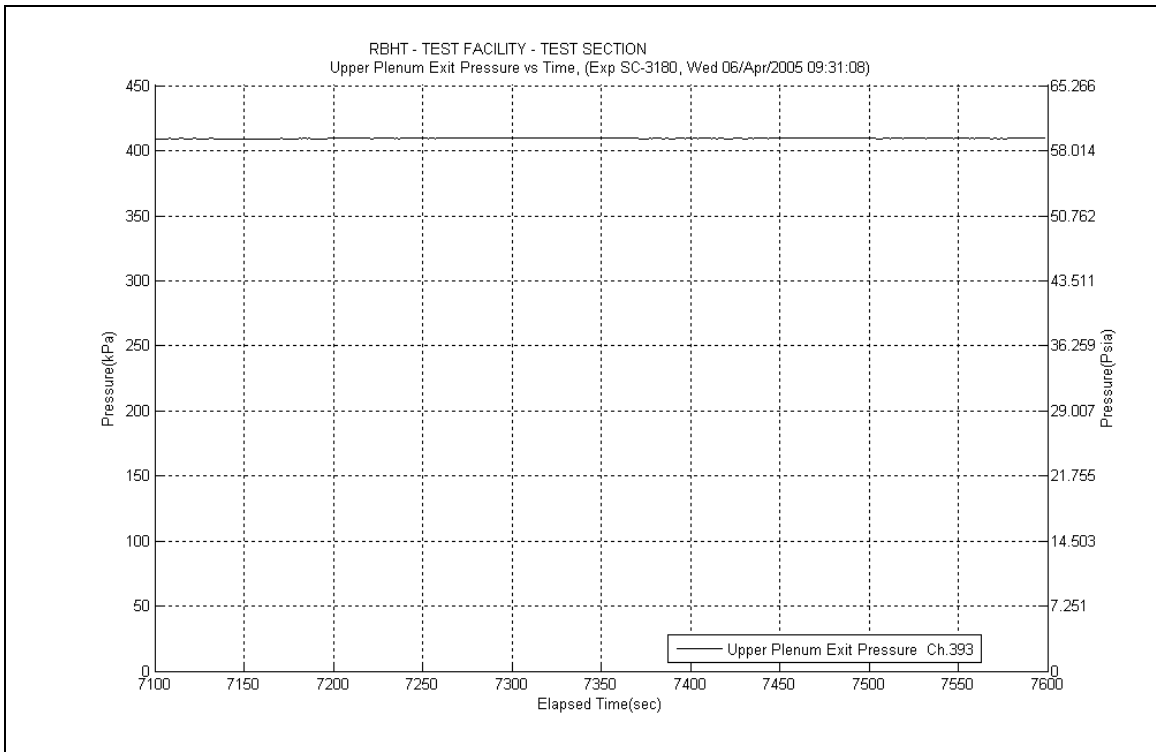
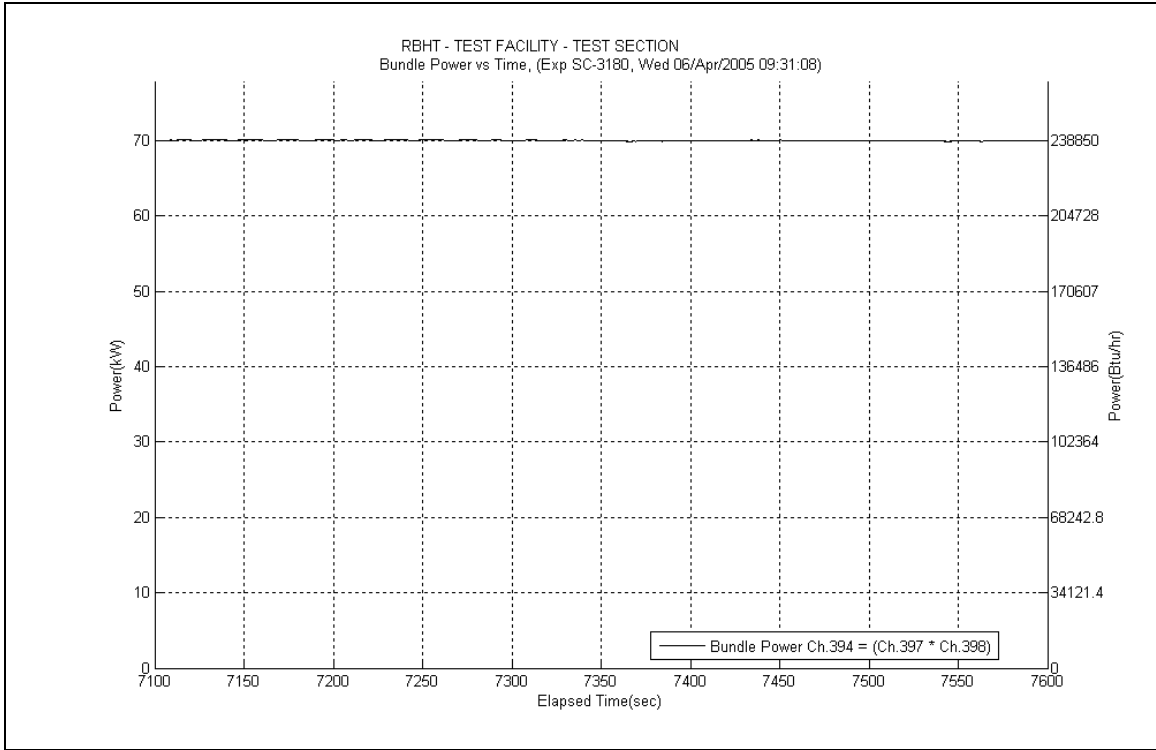
$$T_{cl} = -13.97x^3 + 88.205x^2 - 42.988x + 445.08$$

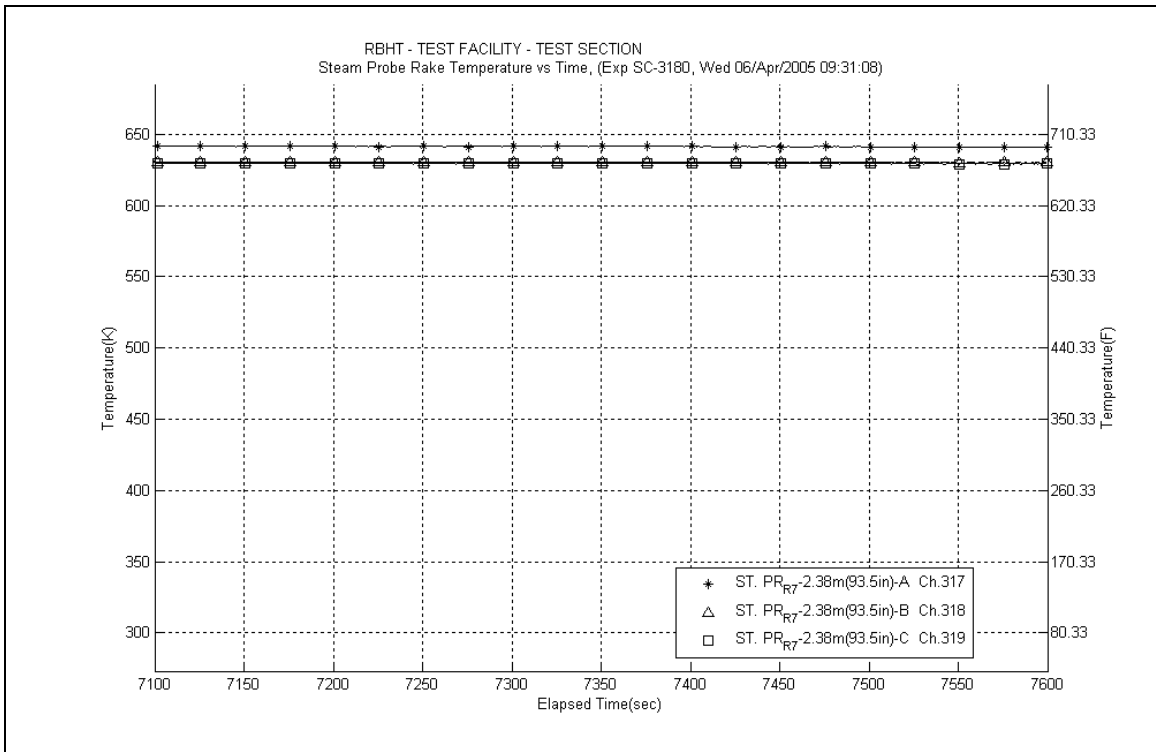
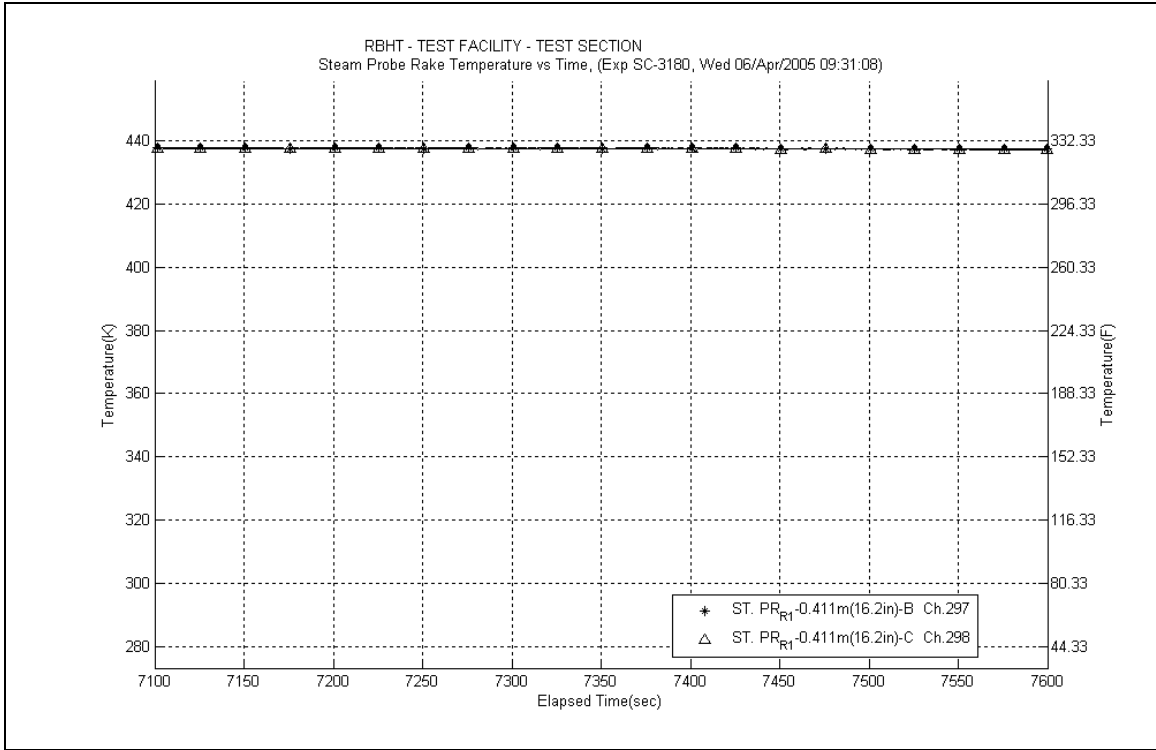
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

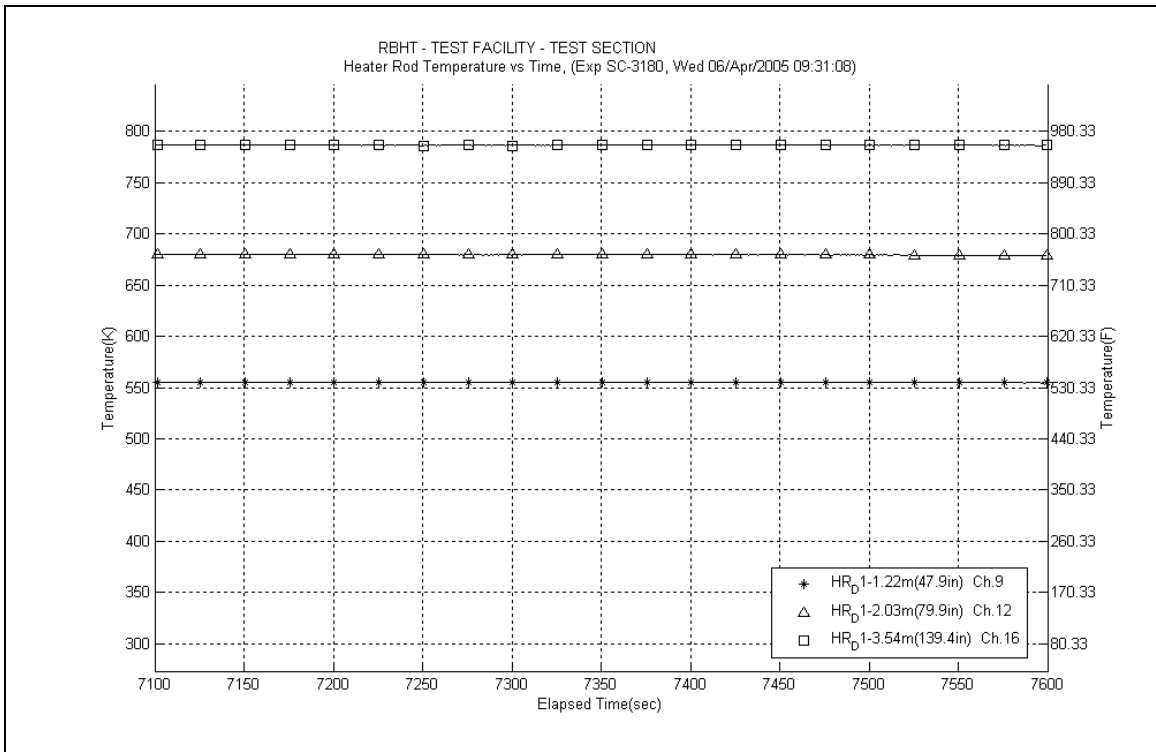
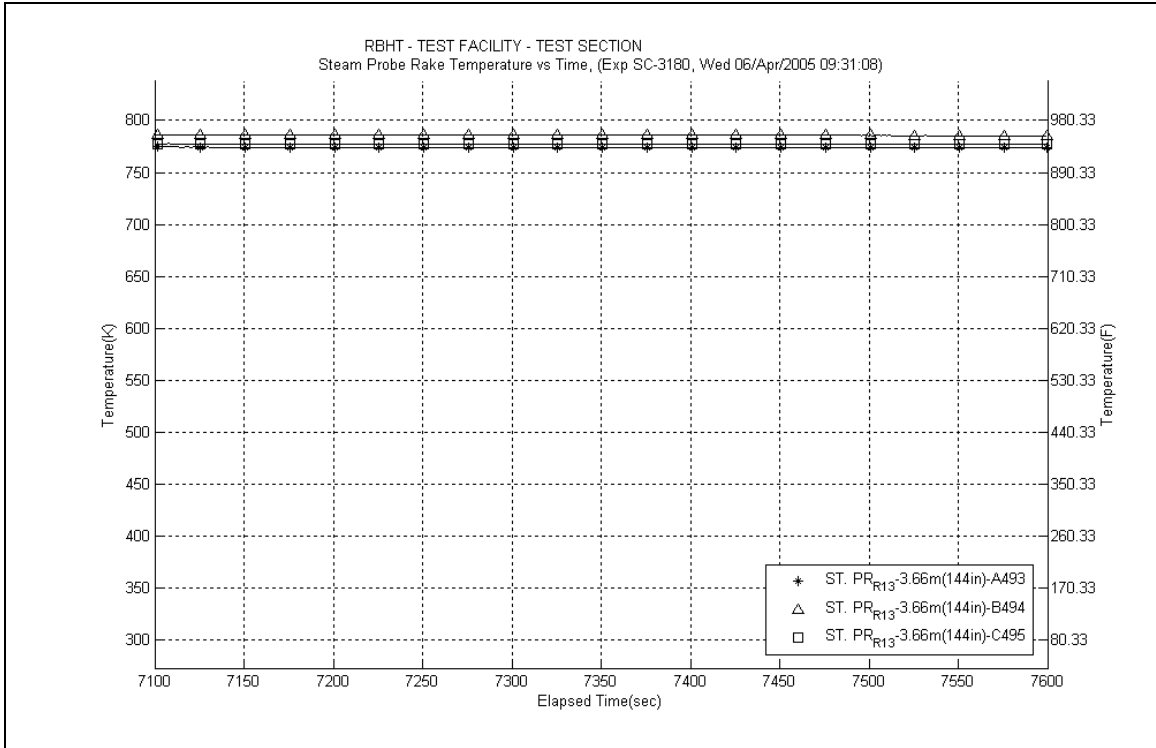
$$T_{cl} = -9.3462x^3 + 64.485x^2 - 15.996x + 436.62$$

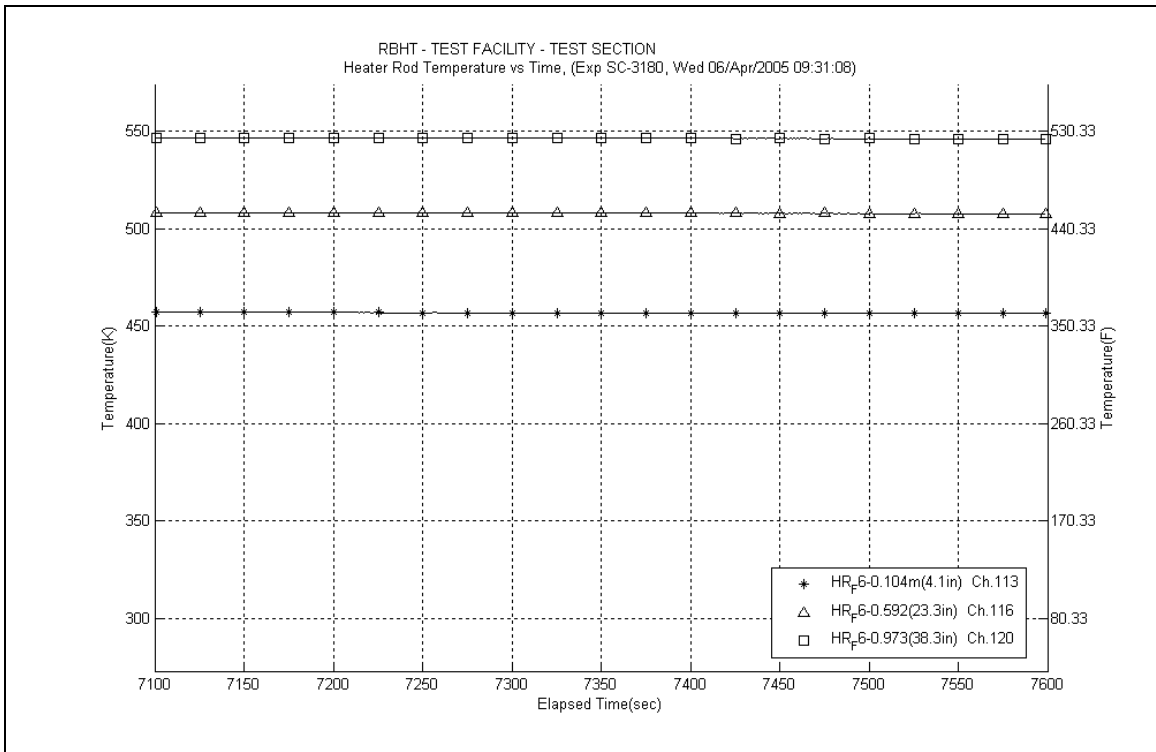
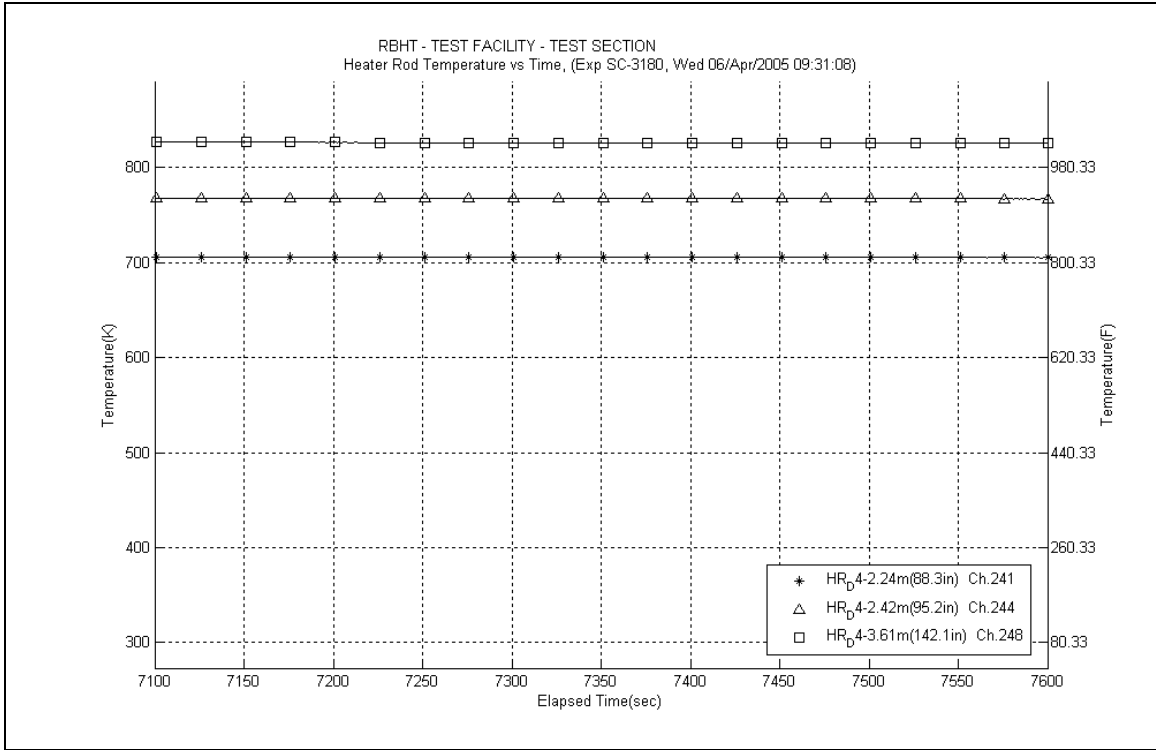
where x is the elevation (m) and T_{cl} is in (K)











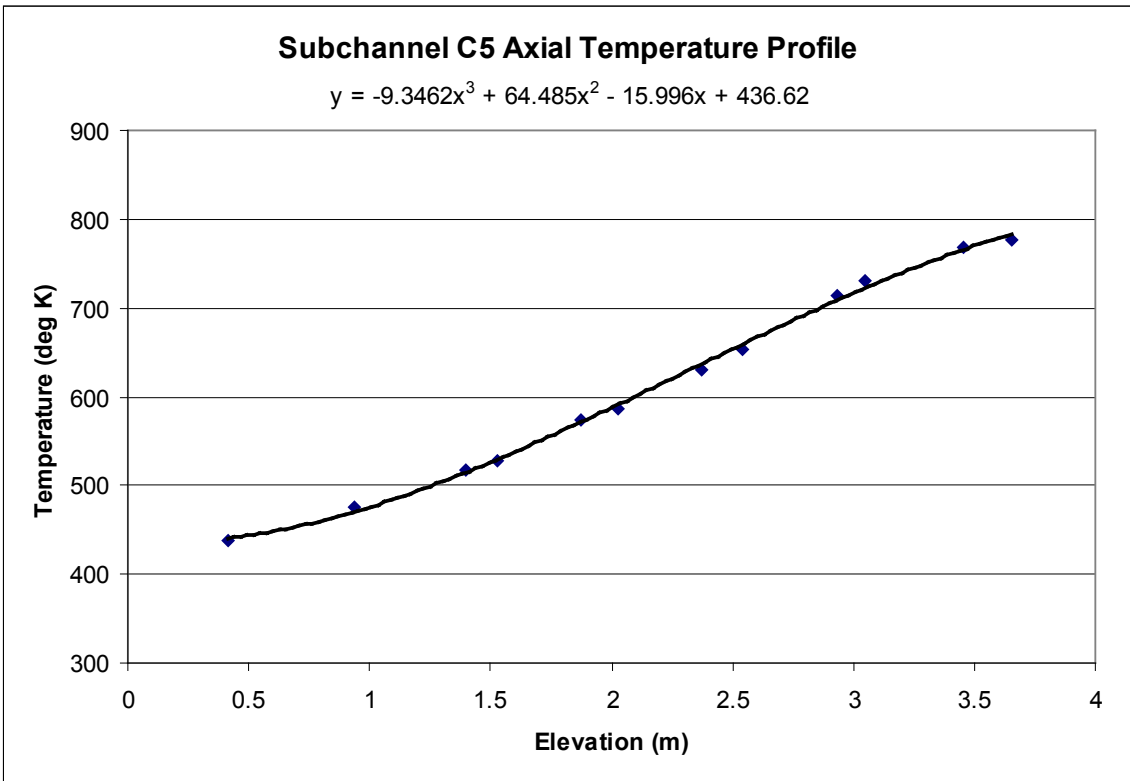
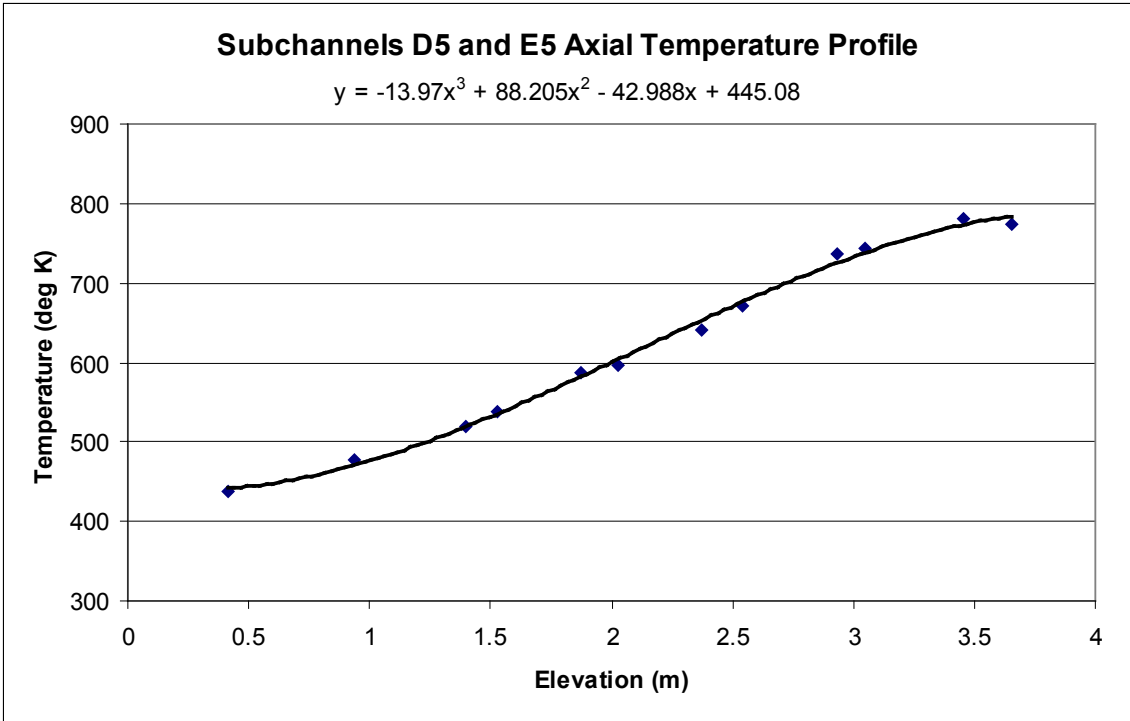


Table SC-3180-C.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±0htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	696.1	18763.8	634.8	1.20	645.0	9673	366.85	17.12	4.67%	83.33
RodD3_91.3	186	2.319	0.071	737.8	19164.9	645.5	1.20	660.9	9404	249.34	10.50	4.21%	54.71
RodD3_93.1	187	2.365	0.117	754.2	19404.9	651.9	1.20	669.0	9274	227.77	9.43	4.14%	49.11
RodD3_95.3	188	2.421	0.173	768.4	19697.1	659.7	1.20	677.8	9135	217.52	8.92	4.10%	46.03
RodD3_100.1	189	2.543	0.295	784.5	20333.9	676.4	1.20	694.4	8886	225.68	9.26	4.11%	46.13
RodD3_106.1	190	2.695	0.447	806.2	21133.8	696.4	1.20	714.7	8599	230.93	9.46	4.10%	45.29
RodD3_110	191	2.794	0.546	790.6	20869.4	708.8	1.20	722.5	8495	306.39	13.18	4.30%	59.16
RodD3_142.1	192	3.609	0.218	817.0	7301.9	782.1	1.20	787.9	7711	251.60	15.44	6.14%	42.87
RodC4_88.4	233	2.245	-0.003	701.3	18972.1	635.1	1.20	646.1	9653	343.99	15.65	4.55%	77.94
RodC4_91.1	234	2.314	0.066	735.9	19339.3	644.8	1.20	660.0	9419	254.66	10.73	4.21%	55.98
RodC4_93.4	235	2.372	0.124	750.9	19651.8	653.0	1.20	669.3	9268	240.95	10.02	4.16%	51.92
RodC4_95.3	236	2.421	0.173	766.7	19909.5	659.7	1.20	677.5	9139	223.35	9.16	4.10%	47.29
RodC4_100.1	237	2.543	0.295	781.7	20561.1	676.4	1.20	693.9	8893	234.24	9.63	4.11%	47.93
RodC4_106.1	238	2.695	0.447	807.9	21375.4	696.4	1.20	715.0	8596	229.99	9.38	4.08%	45.08
RodC4_110	239	2.794	0.546	788.9	20685.9	708.8	1.20	722.2	8499	310.14	13.42	4.33%	59.92
RodC4_142.2	240	3.612	0.221	831.9	7910.0	782.2	1.20	790.5	7684	191.18	9.67	5.06%	32.42
RodD4_88.3	241	2.243	-0.005	704.5	18907.8	634.8	1.20	646.4	9649	325.31	14.58	4.48%	73.67
RodD4_91.3	242	2.319	0.071	739.0	19313.0	645.5	1.20	661.1	9401	247.88	10.40	4.19%	54.36
RodD4_93.2	243	2.367	0.119	754.1	19568.5	652.3	1.20	669.3	9269	230.64	9.54	4.14%	49.70
RodD4_95.2	244	2.418	0.170	766.4	19838.7	659.4	1.20	677.2	9145	222.47	9.13	4.10%	47.14
RodD4_100.1	245	2.543	0.295	783.7	20496.7	676.4	1.20	694.3	8888	229.11	9.40	4.10%	46.85
RodD4_106.1	246	2.695	0.447	802.6	21302.1	696.4	1.20	714.1	8608	240.82	9.90	4.11%	47.29
RodD4_110	247	2.794	0.546	787.3	20575.0	708.8	1.20	721.9	8503	314.73	13.70	4.35%	60.84
RodD4_142.1	248	3.609	0.218	825.8	7654.9	782.1	1.20	789.4	7695	210.10	11.32	5.39%	35.70
RodE4_88.4	201	2.245	-0.003	696.1	18623.0	635.1	1.20	645.3	9668	366.27	17.15	4.68%	83.14
RodE4_91.2	202	2.316	0.069	731.8	18984.1	645.2	1.20	659.6	9426	262.99	11.23	4.27%	57.86
RodE4_95.3	204	2.421	0.173	760.8	19512.1	659.7	1.20	676.6	9154	231.54	9.62	4.15%	49.13
RodE4_100.9	205	2.563	0.315	781.8	20231.4	679.1	1.20	696.2	8859	236.33	9.79	4.14%	48.13
RodE4_142.3	208	3.614	0.224	817.0	7738.0	782.4	1.20	788.1	7709	268.01	16.39	6.11%	45.65
RodE3_63.4	193	1.610	0.417	637.7	15426.6	546.3	1.20	561.5	11386	202.47	8.52	4.21%	55.74
RodE3_113.6	194	2.885	0.022	798.7	19015.6	719.8	1.20	733.0	8358	289.30	12.59	4.35%	54.71
RodE3_115.5	195	2.934	0.070	814.5	18310.7	725.4	1.20	740.2	8266	246.48	10.45	4.24%	45.96
RodE3_118.5	196	3.010	0.146	826.5	17196.1	733.8	1.20	749.3	8154	222.67	9.37	4.21%	40.79
RodE3_122.7	197	3.117	0.253	828.2	15637.2	745.0	1.20	758.8	8040	225.41	9.67	4.29%	40.55
RodE3_126.5	198	3.213	0.349	824.8	14228.3	754.2	1.20	765.9	7957	241.77	10.79	4.46%	42.91
RodE3_131.7	199	3.345	-0.046	800.0	12296.7	765.4	1.20	771.1	7897	426.61	26.03	6.10%	74.98
RodE3_135.6	200	3.444	0.053	812.7	10849.1	772.6	1.20	779.3	7806	324.57	18.15	5.59%	56.19

Table SC-3180-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	638.7	15124.0	547.3	1.20	562.5	11362	198.43	8.39	4.23%	54.50
RodC5_113.6	226	2.885	0.022	800.8	18541.6	719.8	1.20	733.3	8354	274.63	11.94	4.35%	51.90
RodC5_115.7	227	2.939	0.075	820.8	17801.6	726.0	1.20	741.8	8247	225.29	9.49	4.21%	41.88
RodC5_122.7	229	3.117	0.253	832.0	15334.4	745.0	1.20	759.5	8032	211.29	9.02	4.27%	37.96
RodC5_126.7	230	3.218	0.354	829.5	13923.9	754.6	1.20	767.1	7943	223.05	9.83	4.41%	39.50
RodC5_131.6	231	3.343	-0.048	806.2	12192.4	765.2	1.20	772.0	7888	356.48	19.74	5.54%	62.55
RodC5_135.7	232	3.447	0.056	822.2	10747.3	772.8	1.20	781.0	7787	260.98	13.18	5.05%	45.04
RodE5_63.6	209	1.615	0.422	631.3	15499.2	546.9	1.20	561.0	11398	220.51	9.42	4.27%	60.79
RodE5_113.6	210	2.885	0.022	793.2	19124.1	719.8	1.20	732.0	8370	312.58	13.83	4.43%	59.22
RodE5_115.4	211	2.931	0.067	805.0	18465.5	725.1	1.20	738.4	8289	277.45	12.02	4.33%	51.91
RodE5_118.7	212	3.015	0.151	812.7	17261.1	734.4	1.20	747.4	8177	264.51	11.50	4.35%	48.63
RodE5_122.6	213	3.114	0.250	815.0	15832.5	744.7	1.20	756.4	8068	270.13	12.06	4.46%	48.82
RodE5_126.6	214	3.216	0.352	812.9	14371.2	754.4	1.20	764.1	7978	294.98	13.94	4.73%	52.53
RodE5_131.6	215	3.343	-0.048	789.5	12546.5	765.2	1.20	769.2	7919	617.75	47.98	7.77%	108.96
RodE5_135.6	216	3.444	0.053	807.5	11089.8	772.6	1.20	778.4	7816	381.04	23.05	6.05%	66.07
RodC3_79.8	177	2.027	0.227	681.7	17539.1	604.0	1.20	616.9	10188	270.96	11.84	4.37%	65.53
RodC3_85.6	178	2.174	0.374	687.3	18303.1	625.0	1.20	635.4	9843	352.60	16.39	4.65%	81.81
RodC3_88.5	179	2.248	0.000	695.7	18684.7	635.5	1.20	645.5	9664	372.36	17.51	4.70%	84.48
RodC3_92.4	180	2.347	0.099	738.1	19196.0	649.4	1.20	664.2	9350	259.77	11.03	4.25%	56.59
RodC3_94.4	181	2.398	0.150	744.7	19457.6	656.5	1.20	671.2	9238	264.75	11.26	4.25%	56.81
RodC3_97.2	182	2.469	0.221	766.0	19823.3	666.4	1.20	683.0	9056	238.68	9.93	4.16%	49.96
RodC3_108.8	183	2.764	0.516	800.4	20900.7	705.1	1.20	721.0	8515	262.97	11.02	4.19%	50.93
RodD5_50	217	1.270	0.076	590.0	13695.3	504.1	1.20	518.4	12528	191.38	8.14	4.26%	58.48
RodD5_54.1	218	1.374	0.180	612.3	14234.2	516.3	1.20	532.3	12137	178.00	7.42	4.17%	52.59
RodD5_56.9	219	1.445	0.251	620.8	14604.4	525.0	1.20	541.0	11904	182.98	7.63	4.17%	52.93
RodD5_60	220	1.524	0.330	627.1	15011.9	535.0	1.20	550.3	11662	195.64	8.22	4.20%	55.33
RodD5_66.1	221	1.679	0.485	643.8	15814.3	555.4	1.20	570.2	11181	214.64	9.08	4.23%	57.88
RodD5_69.9	222	1.775	-0.025	623.3	16311.7	568.6	1.20	577.7	11007	357.66	17.28	4.83%	94.74
RodD5_72.9	223	1.852	0.051	660.1	16705.5	579.2	1.20	592.7	10679	247.96	10.73	4.33%	63.41
RodD5_74.9	224	1.902	0.102	676.6	16968.6	586.4	1.20	601.4	10497	225.50	9.54	4.23%	56.51

Table SC-3180-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	568.3	12447.0	479.3	1.20	494.2	13275	167.81	7.10	4.23%	54.37
RodB5_52.9	154	1.344	0.150	606.8	14030.1	508.9	1.20	525.2	12334	171.84	7.15	4.16%	51.65
RodB5_55	155	1.397	0.203	614.6	14308.4	514.6	1.20	531.3	12164	171.69	7.12	4.15%	50.85
RodB5_57.8	156	1.468	0.274	621.6	14680.9	522.5	1.20	539.1	11955	177.89	7.39	4.15%	51.70
RodB5_64	157	1.626	0.432	636.5	15504.1	540.9	1.20	556.8	11501	194.63	8.13	4.18%	54.19
RodB5_73.9	158	1.877	0.077	668.3	16818.4	572.0	1.20	588.0	10779	209.63	8.77	4.18%	54.20
RodB5_75.9	159	1.928	0.128	680.7	17084.1	578.5	1.20	595.5	10620	200.64	8.31	4.14%	50.98
RodB5_76.9	160	1.953	0.153	685.5	17215.6	581.7	1.20	599.0	10546	199.20	8.23	4.13%	50.20
RodF5_41	105	1.041	0.343	559.0	12372.2	479.3	1.20	492.6	13326	186.44	8.08	4.33%	60.64
RodF5_53.1	106	1.349	0.155	597.4	13978.2	509.4	1.20	524.1	12366	190.58	8.09	4.24%	57.44
RodF5_55	107	1.397	0.203	604.1	14230.8	514.6	1.20	529.5	12213	190.97	8.08	4.23%	56.80
RodF5_57.8	108	1.468	0.274	611.7	14602.2	522.5	1.20	537.4	11999	196.59	8.32	4.23%	57.36
RodF5_64	109	1.626	0.432	628.0	15426.3	540.9	1.20	555.4	11536	212.57	9.03	4.25%	59.39
RodF5_73.8	110	1.875	0.074	653.8	16724.8	571.7	1.20	585.4	10837	244.19	10.54	4.31%	63.53
RodF5_75.8	111	1.925	0.125	665.4	16991.1	578.2	1.20	592.7	10679	233.75	9.96	4.26%	59.78
RodF5_76.8	112	1.951	0.150	668.9	17124.5	581.4	1.20	596.0	10609	234.77	10.00	4.26%	59.58
RodC2_41	57	1.041	0.343	559.2	12427.4	479.3	1.20	492.6	13325	186.69	8.08	4.33%	60.71
RodC2_53.1	58	1.349	0.155	600.3	14034.4	509.4	1.20	524.6	12353	185.39	7.81	4.21%	55.81
RodC2_55	59	1.397	0.203	606.5	14286.4	514.6	1.20	529.9	12202	186.59	7.85	4.21%	55.44
RodC2_57.8	60	1.468	0.274	614.0	14657.1	522.5	1.20	537.8	11988	192.33	8.10	4.21%	56.07
RodC2_63.9	61	1.623	0.429	629.5	15467.4	540.6	1.20	555.4	11536	208.82	8.83	4.23%	58.34
RodC2_73.8	62	1.875	0.074	656.1	16783.7	571.7	1.20	585.7	10829	238.56	10.23	4.29%	62.01
RodC2_75.8	63	1.925	0.125	666.5	17048.1	578.2	1.20	592.9	10675	231.55	9.84	4.25%	59.19
RodC2_76.8	64	1.951	0.150	670.4	17180.3	581.4	1.20	596.2	10604	231.66	9.83	4.24%	58.76
RodC6_40.9	137	1.039	0.340	563.4	12367.2	479.1	1.20	493.2	13308	176.08	7.54	4.28%	57.19
RodC6_52.8	138	1.341	0.147	604.4	14014.5	508.6	1.20	524.6	12352	175.52	7.33	4.17%	52.84
RodC6_54.8	139	1.392	0.198	611.9	14293.8	514.1	1.20	530.4	12189	175.32	7.29	4.16%	52.04
RodC6_57.8	140	1.468	0.274	620.9	14709.0	522.5	1.20	538.9	11958	179.40	7.45	4.15%	52.15
RodC6_63.8	141	1.621	0.427	638.8	15541.5	540.3	1.20	556.7	11504	189.28	7.86	4.15%	52.72
RodC6_73.7	142	1.872	0.072	669.7	16912.1	571.3	1.20	587.7	10786	206.25	8.58	4.16%	53.36
RodC6_75.8	143	1.925	0.125	679.4	17203.7	578.2	1.20	595.0	10630	203.81	8.44	4.14%	51.84
RodC6_76.8	144	1.951	0.150	685.3	17341.0	581.4	1.20	598.7	10552	200.28	8.26	4.12%	50.51

Table SC-3180-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	696.0	18604.6	620.0	1.20	632.7	9892	293.81	12.91	4.40%	68.58
RodB4_91.3	162	2.319	0.071	735.0	18977.7	629.7	1.20	647.3	9633	216.33	8.93	4.13%	48.89
RodB4_93.3	163	2.370	0.122	747.1	19233.3	636.5	1.20	654.9	9504	208.68	8.56	4.10%	46.38
RodB4_95.1	164	2.416	0.168	759.9	19463.6	642.5	1.20	662.1	9385	198.98	8.10	4.07%	43.55
RodB4_100	165	2.540	0.292	772.6	20092.1	658.9	1.20	677.8	9135	212.00	8.66	4.09%	44.86
RodB4_106	166	2.692	0.445	799.5	20863.6	678.6	1.20	698.7	8823	207.09	8.40	4.06%	41.96
RodB4_109.9	167	2.791	0.544	777.5	20197.4	691.1	1.20	705.5	8726	280.72	12.01	4.28%	56.09
RodB4_142.3	168	3.614	0.224	829.3	7848.3	779.9	1.20	788.1	7709	190.57	9.66	5.07%	32.46
RodF4_85.6	98	2.174	0.374	684.0	18361.2	610.6	1.20	622.8	10075	300.21	13.30	4.43%	71.64
RodF4_88.4	99	2.245	-0.003	689.9	18728.5	620.0	1.20	631.6	9911	321.76	14.44	4.49%	75.28
RodF4_92.4	100	2.347	0.099	732.0	19253.7	633.4	1.20	649.9	9589	234.47	9.77	4.17%	52.69
RodF4_94.3	101	2.395	0.147	745.5	19502.6	639.8	1.20	657.4	9462	221.50	9.13	4.12%	48.96
RodF4_97.2	102	2.469	0.221	761.0	19888.0	649.5	1.20	668.1	9288	214.11	8.76	4.09%	46.25
RodF4_108.8	103	2.764	0.516	792.0	20999.1	687.6	1.20	705.0	8734	241.51	9.96	4.13%	48.30
RodF4_111	104	2.819	-0.044	764.0	20142.6	694.6	1.20	706.2	8717	348.65	15.67	4.49%	69.56
RodD2_103.2	65	2.621	0.373	773.5	20777.3	669.4	1.20	686.8	8999	239.54	9.88	4.13%	49.75
RodD2_106	66	2.692	0.445	783.1	21152.2	678.6	1.20	696.0	8863	242.93	10.02	4.12%	49.50
RodD2_112.6	67	2.860	-0.004	773.9	19405.6	699.7	1.20	712.1	8636	313.77	13.86	4.42%	61.87
RodD2_114.9	68	2.918	0.055	795.0	18505.9	706.8	1.20	721.5	8507	251.83	10.70	4.25%	48.72
RodD2_117.4	69	2.982	0.118	804.8	17527.5	714.5	1.20	729.5	8402	233.03	9.86	4.23%	44.37
RodD2_120.8	70	3.068	0.204	811.5	16196.3	724.6	1.20	739.1	8280	223.90	9.55	4.26%	41.84
RodD2_124.8	71	3.170	0.306	809.6	14632.2	736.2	1.20	748.4	8165	239.15	10.59	4.43%	43.89
RodD2_128.6	72	3.266	0.403	806.9	13144.2	746.7	1.20	756.7	8065	261.85	12.31	4.70%	47.30
RodD6_103.1	129	2.619	0.371	773.6	20809.7	669.1	1.20	686.5	9003	239.05	9.85	4.12%	49.67
RodD6_106	130	2.692	0.445	781.9	21192.4	678.6	1.20	695.8	8866	246.27	10.17	4.13%	50.20
RodD6_112.9	131	2.868	0.004	776.3	19340.1	700.6	1.20	713.2	8620	306.67	13.47	4.39%	60.32
RodD6_114.9	132	2.918	0.055	797.1	18547.5	706.8	1.20	721.9	8503	246.65	10.43	4.23%	47.68
RodD6_116.8	133	2.967	0.103	806.5	17795.4	712.7	1.20	728.3	8418	227.62	9.56	4.20%	43.44
RodD6_120.9	134	3.071	0.207	810.0	16172.3	724.9	1.20	739.1	8280	228.27	9.77	4.28%	42.65
RodD6_124.8	135	3.170	0.306	807.1	14628.7	736.2	1.20	748.0	8170	247.38	11.06	4.47%	45.43
RodD6_128.7	136	3.269	0.405	806.9	13087.2	746.9	1.20	756.9	8062	261.79	12.32	4.71%	47.26

Table SC-3180-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	582.1	13736.7	501.4	1.20	514.9	12633	204.33	8.81	4.31%	62.98
RodE2_54	74	1.372	0.178	601.0	14260.6	511.9	1.20	526.7	12292	192.11	8.11	4.22%	57.53
RodE2_56.9	75	1.445	0.251	612.4	14651.2	520.0	1.20	535.4	12053	190.31	7.98	4.20%	55.80
RodE2_59.9	76	1.521	0.328	619.5	15054.1	528.6	1.20	543.8	11830	198.74	8.36	4.21%	57.10
RodE2_66	77	1.676	0.483	632.6	15873.9	547.0	1.20	561.3	11392	222.62	9.47	4.25%	61.33
RodE2_69.8	78	1.773	-0.027	612.6	16383.3	558.9	1.20	567.8	11235	365.75	17.78	4.86%	99.19
RodE2_72.9	79	1.852	0.051	647.1	16798.8	568.8	1.20	581.8	10916	257.40	11.16	4.34%	67.53
RodE2_74.9	80	1.902	0.102	661.6	17068.7	575.2	1.20	589.6	10745	237.23	10.11	4.26%	61.11
RodB3_50.2	169	1.275	0.081	582.1	13654.9	501.7	1.20	515.1	12627	203.86	8.80	4.32%	62.80
RodB3_54.1	170	1.374	0.180	594.6	14172.8	512.1	1.20	525.9	12315	206.27	8.86	4.29%	61.89
RodB3_56.9	171	1.445	0.251	603.4	14544.9	520.0	1.20	533.9	12094	209.22	8.96	4.28%	61.57
RodB3_60.1	172	1.527	0.333	608.2	14969.2	529.2	1.20	542.4	11867	227.43	9.86	4.33%	65.56
RodB3_66.1	173	1.679	0.485	631.6	15766.3	547.3	1.20	561.3	11390	224.48	9.59	4.27%	61.83
RodB3_69.9	174	1.775	-0.025	614.2	16272.3	559.2	1.20	568.4	11223	354.67	17.11	4.82%	96.06
RodB3_73	175	1.854	0.054	649.3	16684.5	569.1	1.20	582.4	10901	249.56	10.82	4.34%	65.37
RodB3_75	176	1.905	0.105	664.3	16950.3	575.5	1.20	590.3	10729	229.09	9.72	4.24%	58.91
RodF3_50.1	89	1.273	0.079	585.9	13659.4	501.4	1.20	515.5	12614	194.02	8.29	4.27%	59.71
RodF3_54	90	1.372	0.178	602.6	14188.8	511.9	1.20	527.0	12284	187.68	7.91	4.21%	56.16
RodF3_57	91	1.448	0.254	610.6	14596.4	520.3	1.20	535.3	12055	193.99	8.18	4.22%	56.89
RodF3_60	92	1.524	0.330	617.9	15002.5	528.9	1.20	543.8	11831	202.34	8.55	4.23%	58.14
RodF3_66.1	93	1.679	0.485	627.9	15830.9	547.3	1.20	560.7	11405	235.71	10.16	4.31%	65.02
RodF3_70	94	1.778	-0.022	615.8	16358.9	559.5	1.20	568.9	11210	348.45	16.65	4.78%	94.26
RodF3_73	95	1.854	0.054	652.3	16767.4	569.1	1.20	582.9	10891	241.88	10.39	4.30%	63.29
RodF3_75	96	1.905	0.105	669.9	17036.6	575.5	1.20	591.3	10709	216.60	9.08	4.19%	55.58
RodE6_50.2	121	1.275	0.081	583.0	13650.2	501.7	1.20	515.2	12622	201.44	8.68	4.31%	62.03
RodE6_54.1	122	1.374	0.180	600.3	14161.8	512.1	1.20	526.8	12288	192.76	8.17	4.24%	57.71
RodE6_57	123	1.448	0.254	608.3	14543.5	520.3	1.20	534.9	12065	198.33	8.41	4.24%	58.22
RodE6_60.2	124	1.529	0.335	615.1	14963.8	529.5	1.20	543.8	11830	209.78	8.94	4.26%	60.28
RodE6_66.1	125	1.679	0.485	632.7	15739.2	547.3	1.20	561.5	11385	221.07	9.43	4.26%	60.86
RodE6_70	126	1.778	-0.022	614.8	16251.5	559.5	1.20	568.7	11214	352.73	16.99	4.82%	95.45
RodE6_73.1	127	1.857	0.056	650.3	16658.6	569.4	1.20	582.9	10892	247.18	10.70	4.33%	64.68
RodE6_75	128	1.905	0.105	664.1	16906.9	575.5	1.20	590.3	10730	229.00	9.73	4.25%	58.89

RBHT Steam Cooling Test SC-3205-A

Matrix test # 6

Test date – 4/14/2005

Steady state time window: 10680 - 12000 sec

Inlet flow: 2.26 m³/min (79.9 ft³/min)

Inlet steam temperature: 407 K (273 °F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 50.1 kW

Outlet steam temperature: 810 K (999 °F)

Bundle inlet Reynolds number: 9145

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

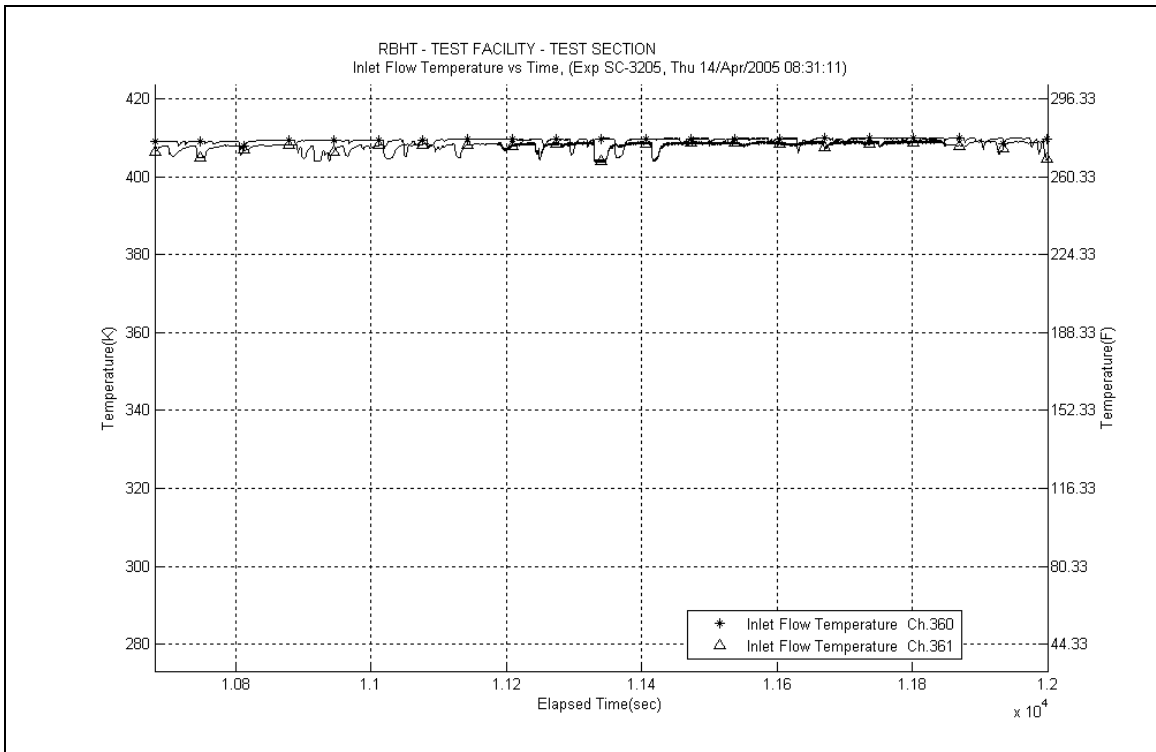
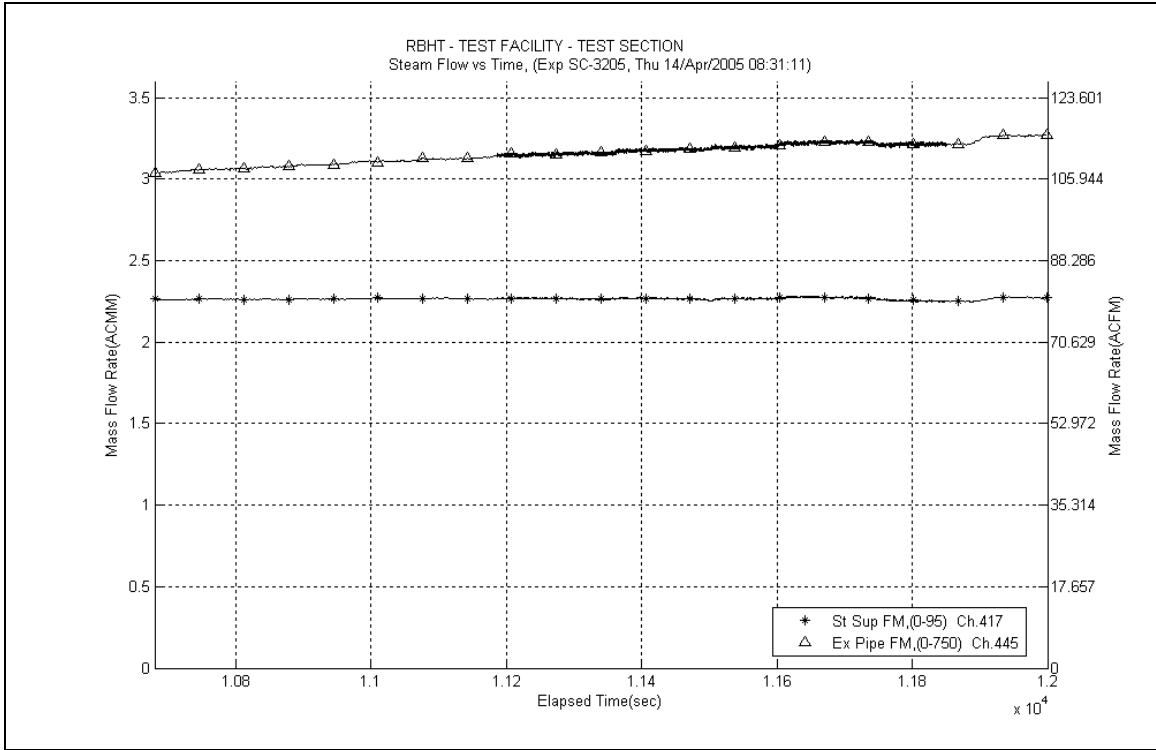
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

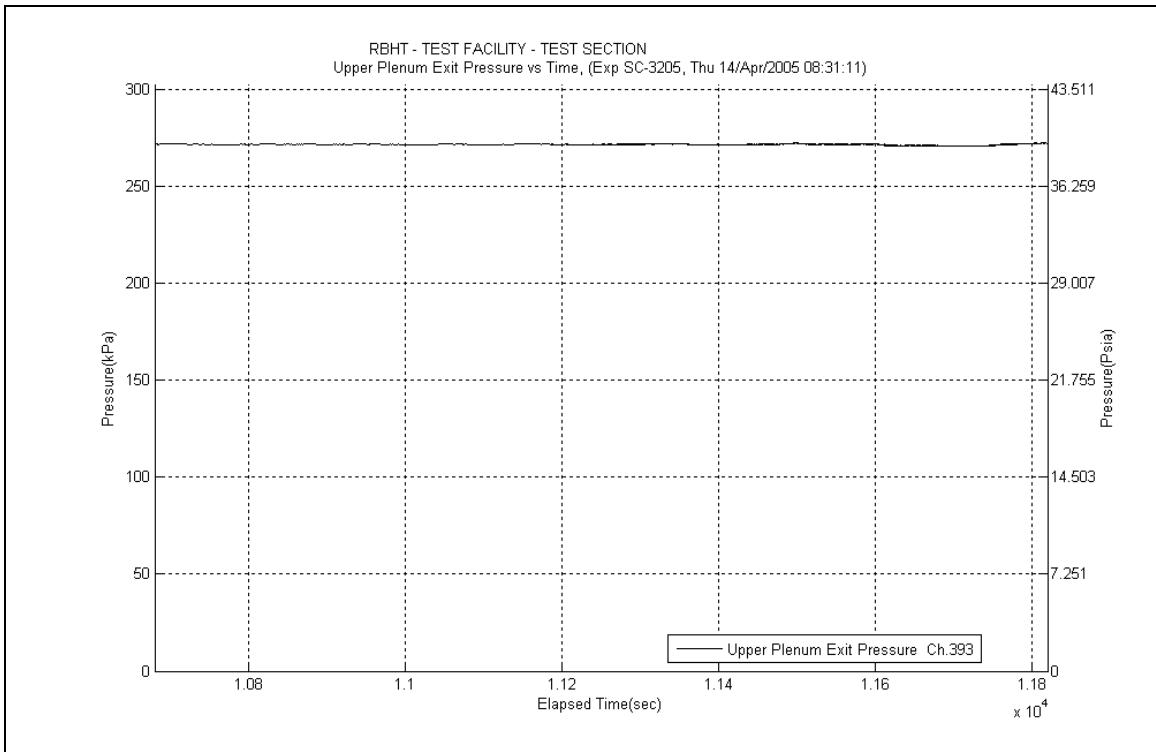
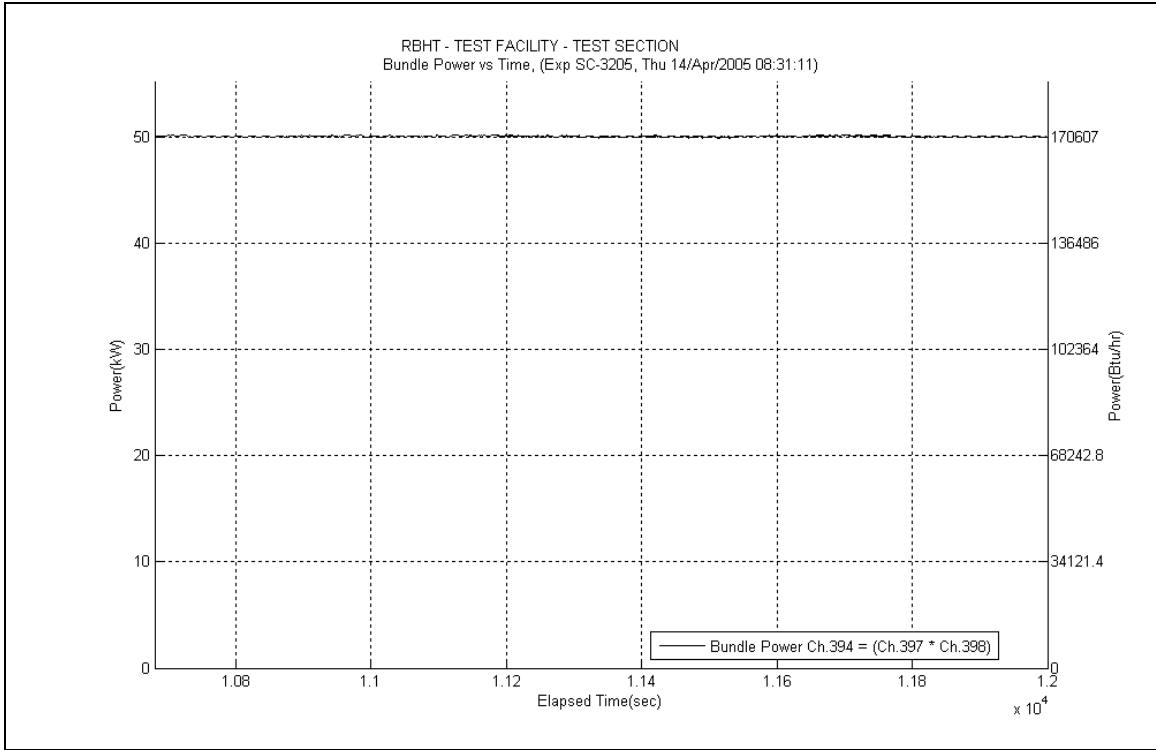
$$T_{cl} = -26.873x^3 + 174.62x^2 - 204.99x + 539.89$$

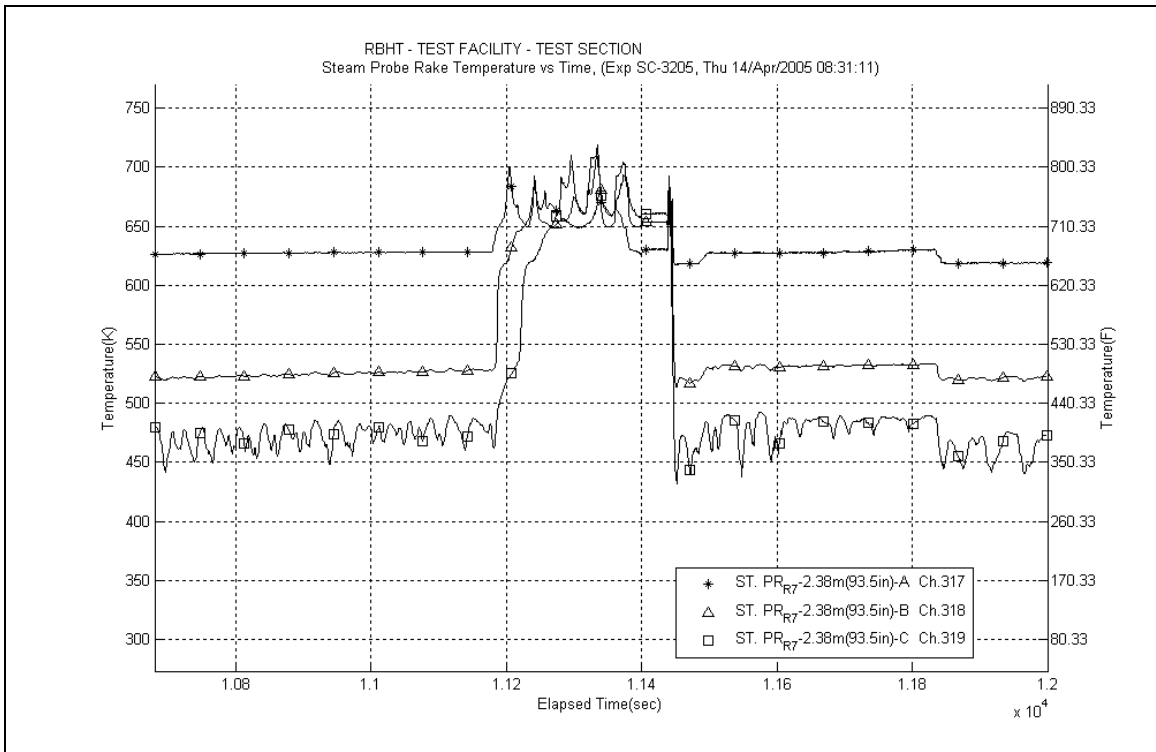
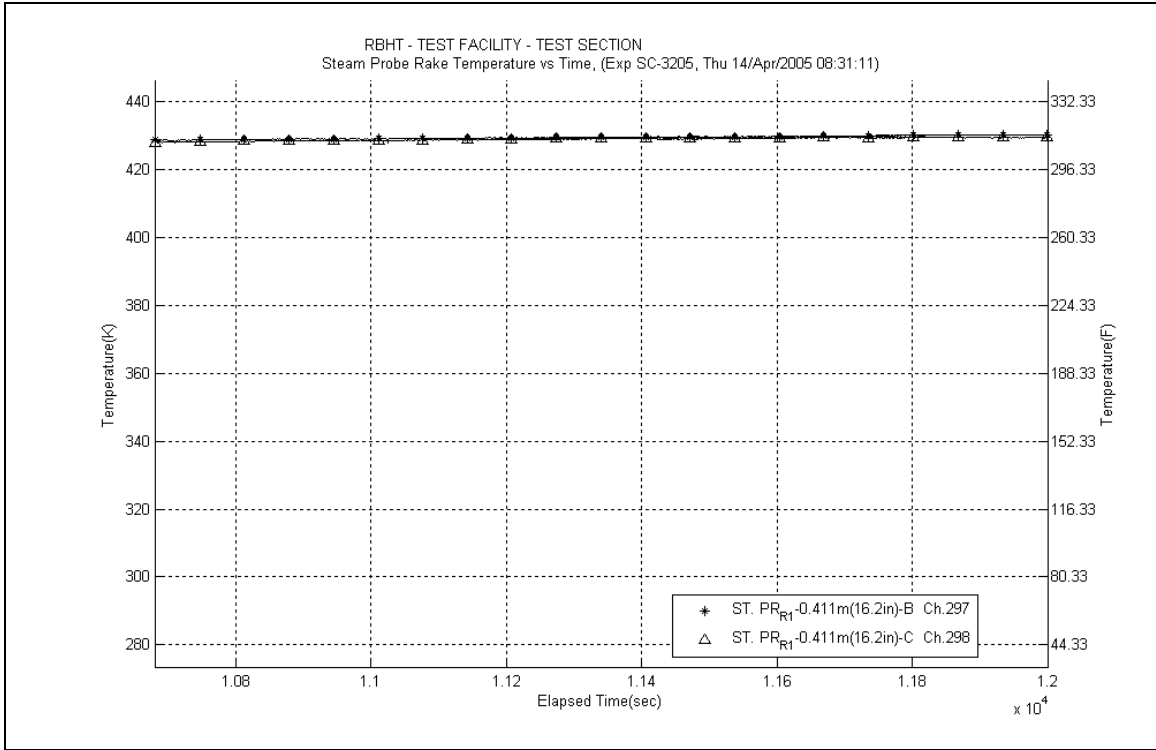
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

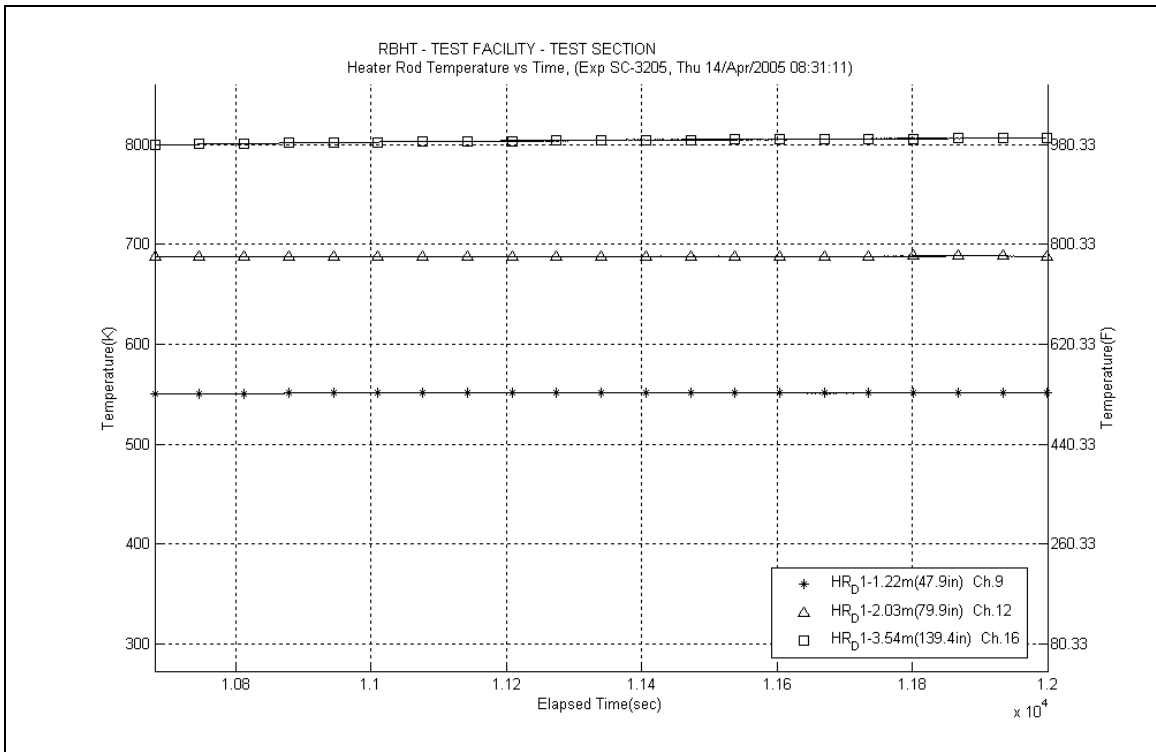
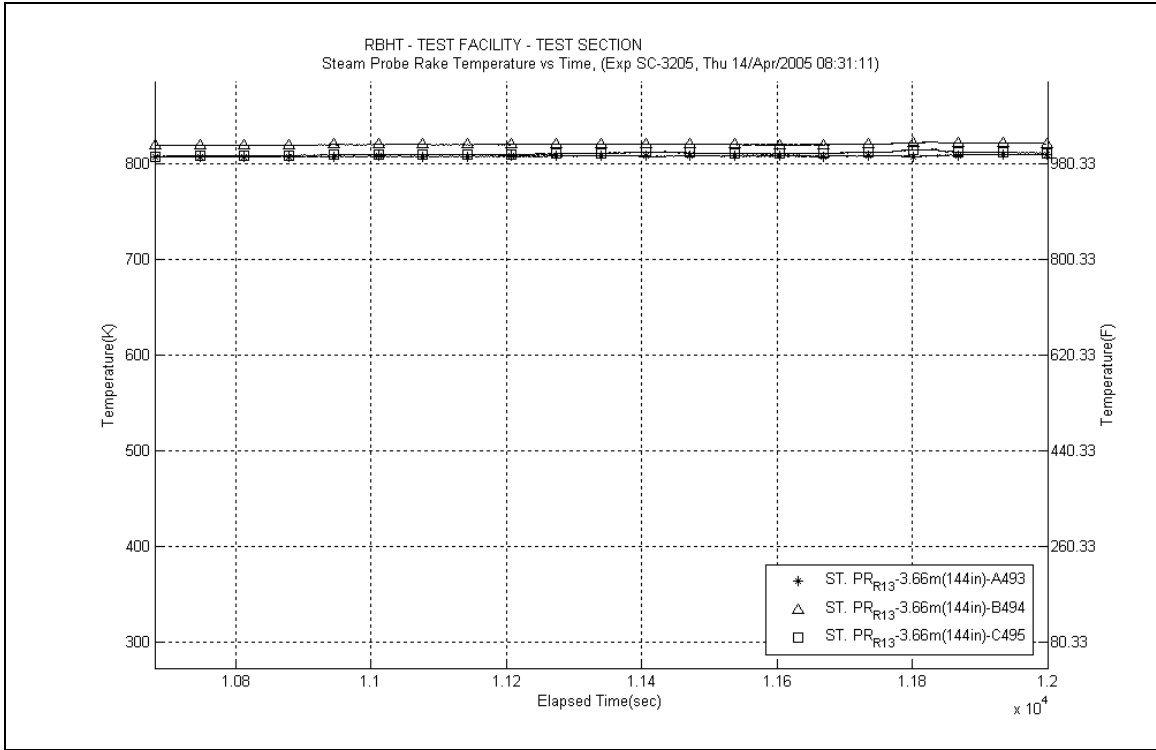
$$T_{cl} = -19.366x^3 + 133.36x^2 - 150.05x + 521.57$$

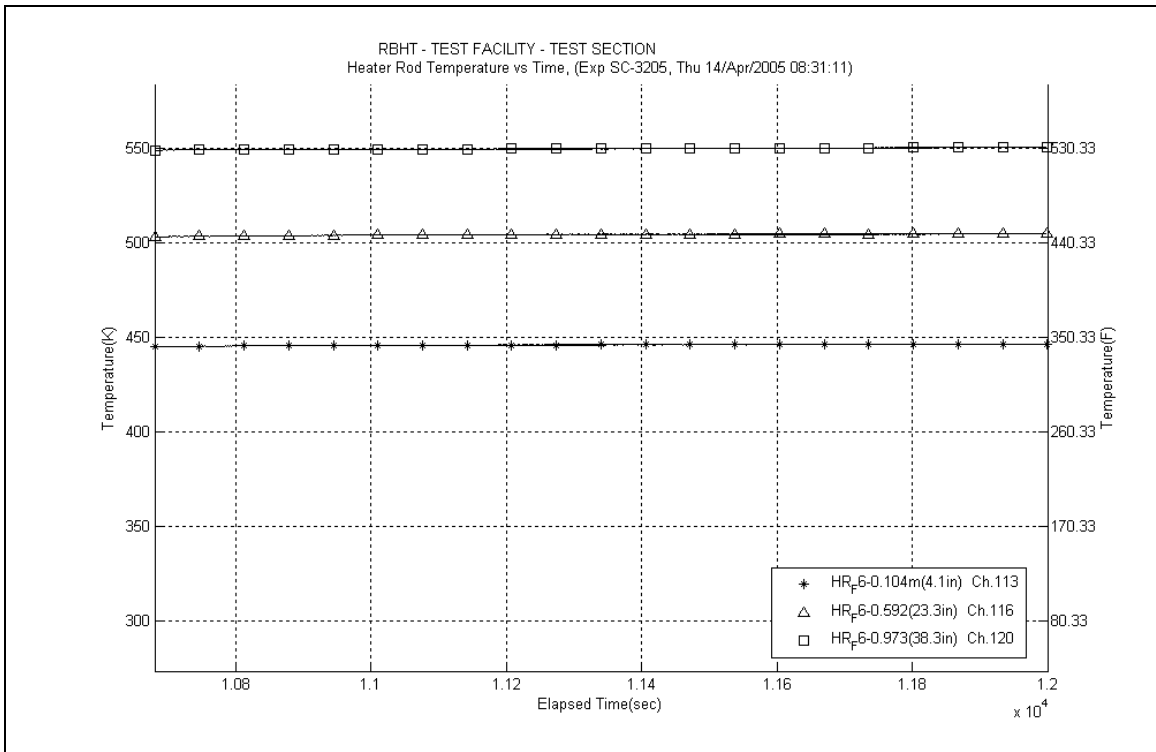
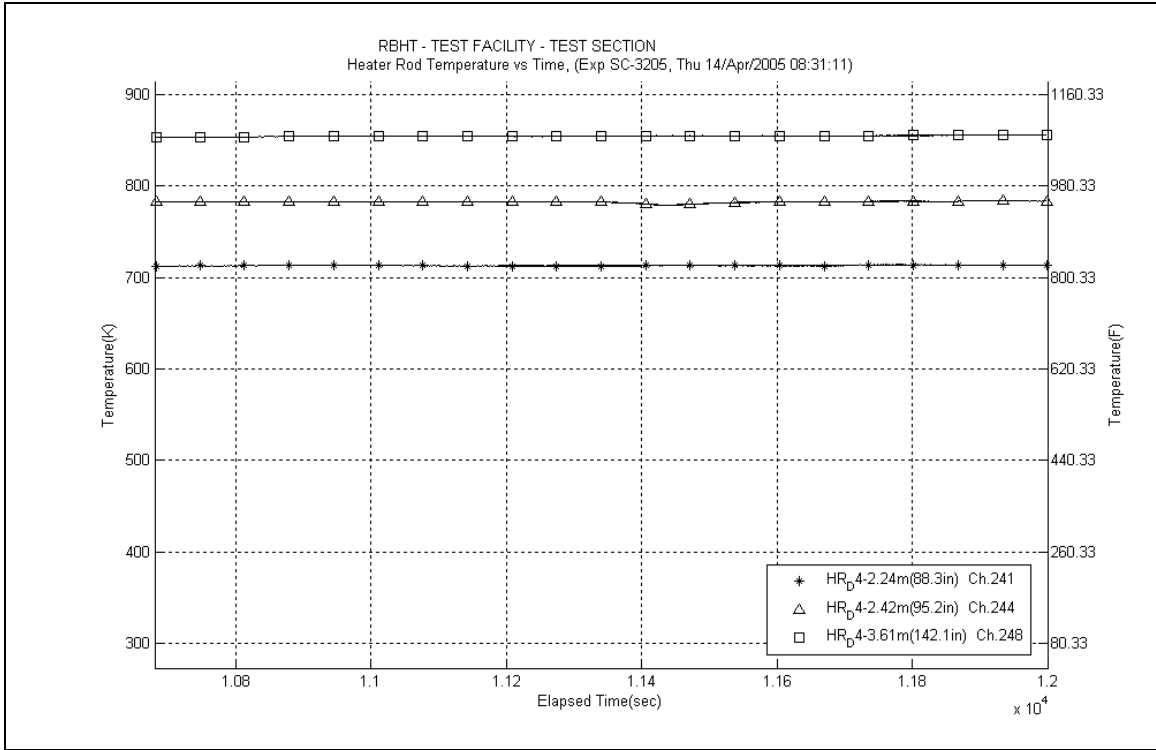
where x is the elevation (m) and T_{cl} is in (K)











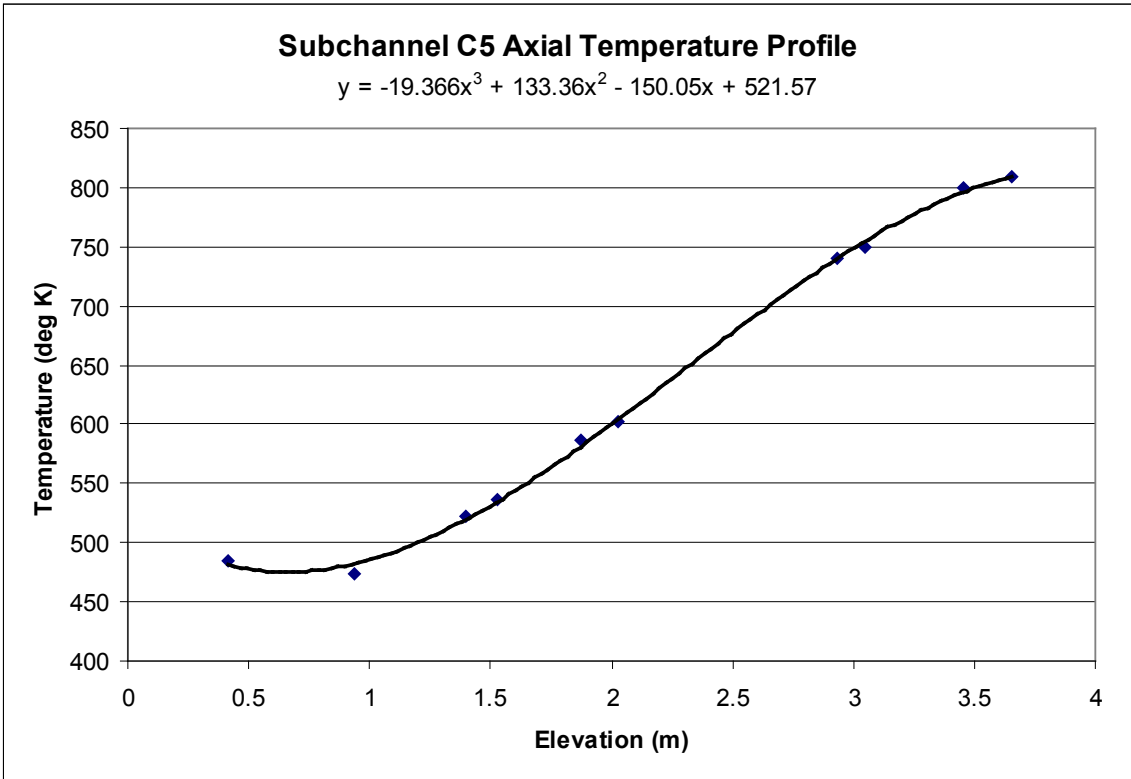
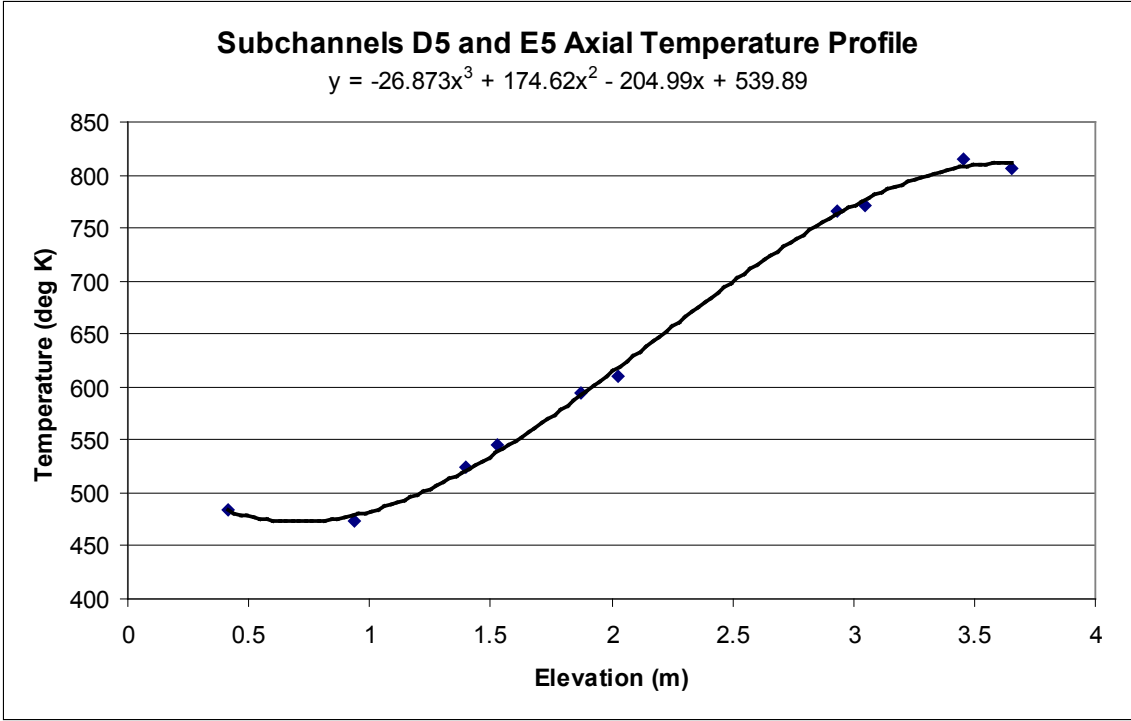


Table SC-3205-A.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ontc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	762.9	13372.6	655.3	1.20	673.3	5802	149.18	6.70	4.49%	31.95
RodD3_91.3	186	2.319	0.071	707.6	13672.7	668.5	1.20	675.0	5785	419.06	25.02	5.97%	89.42
RodD3_93.1	187	2.365	0.117	746.9	13842.9	676.3	1.20	688.0	5660	235.36	11.36	4.83%	48.86
RodD3_95.3	188	2.421	0.173	763.9	14048.5	685.7	1.20	698.7	5561	215.64	10.18	4.72%	43.77
RodD3_100.1	189	2.543	0.295	810.8	14468.9	705.9	1.20	723.3	5348	165.50	7.46	4.51%	31.96
RodD3_106.1	190	2.695	0.447	831.7	15076.1	729.7	1.20	746.7	5160	177.46	8.02	4.52%	32.73
RodD3_110	191	2.794	0.546	813.5	14895.3	744.2	1.20	755.7	5092	258.04	12.45	4.82%	46.76
RodD3_142.1	192	3.609	0.218	843.1	5168.6	811.3	1.27	818.1	4665	207.05	15.67	7.57%	33.45
RodC4_88.4	233	2.245	-0.003	715.4	13543.1	655.8	1.20	665.7	5878	272.46	13.72	5.03%	59.31
RodC4_91.1	234	2.314	0.066	750.6	13805.3	667.6	1.20	681.4	5723	199.64	9.28	4.65%	42.02
RodC4_93.4	235	2.372	0.124	767.4	14026.9	677.6	1.20	692.5	5618	187.42	8.60	4.59%	38.54
RodC4_95.3	236	2.421	0.173	781.0	14207.3	685.7	1.20	701.6	5536	178.89	8.13	4.55%	36.10
RodC4_100.1	237	2.543	0.295	805.0	14609.9	705.9	1.20	722.4	5356	176.82	8.00	4.53%	34.21
RodC4_106.1	238	2.695	0.447	823.9	15251.6	729.7	1.20	745.4	5170	194.29	8.84	4.55%	35.92
RodC4_110	239	2.794	0.546	804.9	14774.5	744.2	1.20	754.3	5102	292.16	14.64	5.01%	53.09
RodC4_142.2	240	3.612	0.221	859.3	5613.5	811.3	1.27	821.6	4644	148.76	9.50	6.39%	23.89
RodD4_88.3	241	2.243	-0.005	712.3	13494.8	655.3	1.20	664.8	5887	284.54	14.55	5.11%	62.06
RodD4_91.3	242	2.319	0.071	747.9	13785.2	668.5	1.20	681.7	5720	208.34	9.78	4.69%	43.83
RodD4_93.2	243	2.367	0.119	766.6	13966.3	676.7	1.20	691.7	5626	186.37	8.55	4.59%	38.39
RodD4_95.2	244	2.418	0.170	781.7	14155.2	685.3	1.20	701.4	5538	176.17	8.00	4.54%	35.57
RodD4_100.1	245	2.543	0.295	811.3	14617.9	705.9	1.20	723.4	5347	166.28	7.46	4.49%	32.10
RodD4_106.1	246	2.695	0.447	825.2	15193.4	729.7	1.20	745.6	5169	190.88	8.68	4.55%	35.28
RodD4_110	247	2.794	0.546	807.9	14671.2	744.2	1.20	754.8	5099	276.40	13.68	4.95%	50.18
RodD4_142.1	248	3.609	0.218	854.3	5432.2	811.3	1.27	820.5	4651	160.79	10.69	6.65%	25.87
RodE4_88.4	201	2.245	-0.003	837.3	13272.8	655.8	1.20	686.0	5679	87.75	3.80	4.33%	18.29
RodE4_91.2	202	2.316	0.069	707.9	13545.2	668.0	1.20	674.7	5788	407.32	24.13	5.92%	86.97
RodE4_95.3	204	2.421	0.173	740.9	13923.5	685.7	1.20	694.9	5596	302.54	15.69	5.19%	61.90
RodE4_100.9	205	2.563	0.315	806.5	14424.6	709.1	1.20	725.4	5331	177.67	8.11	4.56%	34.17
RodE4_142.3	208	3.614	0.224	856.5	5498.0	811.3	1.27	821.0	4648	154.90	10.10	6.52%	24.90
RodE3_63.4	193	1.610	0.417	843.5	10984.3	550.4	1.20	599.3	6642	44.97	1.92	4.26%	11.37
RodE3_113.6	194	2.885	0.022	818.3	13559.4	756.7	1.20	767.0	5009	263.98	13.22	5.01%	46.83
RodE3_115.5	195	2.934	0.070	822.8	13063.4	762.9	1.27	775.7	4946	277.26	16.77	6.05%	48.38
RodE3_118.5	196	3.010	0.146	832.6	12259.8	772.1	1.27	785.1	4881	258.01	15.57	6.03%	44.25
RodE3_122.7	197	3.117	0.253	844.2	11143.6	783.7	1.27	796.6	4803	234.13	14.11	6.02%	39.31
RodE3_126.5	198	3.213	0.349	851.6	10132.3	792.6	1.27	805.2	4747	218.67	13.23	6.05%	36.15
RodE3_131.7	199	3.345	-0.046	851.0	8750.6	802.3	1.27	812.7	4699	228.75	14.50	6.34%	37.32
RodE3_135.6	200	3.444	0.053	828.4	7718.6	807.4	1.27	811.9	4705	467.76	44.51	9.52%	76.42

Table SC-3205-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tdi (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	650.8	10784.9	551.5	1.20	568.1	7073	130.34	5.96	4.58%	35.52
RodC5_113.6	226	2.885	0.022	816.9	13225.6	756.7	1.20	766.7	5011	263.61	13.38	5.08%	46.79
RodC5_115.7	227	2.939	0.075	835.3	12695.5	763.5	1.27	778.9	4924	225.15	13.24	5.88%	39.06
RodC5_122.7	229	3.117	0.253	856.1	10928.2	783.7	1.27	799.2	4786	191.92	11.24	5.86%	32.08
RodC5_126.7	230	3.218	0.354	855.3	9916.7	793.0	1.27	806.4	4740	202.69	12.17	6.00%	33.44
RodC5_131.6	231	3.343	-0.048	833.9	8683.5	802.1	1.27	808.9	4723	347.62	25.98	7.47%	57.09
RodC5_135.7	232	3.447	0.056	846.8	7646.3	807.5	1.27	815.9	4679	247.46	16.83	6.80%	40.14
RodE5_63.6	209	1.615	0.422	640.9	11060.3	551.2	1.20	566.1	7102	147.91	6.79	4.59%	40.50
RodE5_113.6	210	2.885	0.022	810.0	13638.8	756.7	1.20	765.6	5019	307.02	16.08	5.24%	54.61
RodE5_115.4	211	2.931	0.067	821.2	13169.2	762.6	1.27	775.1	4950	286.07	17.36	6.07%	49.98
RodE5_118.7	212	3.015	0.151	828.7	12307.3	772.7	1.27	784.7	4884	279.87	17.15	6.13%	48.03
RodE5_122.6	213	3.114	0.250	837.1	11284.9	783.4	1.27	794.9	4815	267.24	16.51	6.18%	45.01
RodE5_126.6	214	3.216	0.352	840.2	10236.9	792.8	1.27	803.0	4762	274.77	17.54	6.38%	45.61
RodE5_131.6	215	3.343	-0.048	819.0	8933.4	802.1	1.27	805.7	4744	672.13	74.88	11.14%	111.02
RodE5_135.6	216	3.444	0.053	833.5	7888.4	807.4	1.27	813.0	4698	384.06	31.74	8.26%	62.62
RodC3_79.8	177	2.027	0.227	672.9	12510.2	618.0	1.20	627.2	6297	273.60	14.21	5.19%	64.87
RodC3_85.6	178	2.174	0.374	695.3	13052.9	643.5	1.20	652.1	6019	301.97	15.99	5.30%	67.71
RodC3_88.5	179	2.248	0.000	702.0	13328.0	656.2	1.20	663.9	5897	349.31	19.43	5.56%	76.34
RodC3_92.4	180	2.347	0.099	708.1	13692.6	673.2	1.20	679.0	5746	472.02	30.03	6.36%	99.86
RodC3_94.4	181	2.398	0.150	750.6	13878.1	681.9	1.20	693.3	5611	242.21	11.78	4.87%	49.72
RodC3_97.2	182	2.469	0.221	781.7	14129.9	693.8	1.20	708.4	5475	192.91	8.93	4.63%	38.39
RodC3_108.8	183	2.764	0.516	821.0	14918.2	739.8	1.20	753.4	5110	220.58	10.35	4.69%	40.16
RodD5_50	217	1.270	0.076	591.7	9770.5	506.2	1.20	520.4	7850	137.07	6.35	4.63%	42.07
RodD5_54.1	218	1.374	0.180	616.4	10155.7	518.2	1.20	534.6	7602	124.12	5.63	4.53%	36.75
RodD5_56.9	219	1.445	0.251	629.6	10418.6	527.2	1.20	544.3	7441	122.20	5.51	4.51%	35.32
RodD5_60	220	1.524	0.330	639.1	10711.0	537.9	1.20	554.8	7274	127.03	5.74	4.52%	35.77
RodD5_66.1	221	1.679	0.485	653.7	11283.1	560.8	1.20	576.3	6954	145.72	6.68	4.58%	38.93
RodD5_69.9	222	1.775	-0.025	632.0	11638.9	576.0	1.20	585.3	6827	249.14	12.76	5.12%	65.13
RodD5_72.9	223	1.852	0.051	667.5	11920.4	588.4	1.20	601.6	6611	180.84	8.52	4.71%	45.48
RodD5_74.9	224	1.902	0.102	685.2	12107.8	596.9	1.20	611.6	6485	164.58	7.60	4.62%	40.44

Table SC-3205-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	569.6	8877.5	488.1	1.20	501.7	8202	130.62	6.11	4.68%	42.05
RodB5_52.9	154	1.344	0.150	611.7	10004.9	513.8	1.20	530.1	7679	122.59	5.57	4.54%	36.72
RodB5_55	155	1.397	0.203	620.5	10203.6	519.4	1.20	536.3	7574	121.17	5.48	4.52%	35.73
RodB5_57.8	156	1.468	0.274	632.3	10469.8	527.4	1.20	544.9	7431	119.82	5.39	4.50%	34.57
RodB5_64	157	1.626	0.432	648.2	11056.1	546.9	1.20	563.8	7137	130.95	5.93	4.53%	36.07
RodB5_73.9	158	1.877	0.077	677.0	11995.7	581.7	1.20	597.6	6663	151.15	6.90	4.57%	38.38
RodB5_75.9	159	1.928	0.128	691.6	12185.3	589.2	1.20	606.3	6552	142.72	6.45	4.52%	35.51
RodB5_76.9	160	1.953	0.153	697.6	12280.0	593.0	1.20	610.4	6500	140.85	6.35	4.51%	34.70
RodF5_41	105	1.041	0.343	562.3	8821.2	488.1	1.20	500.4	8226	142.63	6.81	4.77%	46.06
RodF5_53.1	106	1.349	0.155	602.2	9968.2	514.3	1.20	528.9	7699	136.04	6.29	4.62%	40.86
RodF5_55	107	1.397	0.203	610.5	10147.9	519.4	1.20	534.6	7602	133.66	6.14	4.60%	39.58
RodF5_57.8	108	1.468	0.274	620.0	10413.4	527.4	1.20	542.9	7464	135.07	6.19	4.58%	39.18
RodF5_64	109	1.626	0.432	635.0	11000.6	546.9	1.20	561.6	7170	149.80	6.92	4.62%	41.48
RodF5_73.8	110	1.875	0.074	659.5	11932.4	581.3	1.20	594.4	6705	183.13	8.66	4.73%	46.85
RodF5_75.8	111	1.925	0.125	674.3	12121.7	588.8	1.20	603.1	6592	170.22	7.92	4.65%	42.67
RodF5_76.8	112	1.951	0.150	680.0	12216.7	592.6	1.20	607.2	6540	167.77	7.78	4.63%	41.65
RodC2_41	57	1.041	0.343	562.7	8863.1	488.1	1.20	500.5	8225	142.49	6.78	4.76%	46.01
RodC2_53.1	58	1.349	0.155	605.5	10009.6	514.3	1.20	529.5	7690	131.72	6.05	4.59%	39.51
RodC2_55	59	1.397	0.203	613.5	10189.0	519.4	1.20	535.1	7593	129.97	5.94	4.57%	38.44
RodC2_57.8	60	1.468	0.274	625.4	10453.8	527.4	1.20	543.8	7449	128.02	5.81	4.54%	37.05
RodC2_63.9	61	1.623	0.429	639.5	11031.8	546.5	1.20	562.0	7163	142.46	6.52	4.58%	39.40
RodC2_73.8	62	1.875	0.074	661.8	11971.0	581.3	1.20	594.8	6700	178.57	8.39	4.70%	45.64
RodC2_75.8	63	1.925	0.125	673.8	12161.1	588.8	1.20	603.0	6593	171.75	7.99	4.65%	43.06
RodC2_76.8	64	1.951	0.150	678.5	12256.0	592.6	1.20	606.9	6543	171.10	7.94	4.64%	42.50
RodC6_40.9	137	1.039	0.340	566.5	8819.4	487.9	1.20	501.0	8215	134.68	6.35	4.72%	43.43
RodC6_52.8	138	1.341	0.147	610.3	9995.7	513.5	1.20	529.6	7687	123.85	5.63	4.55%	37.14
RodC6_54.8	139	1.392	0.198	619.7	10192.8	518.9	1.20	535.7	7583	121.25	5.48	4.52%	35.81
RodC6_57.8	140	1.468	0.274	632.3	10489.3	527.4	1.20	544.9	7431	120.01	5.40	4.50%	34.63
RodC6_63.8	141	1.621	0.427	648.3	11082.6	546.2	1.20	563.2	7145	130.22	5.88	4.52%	35.91
RodC6_73.7	142	1.872	0.072	676.8	12061.6	581.0	1.20	596.9	6672	151.08	6.88	4.55%	38.42
RodC6_75.8	143	1.925	0.125	688.4	12268.6	588.8	1.20	605.4	6562	147.77	6.69	4.53%	36.84
RodC6_76.8	144	1.951	0.150	695.5	12367.5	592.6	1.20	609.7	6508	144.27	6.50	4.51%	35.60

Table SC-3205-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	709.8	13268.3	637.8	1.20	649.8	6044	221.10	10.65	4.82%	49.83
RodB4_91.3	162	2.319	0.071	746.6	13532.2	649.3	1.20	665.5	5880	166.78	7.61	4.56%	36.32
RodB4_93.3	163	2.370	0.122	761.7	13714.6	657.2	1.20	674.6	5789	157.49	7.12	4.52%	33.63
RodB4_95.1	164	2.416	0.168	774.2	13878.0	664.3	1.20	682.6	5711	151.58	6.81	4.50%	31.83
RodB4_100	165	2.540	0.292	795.1	14255.4	683.5	1.20	702.1	5531	153.21	6.89	4.50%	30.89
RodB4_106	166	2.692	0.445	818.3	14885.0	706.3	1.20	725.0	5334	159.53	7.16	4.49%	30.70
RodB4_109.9	167	2.791	0.544	797.8	14412.3	720.6	1.20	733.5	5265	224.22	10.67	4.76%	42.43
RodB4_142.3	168	3.614	1.367	304.3	5602.0	807.0	1.20	723.2	5349	-13.37	0.56	-4.22%	-2.58
RodF4_85.6	98	2.174	0.374	695.8	13096.3	626.7	1.20	638.2	6171	227.43	11.04	4.85%	52.59
RodF4_88.4	99	2.245	-0.003	700.4	13356.9	637.8	1.20	648.2	6061	255.81	12.74	4.98%	57.85
RodF4_92.4	100	2.347	0.099	742.2	13730.7	653.6	1.20	668.4	5851	186.01	8.59	4.62%	40.26
RodF4_94.3	101	2.395	0.147	756.3	13908.7	661.2	1.20	677.0	5766	175.45	8.01	4.57%	37.28
RodF4_97.2	102	2.469	0.221	774.1	14181.3	672.6	1.20	689.5	5647	167.66	7.59	4.53%	34.70
RodF4_108.8	103	2.764	0.516	806.8	14971.2	716.7	1.20	731.7	5279	199.28	9.17	4.60%	37.85
RodF4_111	104	2.819	-0.044	783.9	14357.8	724.6	1.20	734.5	5257	290.41	14.69	5.06%	54.85
RodD2_103.2	65	2.621	0.373	797.4	14832.6	695.8	1.20	712.7	5438	175.16	7.91	4.52%	34.56
RodD2_106	66	2.692	0.445	806.1	15095.7	706.3	1.20	723.0	5351	181.64	8.23	4.53%	35.10
RodD2_112.6	67	2.860	-0.004	791.9	13846.3	730.2	1.20	740.5	5209	269.58	13.49	5.01%	50.32
RodD2_114.9	68	2.918	0.055	812.3	13200.8	738.1	1.20	750.5	5131	213.70	10.21	4.78%	39.12
RodD2_117.4	69	2.982	0.118	821.4	12499.8	746.5	1.20	759.0	5068	200.13	9.54	4.77%	36.05
RodD2_120.8	70	3.068	0.204	832.0	11543.5	757.3	1.27	773.3	4964	196.66	11.45	5.82%	34.48
RodD2_124.8	71	3.170	0.306	834.7	10421.4	769.1	1.27	783.2	4894	202.13	12.02	5.95%	34.79
RodD2_128.6	72	3.266	0.403	833.3	9358.6	779.4	1.27	791.0	4841	220.85	13.69	6.20%	37.47
RodD6_103.1	129	2.619	0.371	796.8	14843.5	695.4	1.20	712.3	5442	175.66	7.93	4.52%	34.68
RodD6_106	130	2.692	0.445	805.0	15116.7	706.3	1.20	722.8	5353	183.91	8.34	4.53%	35.55
RodD6_112.9	131	2.868	0.004	796.6	13789.2	731.3	1.20	742.2	5196	253.47	12.48	4.92%	47.16
RodD6_114.9	132	2.918	0.055	814.9	13222.6	738.1	1.20	750.9	5128	206.66	9.80	4.74%	37.80
RodD6_116.8	133	2.967	0.103	824.9	12684.0	744.5	1.20	757.9	5075	189.24	8.89	4.70%	34.15
RodD6_120.9	134	3.071	0.207	833.4	11523.1	757.6	1.27	773.8	4960	193.35	11.23	5.81%	33.86
RodD6_124.8	135	3.170	0.306	836.3	10418.9	769.1	1.27	783.5	4892	197.32	11.68	5.92%	33.94
RodD6_128.7	136	3.269	0.405	835.5	9316.4	779.7	1.27	791.6	4837	212.46	13.07	6.15%	36.00

Table SC-3205-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	583.0	9803.0	506.7	1.20	519.4	7868	154.17	7.28	4.72%	47.44
RodE2_54	74	1.372	0.178	607.0	10177.7	516.7	1.20	531.7	7650	135.19	6.20	4.58%	40.32
RodE2_56.9	75	1.445	0.251	620.9	10456.4	524.8	1.20	540.8	7498	130.59	5.93	4.54%	38.07
RodE2_59.9	76	1.521	0.328	632.9	10743.4	533.8	1.20	550.3	7344	130.04	5.88	4.52%	37.03
RodE2_66	77	1.676	0.483	642.5	11327.0	553.6	1.20	568.4	7068	152.88	7.02	4.59%	41.63
RodE2_69.8	78	1.773	-0.027	618.7	11691.2	566.8	1.20	575.5	6966	270.18	14.18	5.25%	72.32
RodE2_72.9	79	1.852	0.051	651.2	11985.9	578.0	1.20	590.2	6761	196.68	9.40	4.78%	50.82
RodE2_74.9	80	1.902	0.102	665.1	12177.2	585.4	1.20	598.7	6649	183.52	8.62	4.70%	46.47
RodB3_50.2	169	1.275	0.081	853.3	9715.9	506.9	1.20	564.7	7124	33.66	1.43	4.26%	9.25
RodB3_54.1	170	1.374	0.180	585.6	10112.2	517.0	1.20	528.4	7708	176.87	8.57	4.85%	53.20
RodB3_56.9	171	1.445	0.251	601.4	10375.4	524.8	1.20	537.6	7552	162.53	7.69	4.73%	47.77
RodB3_60.1	172	1.527	0.333	611.7	10677.6	534.4	1.20	547.3	7393	165.83	7.83	4.72%	47.57
RodB3_66.1	173	1.679	0.485	618.1	11246.1	553.9	1.20	564.6	7124	210.34	10.37	4.93%	57.81
RodB3_69.9	174	1.775	-0.025	643.7	11607.2	567.2	1.20	579.9	6903	181.97	8.61	4.73%	48.19
RodB3_73	175	1.854	0.054	623.9	11903.6	578.4	1.20	586.0	6819	313.78	17.36	5.53%	81.89
RodB3_75	176	1.905	0.105	657.5	12091.8	585.8	1.20	597.8	6661	202.46	9.75	4.81%	51.38
RodF3_50.1	89	1.273	0.079	587.5	9742.2	506.7	1.20	520.2	7854	144.57	6.77	4.68%	44.40
RodF3_54	90	1.372	0.178	609.0	10119.0	516.7	1.20	532.1	7645	131.58	6.02	4.58%	39.21
RodF3_57	91	1.448	0.254	620.1	10409.2	525.1	1.20	540.9	7496	131.47	5.99	4.56%	38.32
RodF3_60	92	1.524	0.330	628.9	10699.0	534.1	1.20	549.9	7351	135.44	6.17	4.56%	38.60
RodF3_66.1	93	1.679	0.485	636.3	11290.7	553.9	1.20	567.6	7079	164.52	7.66	4.66%	44.88
RodF3_70	94	1.778	-0.022	622.6	11668.5	567.5	1.20	576.7	6948	254.03	13.08	5.15%	67.79
RodF3_73	95	1.854	0.054	655.7	11959.0	578.4	1.20	591.3	6747	185.71	8.78	4.73%	47.86
RodF3_75	96	1.905	0.105	673.3	12152.6	585.8	1.20	600.4	6627	166.73	7.71	4.62%	42.05
RodE6_50.2	121	1.275	0.081	584.6	9743.7	506.9	1.20	519.9	7859	150.50	7.10	4.72%	46.26
RodE6_54.1	122	1.374	0.180	605.8	10109.8	517.0	1.20	531.8	7650	136.52	6.29	4.61%	40.71
RodE6_57	123	1.448	0.254	617.4	10382.0	525.1	1.20	540.5	7503	135.01	6.18	4.58%	39.39
RodE6_60.2	124	1.529	0.335	626.9	10682.1	534.7	1.20	550.1	7348	139.07	6.37	4.58%	39.62
RodE6_66.1	125	1.679	0.485	641.5	11235.9	553.9	1.20	568.5	7066	153.96	7.11	4.62%	41.91
RodE6_70	126	1.778	-0.022	621.9	11600.4	567.5	1.20	576.6	6950	255.98	13.26	5.18%	68.34
RodE6_73.1	127	1.857	0.056	654.9	11890.1	578.8	1.20	591.5	6745	187.46	8.91	4.75%	48.29
RodE6_75	128	1.905	0.105	670.5	12067.0	585.8	1.20	599.9	6633	171.09	7.97	4.66%	43.20

RBHT Steam Cooling Test SC-3205-B

Matrix test # 4

Test date – 3/15/2005

Steady state time window: 13400 - 15000 sec

Inlet flow: 1.36 m³/min (47.9 ft³/min)

Inlet steam temperature: 409 K (276 °F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 30.1 kW

Outlet steam temperature: 800 K (981 °F)

Bundle inlet Reynolds number: 5420

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

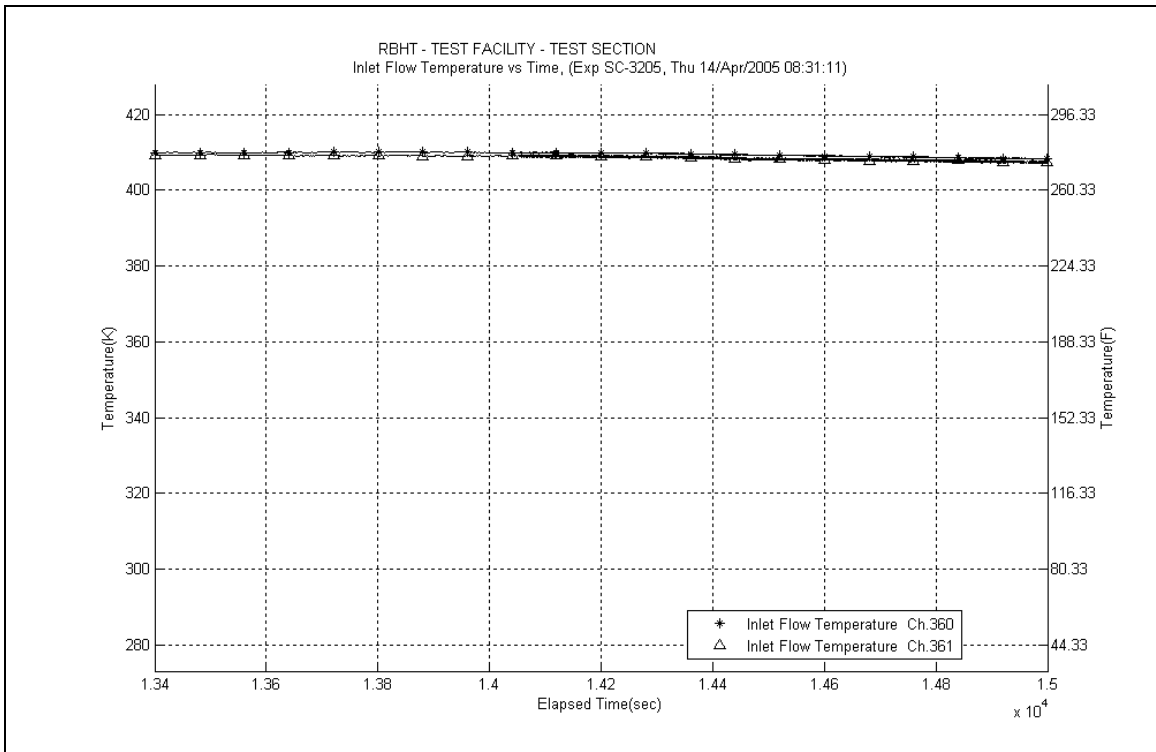
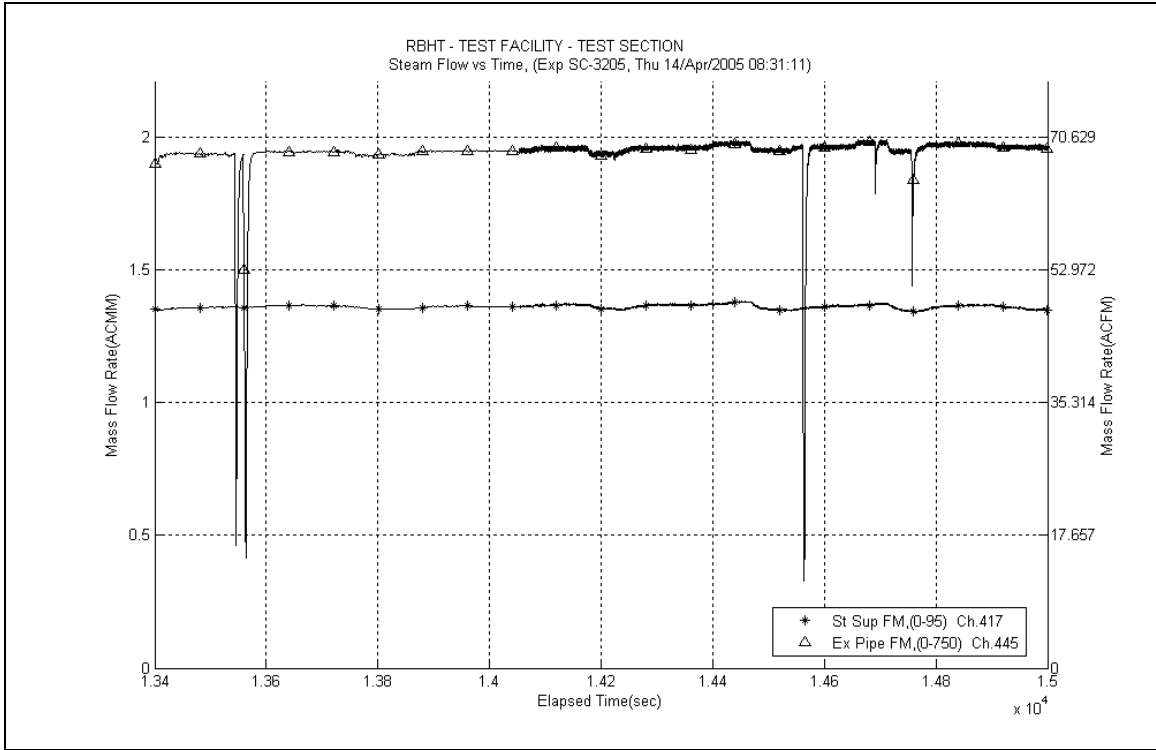
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

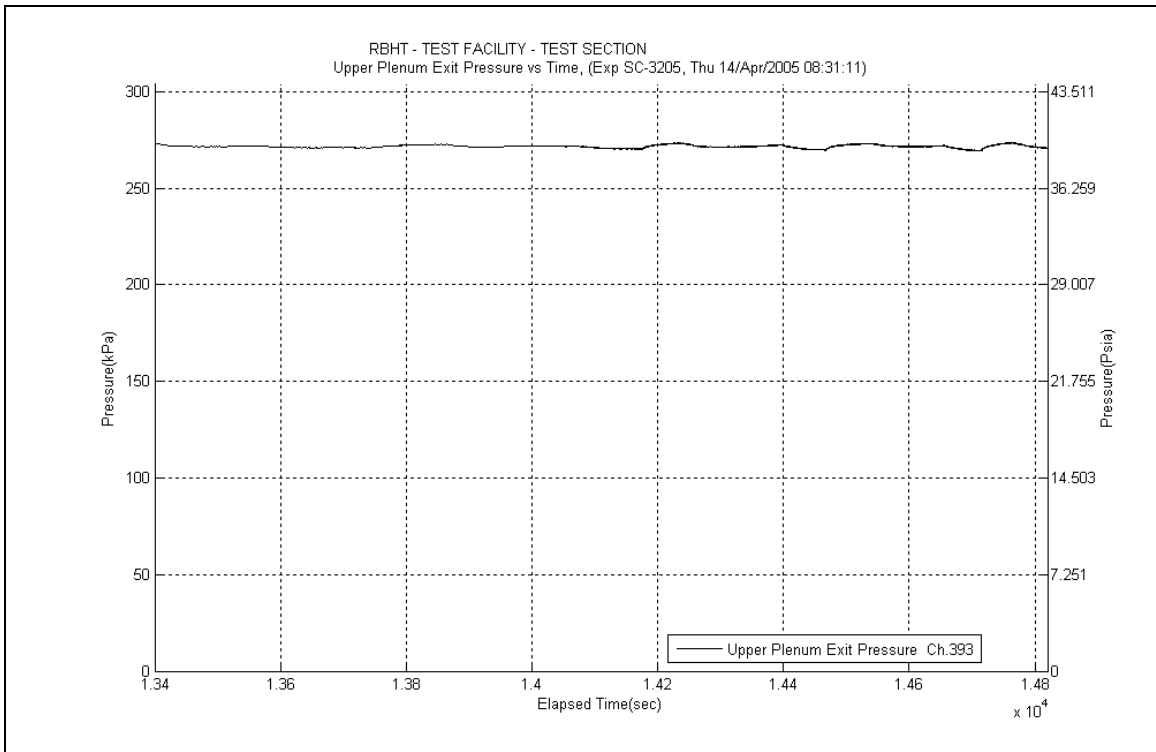
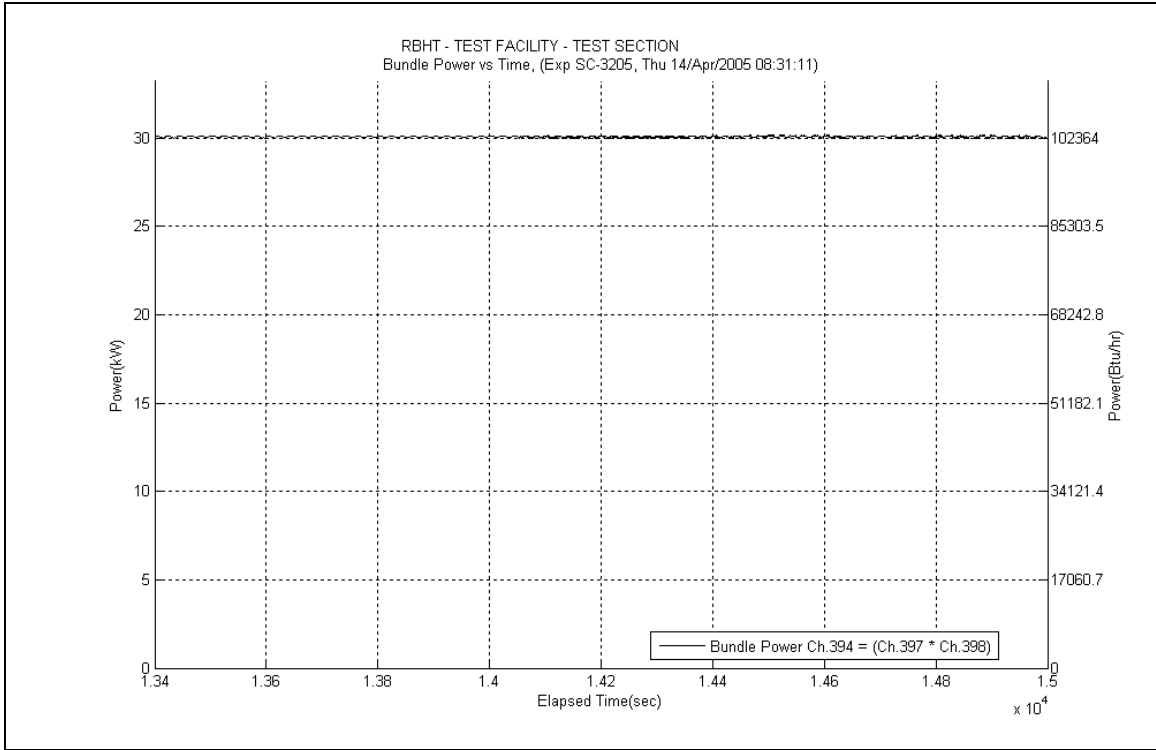
$$T_{cl} = -16.558x^3 + 102.54x^2 - 52.216x + 437.53$$

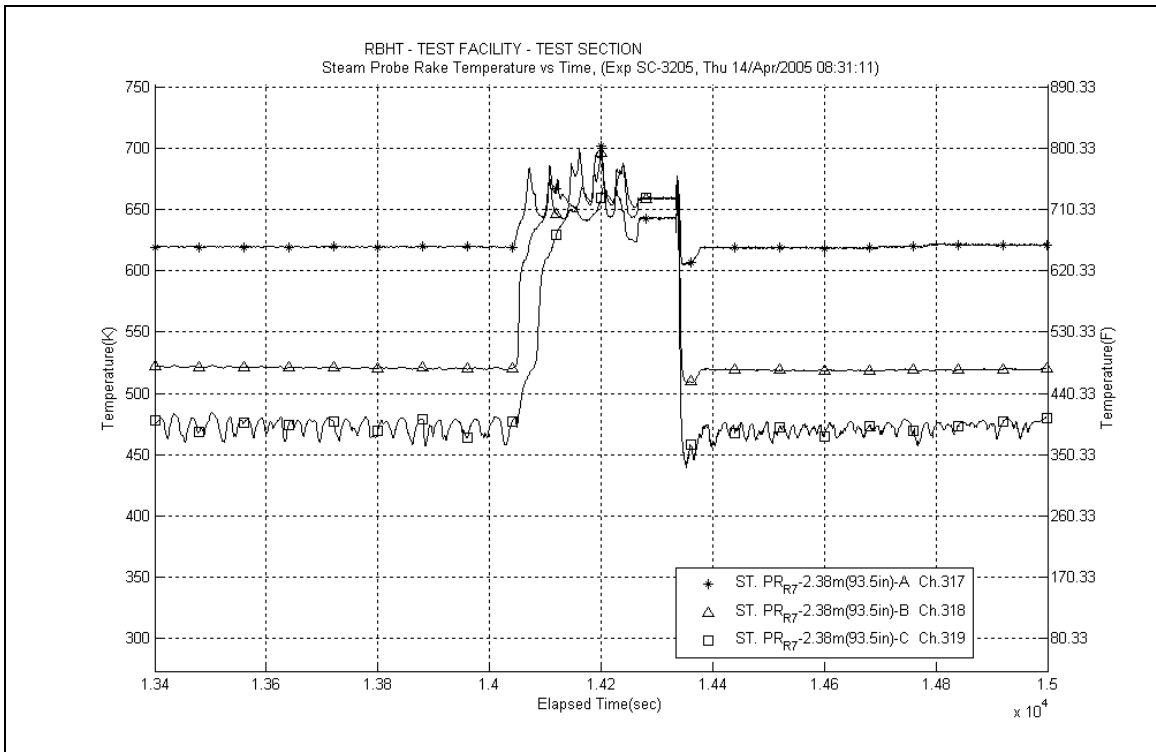
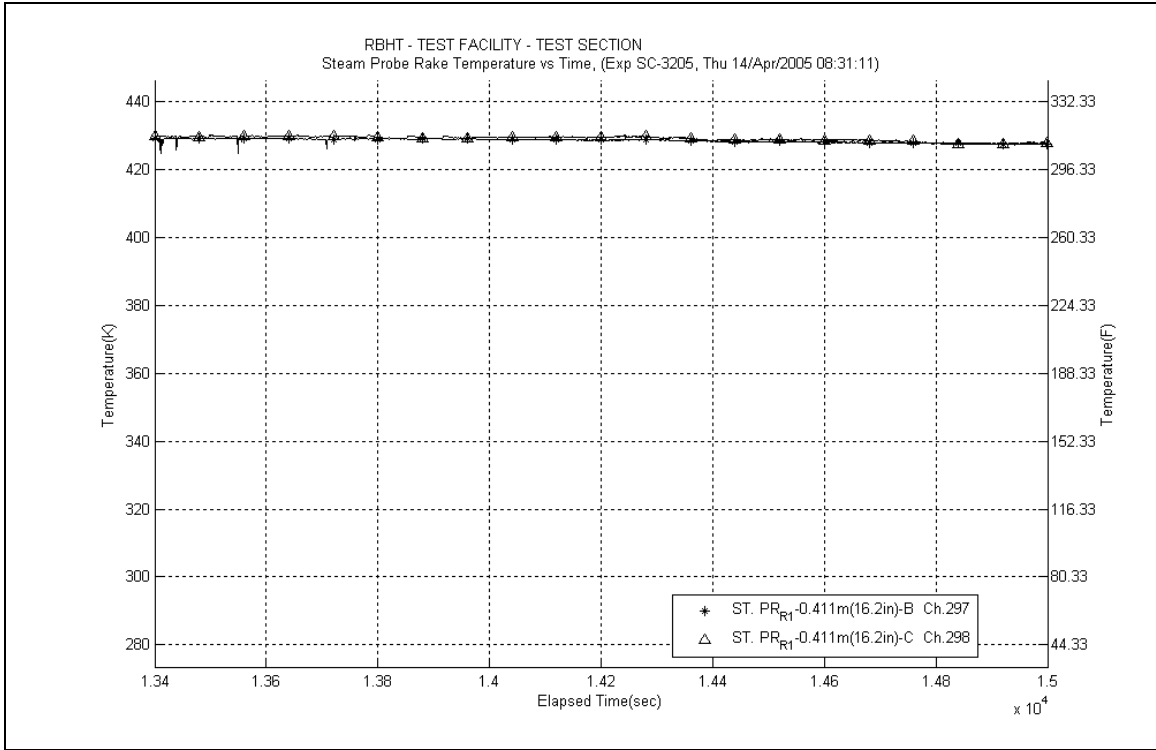
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

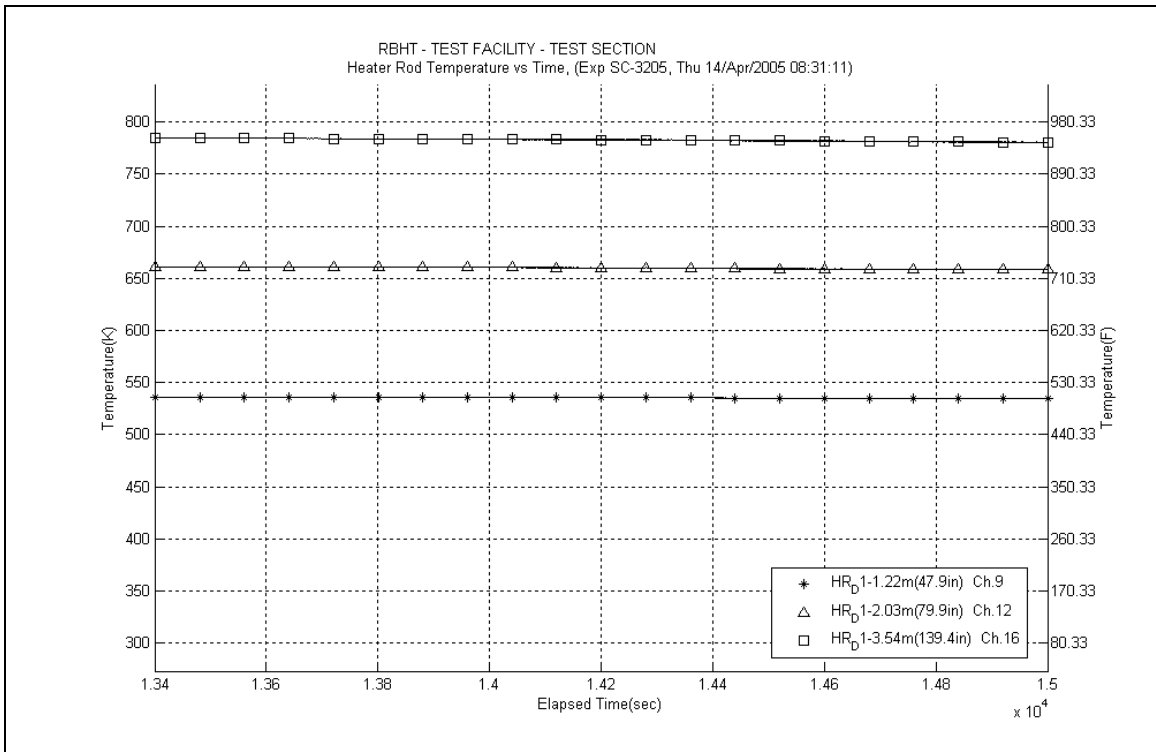
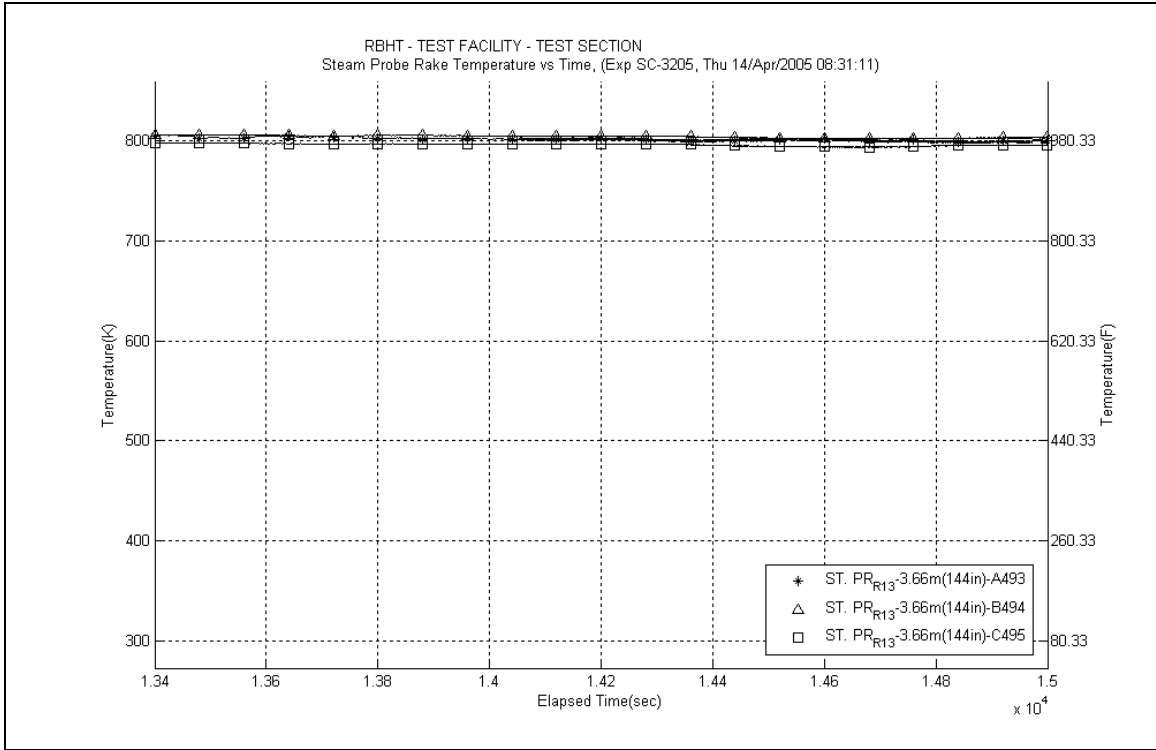
$$T_{cl} = -10.616x^3 + 69.175x^2 - 8.02x + 423.94$$

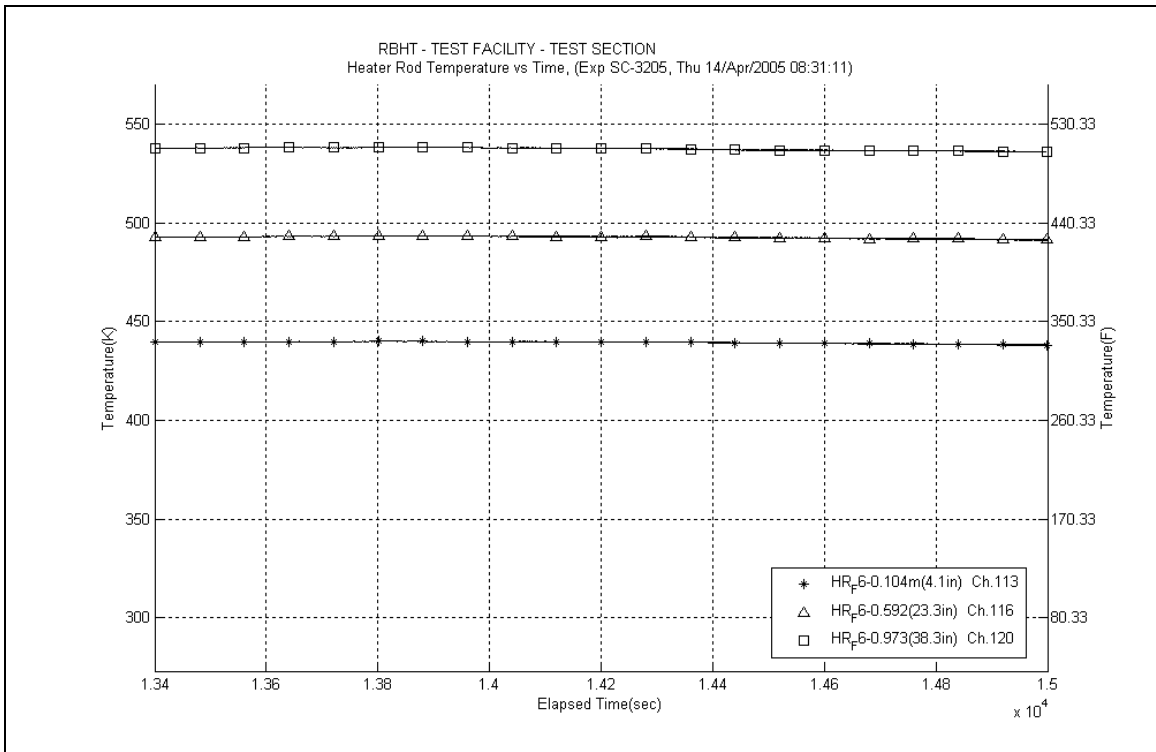
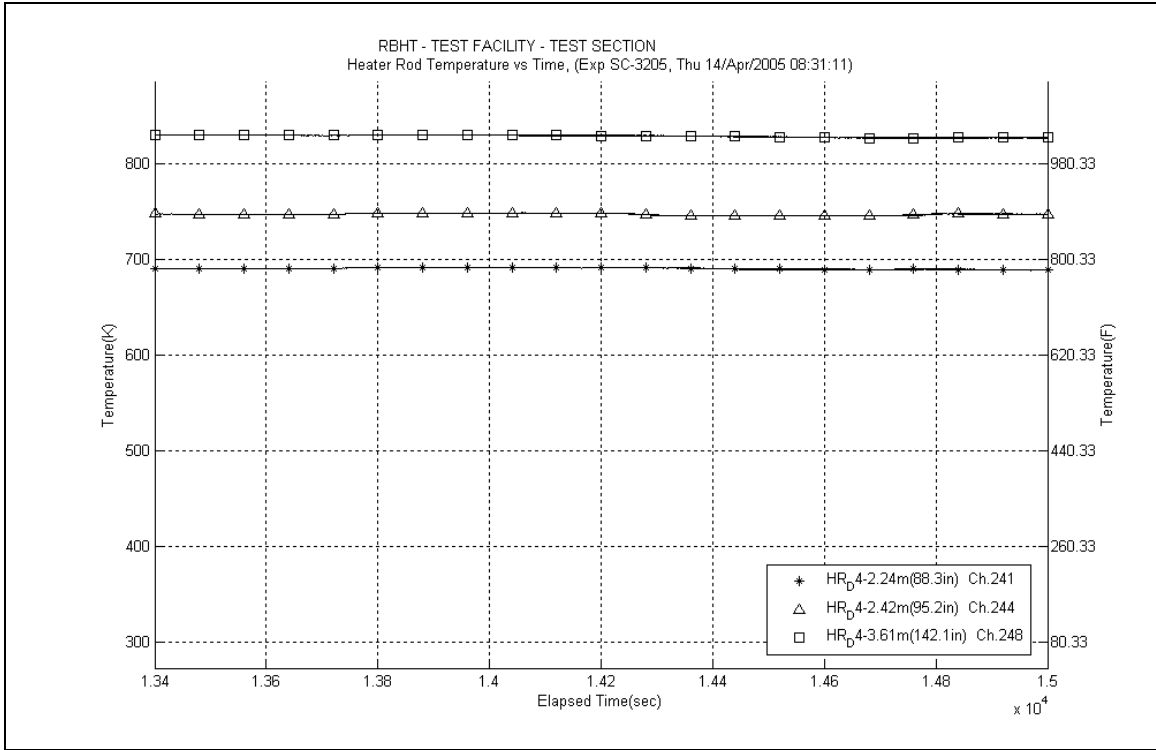
where x is the elevation (m) and T_{cl} is in (K)











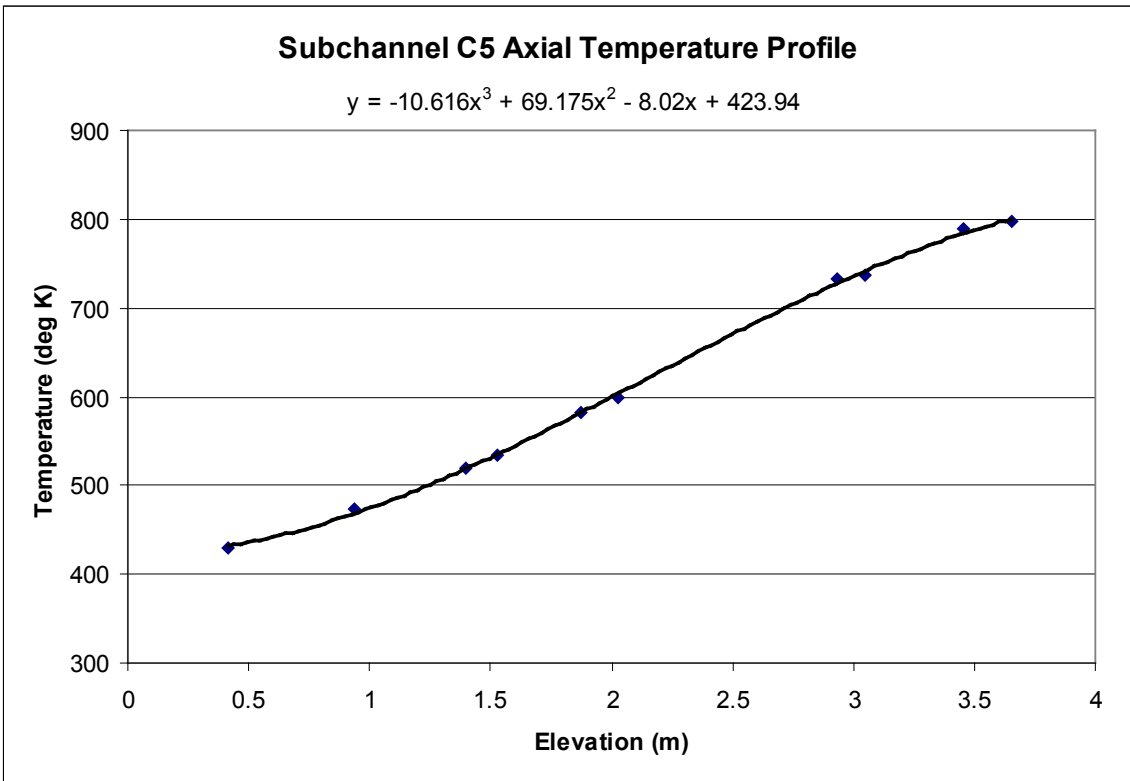
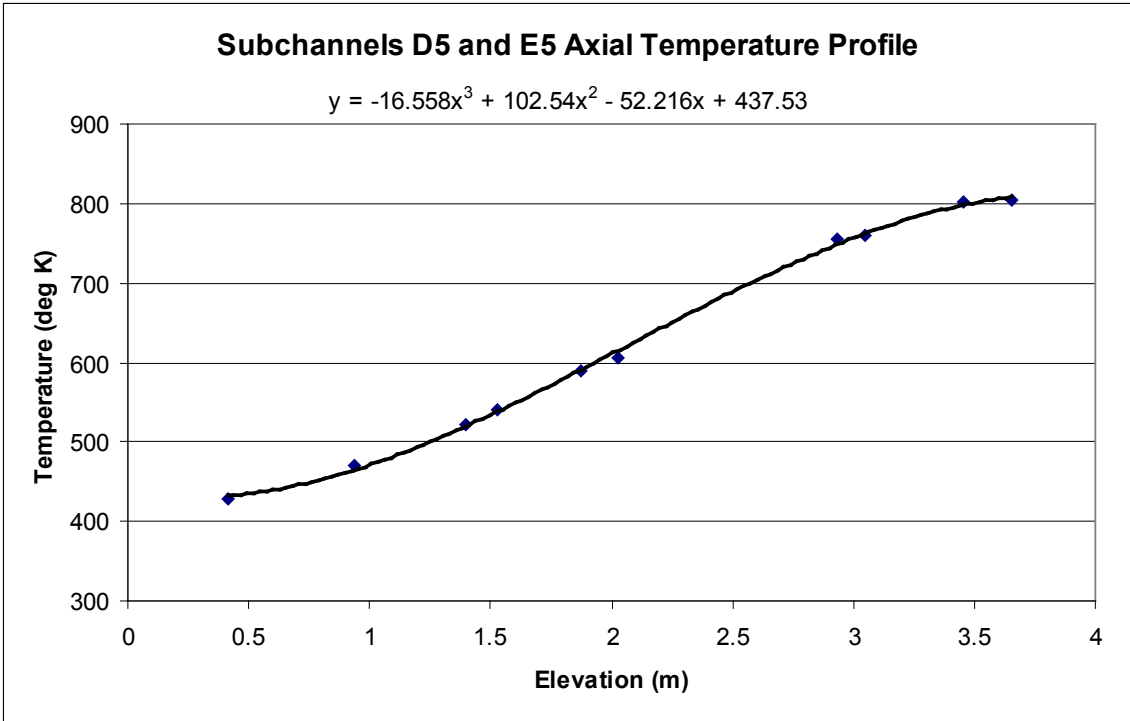


Table SC-3205-B.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	685.5	8066.2	649.4	1.27	657.1	3556	284.42	22.34	7.85%	63.08
RodD3_91.3	186	2.319	0.071	716.2	8243.1	661.4	1.27	673.1	3459	191.15	13.48	7.05%	40.95
RodD3_93.1	187	2.365	0.117	731.3	8351.5	668.5	1.27	681.9	3408	169.22	11.67	6.89%	35.58
RodD3_95.3	188	2.421	0.173	746.7	8478.6	677.1	1.27	692.0	3351	155.01	10.54	6.80%	31.91
RodD3_100.1	189	2.543	0.295	772.7	8786.0	695.4	1.27	712.0	3245	144.76	9.71	6.71%	28.60
RodD3_106.1	190	2.695	0.447	793.3	9086.8	717.4	1.27	733.6	3137	152.42	10.27	6.74%	28.84
RodD3_110	191	2.794	0.546	809.9	9399.9	730.9	1.27	742.3	3096	213.87	15.07	7.05%	39.78
RodD3_142.1	192	3.609	0.218	820.2	3149.5	806.3	1.27	809.2	2814	286.31	38.77	13.54%	46.99
RodC4_88.4	233	2.245	-0.003	692.5	8155.6	649.8	1.27	658.9	3544	243.04	18.07	7.44%	53.69
RodC4_91.1	234	2.314	0.066	719.9	8311.3	660.6	1.27	673.3	3458	178.36	12.36	6.93%	38.20
RodC4_93.4	235	2.372	0.124	734.8	8447.6	669.6	1.27	683.6	3398	165.07	11.28	6.83%	34.59
RodC4_95.3	236	2.421	0.173	747.0	8552.6	677.1	1.27	692.0	3351	155.73	10.55	6.77%	32.06
RodC4_100.1	237	2.543	0.295	771.6	8903.4	695.4	1.27	711.8	3246	148.82	9.95	6.68%	29.42
RodC4_106.1	238	2.695	0.447	790.4	9170.8	717.4	1.27	733.0	3140	159.92	10.78	6.74%	30.29
RodC4_110	239	2.794	0.546	780.5	8863.2	730.9	1.27	741.5	3099	227.52	16.34	7.18%	42.38
RodC4_142.2	240	3.612	0.221	832.5	3407.3	806.4	1.27	812.0	2803	165.75	14.86	8.96%	27.07
RodD4_88.3	241	2.243	-0.005	690.2	8118.7	649.4	1.27	658.1	3549	252.87	19.06	7.54%	55.96
RodD4_91.3	242	2.319	0.071	718.1	8285.2	661.4	1.27	673.5	3456	185.67	12.99	6.99%	39.75
RodD4_93.2	243	2.367	0.119	733.5	8394.8	668.9	1.27	682.7	3403	165.34	11.33	6.85%	34.71
RodD4_95.2	244	2.418	0.170	746.8	8503.3	676.7	1.27	691.7	3353	154.33	10.47	6.78%	31.79
RodD4_100.1	245	2.543	0.295	772.1	8814.5	695.4	1.27	711.9	3245	146.37	9.82	6.71%	28.93
RodD4_106.1	246	2.695	0.447	788.0	9148.4	717.4	1.27	732.5	3142	164.82	11.16	6.77%	31.25
RodD4_110	247	2.794	0.546	778.9	8833.9	730.9	1.27	741.2	3101	234.18	16.96	7.24%	43.65
RodD4_142.1	248	3.609	0.218	828.6	3291.4	806.3	1.27	811.0	2807	187.68	18.47	9.84%	30.71
RodE4_88.4	201	2.245	-0.003	686.3	8001.7	649.8	1.27	657.6	3553	278.94	21.88	7.84%	61.80
RodE4_91.2	202	2.316	0.069	711.6	8156.5	661.0	1.27	671.8	3467	204.87	14.72	7.19%	44.02
RodE4_95.3	204	2.421	0.173	741.2	8381.4	677.1	1.27	690.8	3358	166.29	11.48	6.90%	34.32
RodE4_100.9	205	2.563	0.315	766.5	8703.9	698.4	1.27	713.0	3239	162.68	11.14	6.85%	32.07
RodE4_142.3	208	3.614	0.224	820.6	3334.8	806.5	1.27	809.5	2813	300.07	40.02	13.34%	49.23
RodE3_63.4	193	1.610	0.417	626.6	6632.2	550.2	1.27	566.6	4228	110.44	7.43	6.73%	30.21
RodE3_113.6	194	2.885	0.022	788.7	8175.9	742.8	1.27	752.6	3049	226.64	16.62	7.33%	41.32
RodE3_115.5	195	2.934	0.070	800.1	7874.0	748.7	1.27	759.7	3017	194.95	13.93	7.15%	35.06
RodE3_118.5	196	3.010	0.146	811.3	7398.3	757.8	1.27	769.2	2975	175.74	12.44	7.08%	31.04
RodE3_122.7	197	3.117	0.253	820.4	6731.0	769.5	1.27	780.4	2928	168.25	12.00	7.13%	29.11
RodE3_126.5	198	3.213	0.349	823.0	6127.8	779.1	1.27	788.5	2895	177.55	13.08	7.37%	30.26
RodE3_131.7	199	3.345	-0.046	809.9	5300.0	790.4	1.27	794.6	2871	346.16	36.59	10.57%	58.34
RodE3_135.6	200	3.444	0.053	814.1	4677.1	797.5	1.27	801.1	2845	358.38	42.18	11.77%	59.70

Table SC-3205-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±thtc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	632.8	6505.3	551.3	1.27	568.8	4209	101.62	6.86	6.75%	27.65
RodC5_113.6	226	2.885	0.022	785.6	7959.3	742.8	1.27	751.9	3052	236.67	17.83	7.53%	43.21
RodC5_115.7	227	2.939	0.075	800.3	7643.5	749.4	1.27	760.3	3014	190.98	13.80	7.23%	34.31
RodC5_122.7	229	3.117	0.253	821.2	6586.1	769.5	1.27	780.6	2928	162.04	11.61	7.17%	28.02
RodC5_126.7	230	3.218	0.354	824.3	5983.3	779.5	1.27	789.1	2892	170.02	12.54	7.37%	28.94
RodC5_131.6	231	3.343	-0.048	812.5	5244.4	790.2	1.27	795.0	2869	299.44	29.22	9.76%	50.43
RodC5_135.7	232	3.447	0.056	820.3	4626.4	797.7	1.27	802.5	2840	260.43	25.12	9.65%	43.27
RodE5_63.6	209	1.615	0.422	618.4	6664.2	551.0	1.27	565.4	4239	125.66	8.57	6.82%	34.47
RodE5_113.6	210	2.885	0.022	775.0	8228.7	742.8	1.27	749.7	3062	324.74	26.56	8.18%	59.54
RodE5_115.4	211	2.931	0.067	785.2	7946.0	748.4	1.27	756.3	3032	275.19	21.45	7.79%	49.82
RodE5_118.7	212	3.015	0.151	794.7	7429.7	758.3	1.27	766.1	2989	260.12	20.31	7.81%	46.22
RodE5_122.6	213	3.114	0.250	803.6	6818.8	769.2	1.27	776.6	2944	252.14	20.02	7.94%	43.93
RodE5_126.6	214	3.216	0.352	809.2	6190.7	779.3	1.27	785.7	2906	263.28	22.06	8.38%	45.10
RodE5_131.6	215	3.343	-0.048	799.8	5409.4	790.2	1.27	792.3	2880	717.10	131.48	18.34%	121.37
RodE5_135.6	216	3.444	0.053	806.7	4777.0	797.5	1.27	799.5	2851	663.39	126.67	19.09%	110.83
RodC3_79.8	177	2.027	0.227	673.3	7539.5	615.1	1.27	627.5	3751	164.85	11.53	7.00%	39.05
RodC3_85.6	178	2.174	0.374	682.1	7870.5	638.5	1.27	647.8	3614	229.98	17.10	7.44%	52.06
RodC3_88.5	179	2.248	0.000	686.0	8034.1	650.2	1.27	657.8	3551	285.78	22.55	7.89%	63.28
RodC3_92.4	180	2.347	0.099	719.8	8255.1	665.7	1.27	677.3	3434	194.22	13.76	7.09%	41.24
RodC3_94.4	181	2.398	0.150	731.0	8374.0	673.6	1.27	685.9	3385	185.44	13.00	7.01%	38.67
RodC3_97.2	182	2.469	0.221	748.1	8543.7	684.4	1.27	698.0	3318	170.85	11.78	6.89%	34.73
RodC3_108.8	183	2.764	0.516	788.0	8967.5	726.8	1.27	739.9	3107	186.51	12.94	6.94%	34.85
RodD5_50	217	1.270	0.076	571.6	5884.5	502.7	1.27	517.4	4710	108.58	7.39	6.80%	33.58
RodD5_54.1	218	1.374	0.180	594.2	6115.5	516.4	1.27	533.1	4546	100.08	6.72	6.71%	29.75
RodD5_56.9	219	1.445	0.251	606.3	6273.2	526.2	1.27	543.4	4443	99.65	6.67	6.70%	28.87
RodD5_60	220	1.524	0.330	617.7	6449.3	537.5	1.27	554.7	4336	102.35	6.85	6.70%	28.83
RodD5_66.1	221	1.679	0.485	631.6	6795.6	560.5	1.27	575.8	4149	121.58	8.24	6.78%	32.52
RodD5_69.9	222	1.775	-0.025	615.9	7010.3	575.4	1.27	584.1	4079	219.81	16.56	7.53%	57.64
RodD5_72.9	223	1.852	0.051	643.3	7180.5	587.3	1.27	599.3	3958	163.20	11.44	7.01%	41.28
RodD5_74.9	224	1.902	0.102	657.9	7293.3	595.3	1.27	608.7	3886	148.20	10.24	6.91%	36.66

Table SC-3205-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±thtc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	555.6	5353.5	478.6	1.27	495.1	4966	88.48	5.96	6.73%	28.97
RodB5_52.9	154	1.344	0.150	589.5	6031.9	512.3	1.27	528.8	4589	99.38	6.69	6.73%	29.86
RodB5_55	155	1.397	0.203	597.5	6151.1	518.8	1.27	535.6	4520	99.49	6.68	6.71%	29.38
RodB5_57.8	156	1.468	0.274	609.4	6310.8	527.7	1.27	545.2	4426	98.24	6.57	6.69%	28.33
RodB5_64	157	1.626	0.432	629.2	6665.8	548.1	1.27	565.5	4238	104.60	7.00	6.69%	28.69
RodB5_73.9	158	1.877	0.077	651.8	7228.2	582.4	1.27	597.3	3974	132.51	9.03	6.81%	33.67
RodB5_75.9	159	1.928	0.128	664.7	7341.7	589.5	1.27	605.6	3909	124.27	8.39	6.75%	30.96
RodB5_76.9	160	1.953	0.153	669.9	7399.4	593.1	1.27	609.5	3880	122.53	8.25	6.74%	30.25
RodF5_41	105	1.041	0.343	551.9	5320.8	478.6	1.27	494.3	4975	92.44	6.27	6.78%	30.33
RodF5_53.1	106	1.349	0.155	583.7	6009.1	512.9	1.27	528.1	4597	108.08	7.35	6.81%	32.54
RodF5_55	107	1.397	0.203	592.7	6117.4	518.8	1.27	534.6	4530	105.30	7.13	6.77%	31.18
RodF5_57.8	108	1.468	0.274	603.7	6277.2	527.7	1.27	544.0	4438	105.03	7.09	6.75%	30.38
RodF5_64	109	1.626	0.432	620.4	6631.3	548.1	1.27	563.6	4255	116.76	7.92	6.78%	32.17
RodF5_73.8	110	1.875	0.074	635.9	7190.2	582.0	1.27	593.6	4002	169.82	12.01	7.07%	43.53
RodF5_75.8	111	1.925	0.125	648.6	7304.3	589.1	1.27	601.9	3938	156.34	10.91	6.98%	39.30
RodF5_76.8	112	1.951	0.150	653.9	7361.1	592.7	1.27	605.8	3908	152.99	10.62	6.94%	38.10
RodC2_41	57	1.041	0.343	551.5	5342.5	478.6	1.27	494.2	4976	93.27	6.32	6.78%	30.61
RodC2_53.1	58	1.349	0.155	588.6	6031.2	512.9	1.27	529.1	4586	101.36	6.84	6.75%	30.43
RodC2_55	59	1.397	0.203	596.9	6139.5	518.8	1.27	535.5	4521	100.05	6.73	6.72%	29.56
RodC2_57.8	60	1.468	0.274	608.8	6299.0	527.7	1.27	545.0	4427	98.85	6.62	6.70%	28.52
RodC2_63.9	61	1.623	0.429	625.3	6646.5	547.8	1.27	564.4	4248	109.10	7.34	6.73%	30.00
RodC2_73.8	62	1.875	0.074	637.0	7211.4	582.0	1.27	593.8	4001	167.05	11.76	7.04%	42.80
RodC2_75.8	63	1.925	0.125	647.2	7326.7	589.1	1.27	601.6	3940	160.72	11.21	6.98%	40.43
RodC2_76.8	64	1.951	0.150	651.4	7384.0	592.7	1.27	605.3	3912	160.22	11.19	6.98%	39.95
RodC6_40.9	137	1.039	0.340	556.9	5316.6	478.4	1.27	495.2	4965	86.18	5.80	6.74%	28.21
RodC6_52.8	138	1.341	0.147	591.3	6024.9	512.0	1.27	529.0	4588	96.64	6.48	6.71%	29.03
RodC6_54.8	139	1.392	0.198	600.8	6145.2	518.2	1.27	535.9	4517	94.59	6.32	6.68%	27.92
RodC6_57.8	140	1.468	0.274	613.4	6324.0	527.7	1.27	546.0	4418	93.82	6.25	6.66%	27.00
RodC6_63.8	141	1.621	0.427	631.4	6681.5	547.4	1.27	565.4	4239	101.22	6.74	6.66%	27.77
RodC6_73.7	142	1.872	0.072	652.8	7269.3	581.7	1.27	596.9	3976	130.08	8.81	6.78%	33.08
RodC6_75.8	143	1.925	0.125	664.3	7394.7	589.1	1.27	605.2	3912	125.24	8.43	6.73%	31.23
RodC6_76.8	144	1.951	0.150	670.6	7454.3	592.7	1.27	609.4	3881	121.72	8.16	6.71%	30.06

Table SC-3205-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±thtc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	687.6	8004.2	634.5	1.27	645.9	3627	191.79	13.65	7.12%	43.60
RodB4_91.3	162	2.319	0.071	717.3	8170.4	645.0	1.27	660.5	3535	143.62	9.76	6.79%	31.62
RodB4_93.3	163	2.370	0.122	730.9	8282.9	652.1	1.27	669.0	3483	133.79	9.01	6.73%	28.92
RodB4_95.1	164	2.416	0.168	741.5	8384.9	658.6	1.27	676.3	3440	128.69	8.63	6.70%	27.38
RodB4_100	165	2.540	0.292	760.7	8688.0	675.9	1.27	694.0	3340	130.35	8.71	6.68%	26.72
RodB4_106	166	2.692	0.445	782.9	8974.9	696.6	1.27	715.1	3229	132.34	8.85	6.69%	25.98
RodB4_109.9	167	2.791	0.544	773.8	8670.4	709.7	1.27	723.4	3187	172.06	11.92	6.93%	33.22
RodB4_142.3	168	3.614	0.224	826.3	3386.5	797.4	1.27	803.6	2835	148.88	12.73	8.55%	24.69
RodF4_85.6	98	2.174	0.374	674.1	7898.8	624.4	1.27	635.0	3699	202.31	14.56	7.20%	47.12
RodF4_88.4	99	2.245	-0.003	677.9	8056.2	634.5	1.27	643.8	3641	236.48	17.58	7.44%	54.01
RodF4_92.4	100	2.347	0.099	712.4	8281.0	648.9	1.27	662.5	3522	165.93	11.44	6.89%	36.37
RodF4_94.3	101	2.395	0.147	725.2	8388.2	655.7	1.27	670.6	3474	153.64	10.47	6.81%	33.10
RodF4_97.2	102	2.469	0.221	741.7	8553.6	666.0	1.27	682.2	3406	143.89	9.71	6.75%	30.24
RodF4_108.8	103	2.764	0.516	774.7	9037.2	706.0	1.27	720.7	3200	167.37	11.40	6.81%	32.49
RodF4_111	104	2.819	-0.044	764.5	8671.7	713.3	1.27	724.2	3183	215.48	15.39	7.14%	41.54
RodD2_103.2	65	2.621	0.373	762.2	8923.3	687.0	1.27	703.1	3291	151.01	10.18	6.74%	30.38
RodD2_106	66	2.692	0.445	772.6	9084.9	696.6	1.27	712.9	3240	152.11	10.24	6.73%	30.00
RodD2_112.6	67	2.860	-0.004	763.8	8338.0	718.5	1.27	728.2	3163	234.29	17.24	7.36%	44.81
RodD2_114.9	68	2.918	0.055	780.8	7955.7	725.8	1.27	737.6	3118	184.24	13.01	7.06%	34.59
RodD2_117.4	69	2.982	0.118	789.0	7537.2	733.6	1.27	745.5	3081	173.23	12.22	7.05%	32.02
RodD2_120.8	70	3.068	0.204	800.3	6970.2	743.9	1.27	756.0	3033	157.39	11.06	7.03%	28.51
RodD2_124.8	71	3.170	0.306	806.4	6301.0	755.5	1.27	766.4	2988	157.39	11.27	7.16%	27.95
RodD2_128.6	72	3.266	0.403	807.4	5663.7	765.8	1.27	774.7	2952	173.42	13.04	7.52%	30.32
RodD6_103.1	129	2.619	0.371	763.3	8941.0	686.7	1.27	703.1	3291	148.47	9.98	6.72%	29.87
RodD6_106	130	2.692	0.445	771.9	9106.1	696.6	1.27	712.7	3241	153.77	10.35	6.73%	30.33
RodD6_112.9	131	2.868	0.004	767.4	8313.1	719.4	1.27	729.7	3156	220.79	16.02	7.25%	42.10
RodD6_114.9	132	2.918	0.055	781.9	7973.4	725.8	1.27	737.8	3117	180.79	12.71	7.03%	33.92
RodD6_116.8	133	2.967	0.103	791.7	7650.5	731.8	1.27	744.6	3085	162.48	11.30	6.95%	30.09
RodD6_120.9	134	3.071	0.207	800.5	6956.0	744.2	1.27	756.3	3032	157.37	11.06	7.03%	28.49
RodD6_124.8	135	3.170	0.306	805.5	6295.1	755.5	1.27	766.2	2988	160.11	11.51	7.19%	28.45
RodD6_128.7	136	3.269	0.405	806.6	5631.5	766.1	1.27	774.8	2952	176.92	13.42	7.58%	30.93

Table SC-3205-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±thtc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	566.0	5906.1	503.9	1.27	517.2	4713	120.98	8.33	6.89%	37.44
RodE2_54	74	1.372	0.178	588.3	6130.3	515.7	1.27	531.2	4565	107.47	7.26	6.75%	32.10
RodE2_56.9	75	1.445	0.251	600.4	6297.2	524.8	1.27	541.0	4467	105.92	7.12	6.72%	30.87
RodE2_59.9	76	1.521	0.328	613.2	6470.0	534.5	1.27	551.3	4367	104.64	7.01	6.70%	29.72
RodE2_66	77	1.676	0.483	626.8	6822.5	554.9	1.27	570.3	4196	120.75	8.16	6.76%	32.73
RodE2_69.8	78	1.773	-0.027	605.9	7043.1	568.0	1.27	576.1	4146	236.50	18.16	7.68%	63.21
RodE2_72.9	79	1.852	0.051	630.1	7222.0	578.9	1.27	589.8	4032	179.46	12.76	7.11%	46.41
RodE2_74.9	80	1.902	0.102	641.8	7337.7	585.9	1.27	597.9	3968	167.04	11.69	7.00%	42.38
RodB3_50.2	169	1.275	0.081	566.3	5867.4	504.2	1.27	517.5	4710	120.22	8.31	6.91%	37.18
RodB3_54.1	170	1.374	0.180	582.2	6091.1	516.0	1.27	530.2	4575	117.03	8.01	6.85%	35.04
RodB3_56.9	171	1.445	0.251	592.2	6251.1	524.8	1.27	539.2	4484	118.03	8.06	6.83%	34.55
RodB3_60.1	172	1.527	0.333	601.9	6434.6	535.1	1.27	549.4	4385	122.69	8.39	6.84%	35.01
RodB3_66.1	173	1.679	0.485	623.6	6777.3	555.2	1.27	569.9	4199	126.08	8.59	6.82%	34.21
RodB3_69.9	174	1.775	-0.025	609.8	6993.0	568.3	1.27	577.2	4136	214.77	16.10	7.50%	57.25
RodB3_73	175	1.854	0.054	634.6	7170.1	579.2	1.27	591.1	4022	164.78	11.58	7.03%	42.49
RodB3_75	176	1.905	0.105	647.7	7284.5	586.3	1.27	599.5	3956	150.90	10.43	6.91%	38.15
RodF3_50.1	89	1.273	0.079	570.6	5873.9	503.9	1.27	518.2	4702	112.04	7.66	6.84%	34.59
RodF3_54	90	1.372	0.178	592.0	6101.3	515.7	1.27	532.0	4556	101.68	6.84	6.73%	30.30
RodF3_57	91	1.448	0.254	604.6	6276.6	525.1	1.27	542.1	4455	100.42	6.73	6.70%	29.18
RodF3_60	92	1.524	0.330	616.1	6452.2	534.8	1.27	552.2	4359	101.04	6.76	6.69%	28.63
RodF3_66.1	93	1.679	0.485	623.0	6809.4	555.2	1.27	569.7	4201	127.87	8.71	6.81%	34.71
RodF3_70	94	1.778	-0.022	609.5	7035.0	568.7	1.27	577.4	4135	219.50	16.50	7.52%	58.48
RodF3_73	95	1.854	0.054	634.2	7210.4	579.2	1.27	591.0	4023	167.01	11.73	7.03%	43.07
RodF3_75	96	1.905	0.105	648.2	7326.3	586.3	1.27	599.6	3956	150.61	10.40	6.91%	38.06
RodE6_50.2	121	1.275	0.081	565.1	5866.7	504.2	1.27	517.2	4713	122.58	8.49	6.93%	37.93
RodE6_54.1	122	1.374	0.180	584.5	6086.6	516.0	1.27	530.7	4570	113.12	7.72	6.82%	33.83
RodE6_57	123	1.448	0.254	595.3	6249.8	525.1	1.27	540.1	4475	113.27	7.70	6.80%	33.08
RodE6_60.2	124	1.529	0.335	606.9	6430.6	535.5	1.27	550.8	4373	114.50	7.77	6.79%	32.56
RodE6_66.1	125	1.679	0.485	619.7	6764.8	555.2	1.27	569.0	4207	133.53	9.18	6.87%	36.31
RodE6_70	126	1.778	-0.022	605.6	6984.8	568.7	1.27	576.6	4142	240.51	18.67	7.76%	64.20
RodE6_73.1	127	1.857	0.056	630.6	7159.4	579.6	1.27	590.5	4027	178.53	12.75	7.14%	46.10
RodE6_75	128	1.905	0.105	644.0	7266.6	586.3	1.27	598.7	3963	160.35	11.21	6.99%	40.61

RBHT Steam Cooling Test SC-3205-C

Matrix test # 18

Test date – 4/14/2005

Steady state time window: 16140 - 17400 sec

Inlet flow: 0.48 m³/min (17.0 ft³/min)

Inlet steam temperature: 406 K (272 °F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 14.0 kW

Outlet steam temperature: 830 K (1035 °F)

Bundle inlet Reynolds number: 1951

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

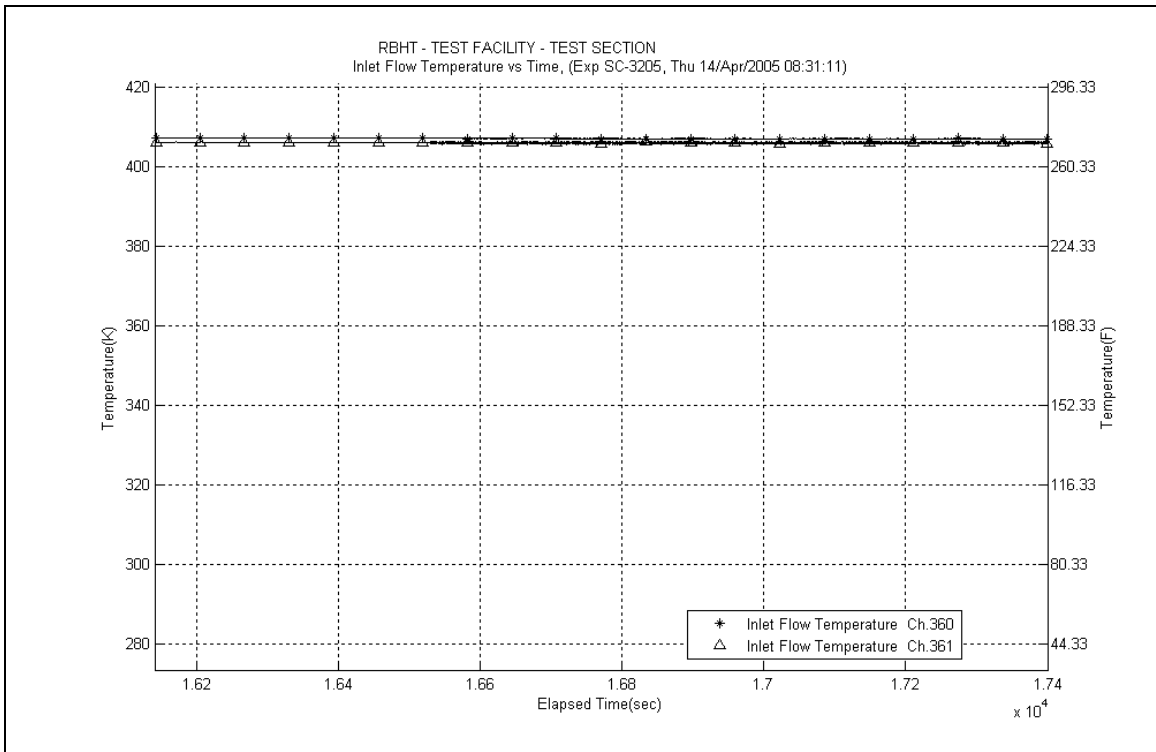
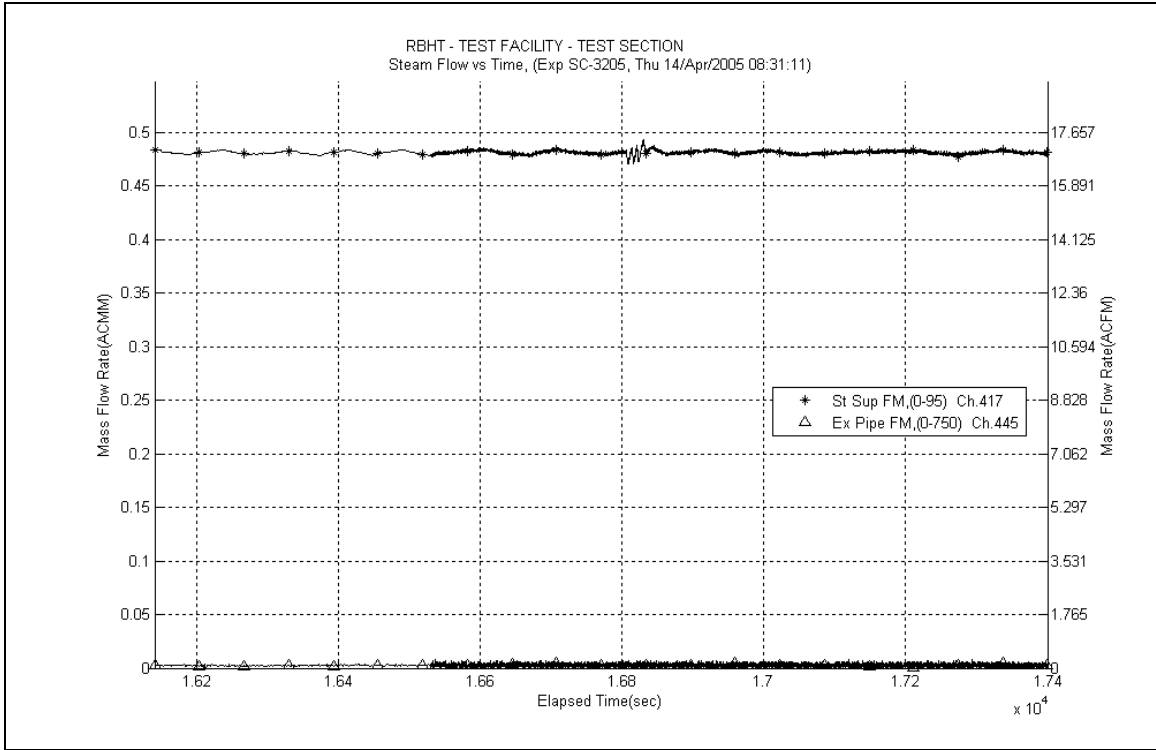
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

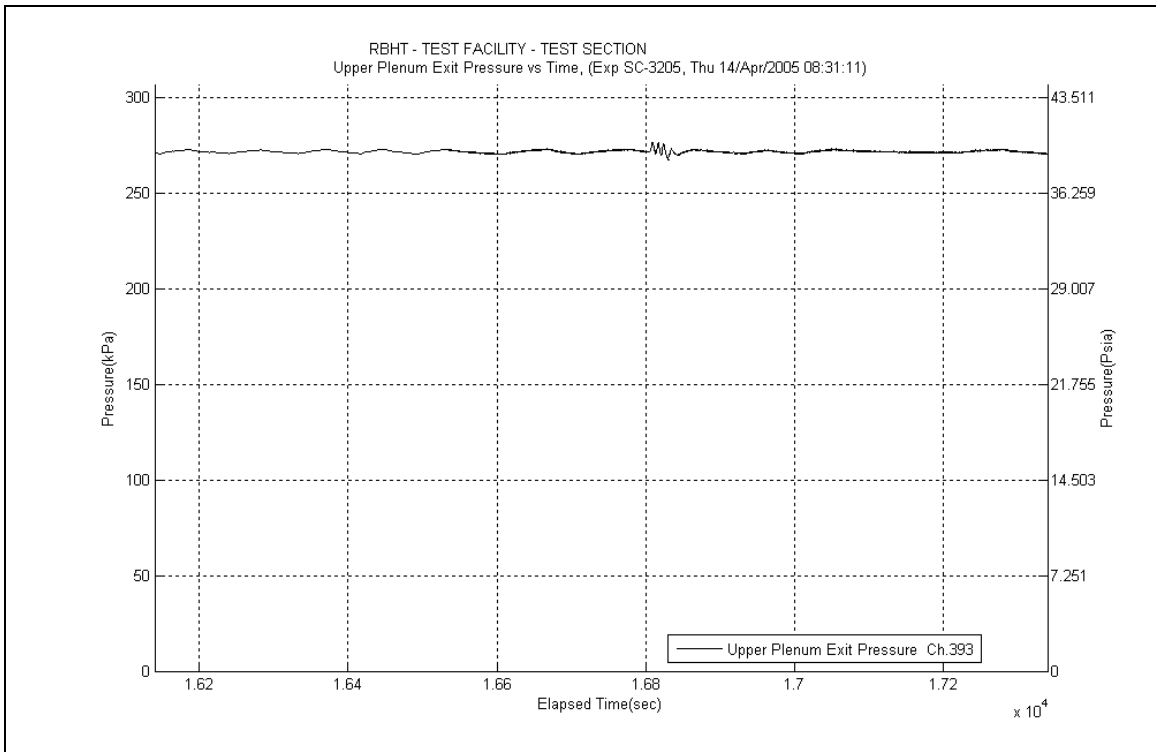
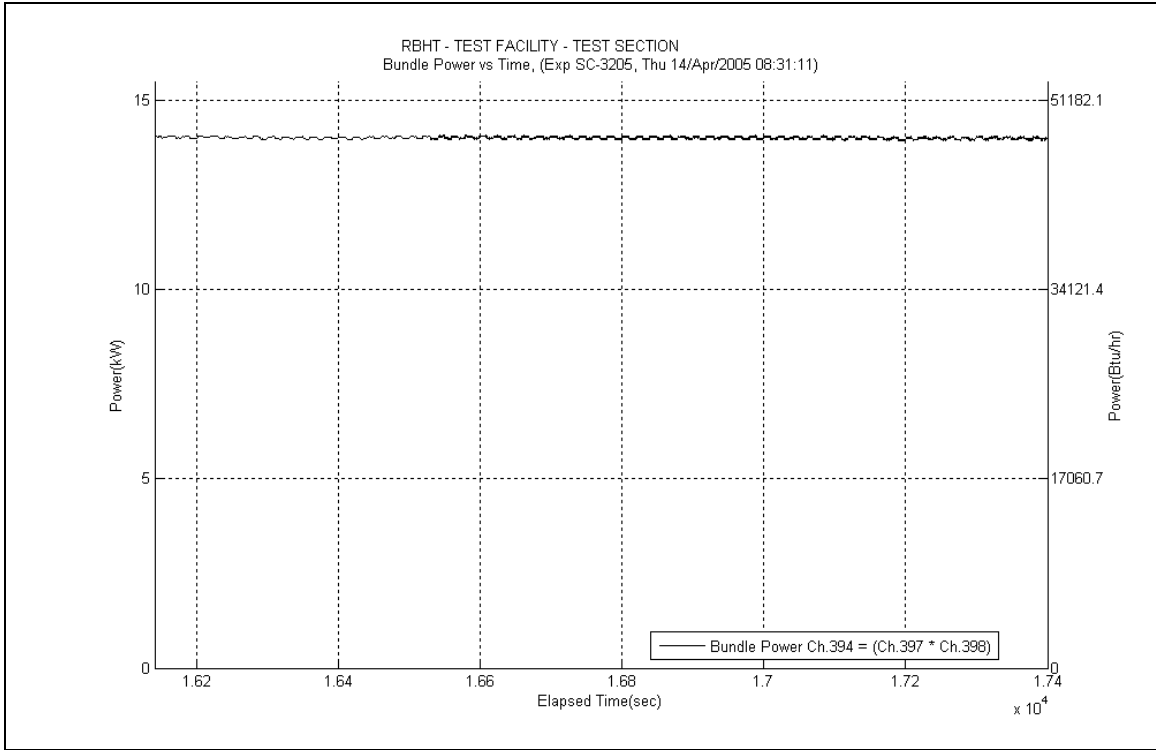
$$T_{cl} = -18.252x^3 + 107.5x^2 - 36.933x + 429.86$$

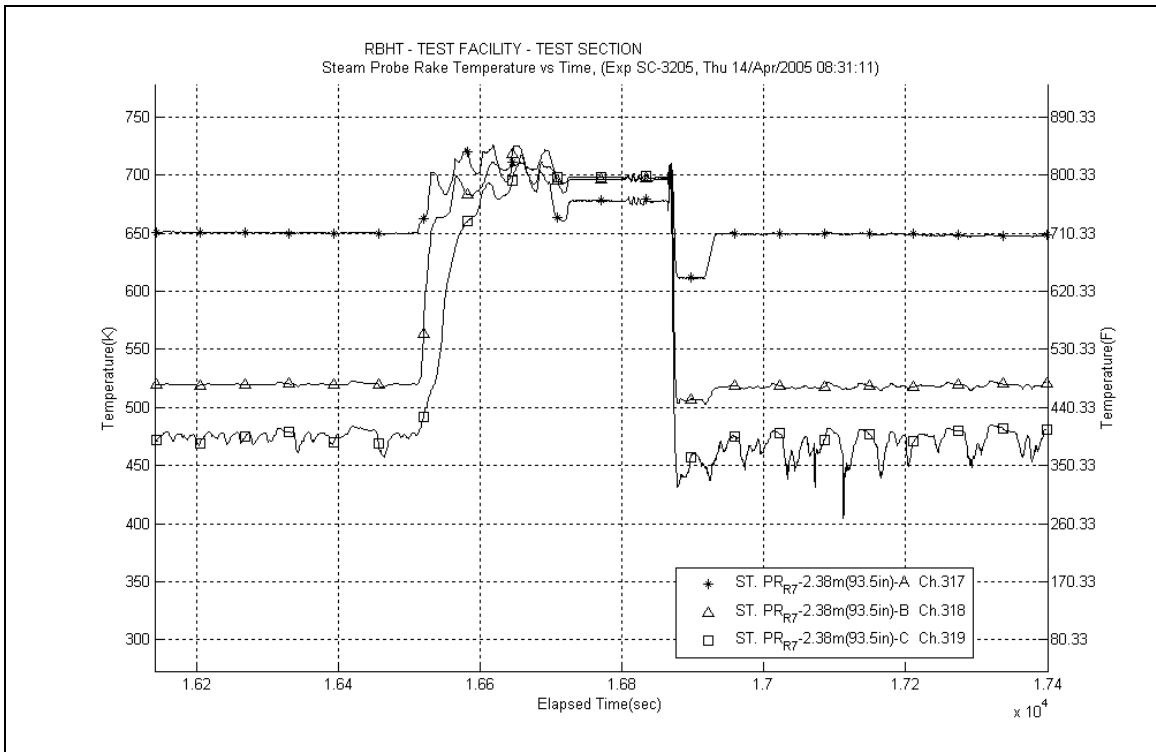
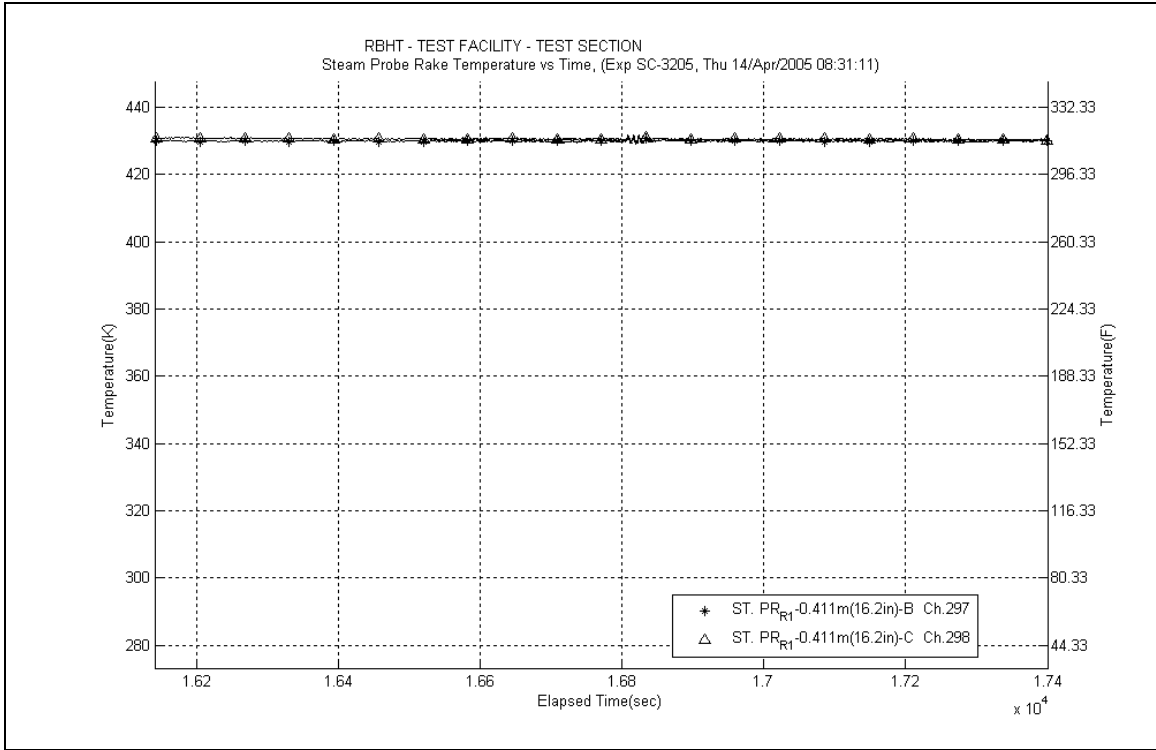
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

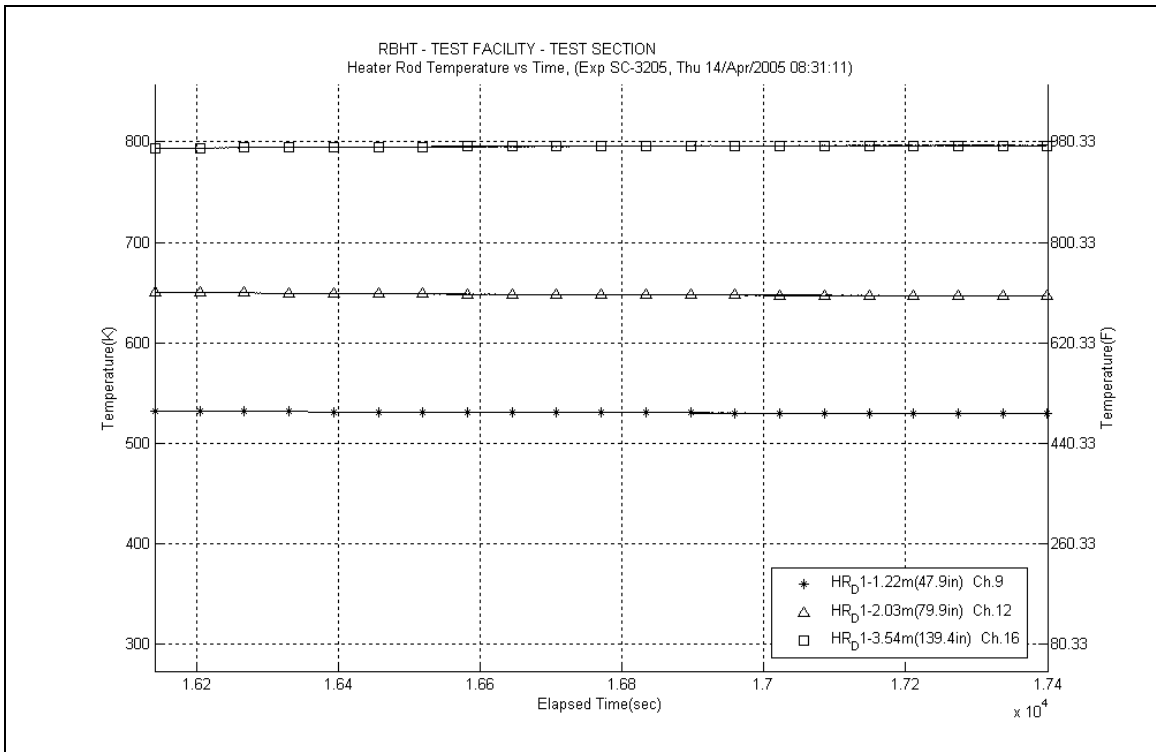
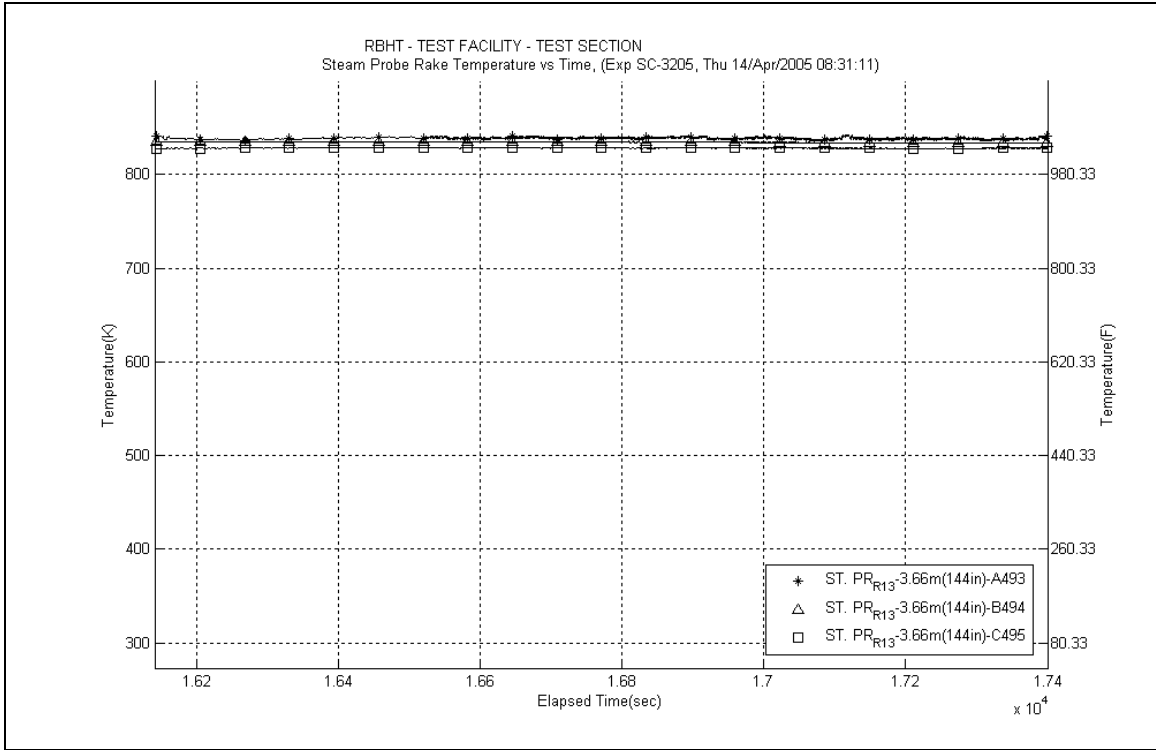
$$T_{cl} = -11.408x^3 + 67.772x^2 + 18.559x + 413.73$$

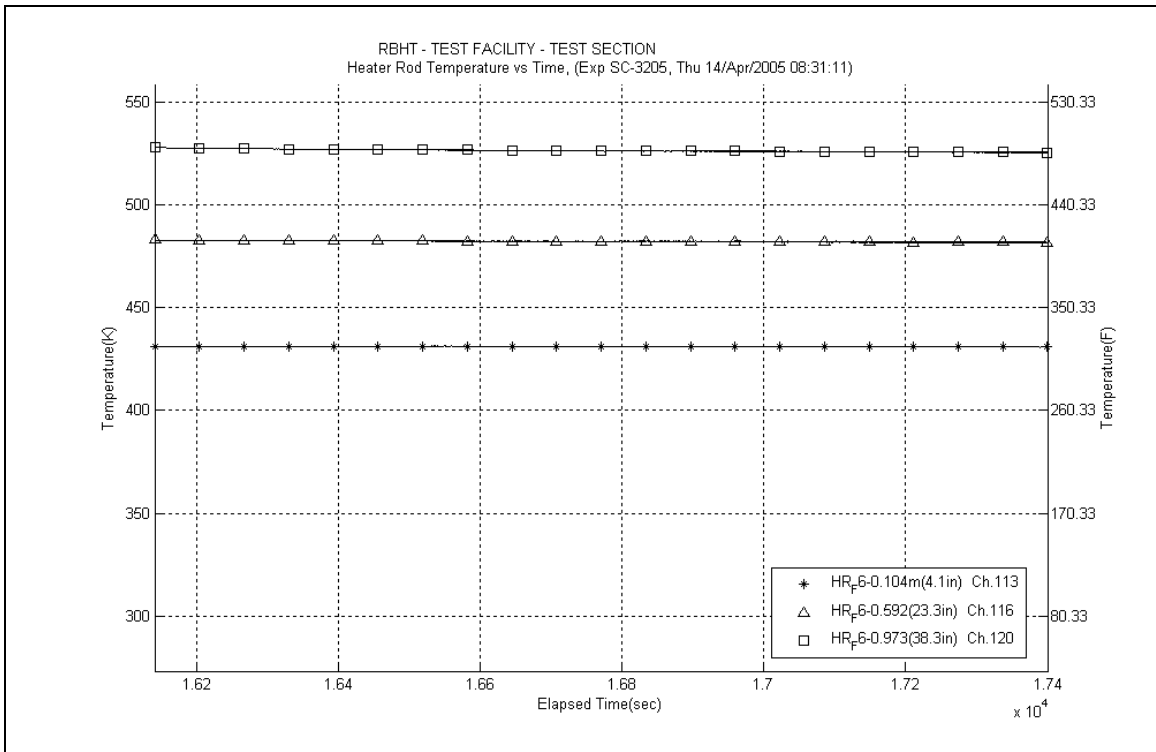
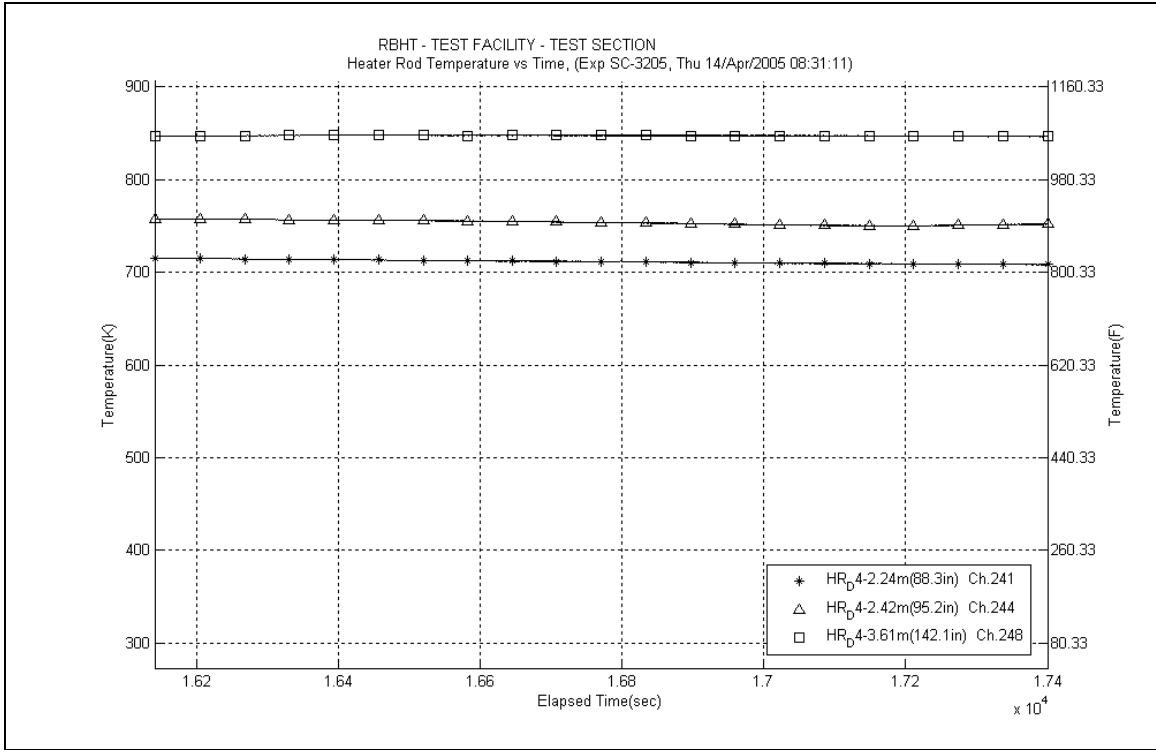
where x is the elevation (m) and T_{cl} is in (K)











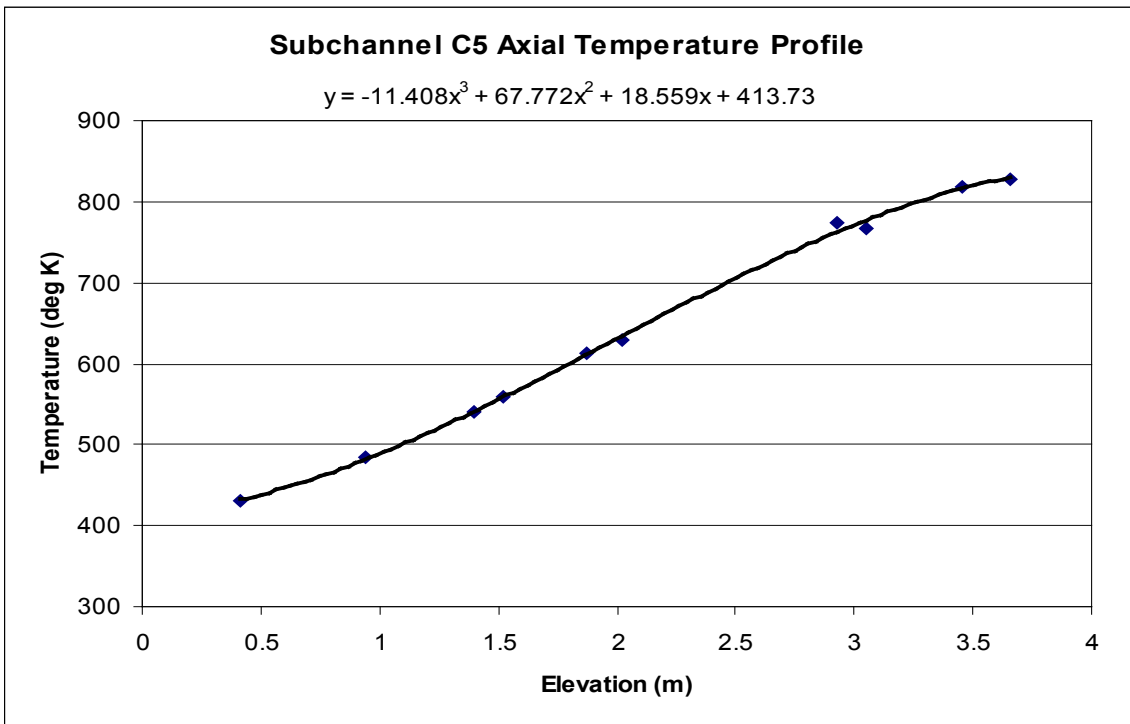
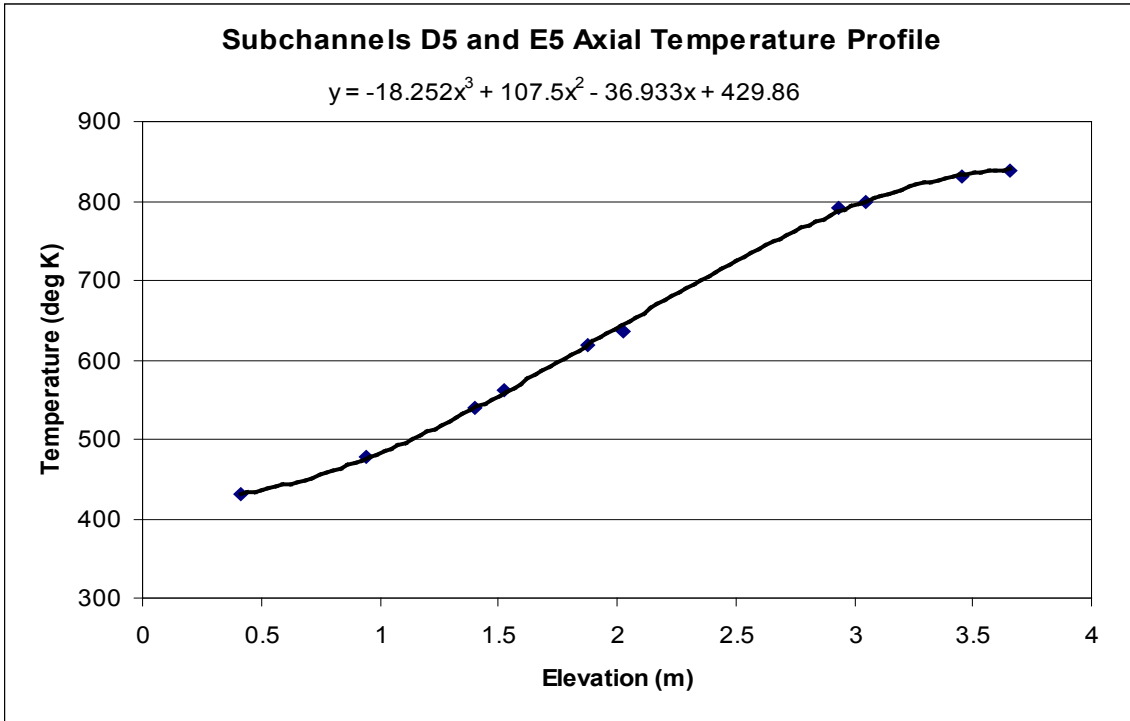


Table SC-3205-C.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±0 _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	707.7	3813.7	681.9	1.50	690.5	1201	221.51	28.70	12.96%	45.75
RodD3_91.3	186	2.319	0.071	727.9	3890.9	694.7	1.50	705.8	1172	175.97	21.68	12.32%	35.21
RodD3_93.1	187	2.365	0.117	741.0	3935.3	702.3	1.50	715.2	1154	152.68	18.41	12.06%	29.97
RodD3_95.3	188	2.421	0.173	754.9	3990.6	711.5	1.50	726.0	1135	137.81	16.41	11.91%	26.47
RodD3_100.1	189	2.543	0.295	778.5	4110.8	730.9	1.50	746.8	1100	129.64	15.32	11.82%	23.90
RodD3_106.1	190	2.695	0.447	794.4	4264.2	753.8	1.50	767.4	1067	157.58	18.94	12.02%	27.93
RodD3_110	191	2.794	0.546	800.1	4200.3	767.8	1.50	778.5	1050	195.07	24.04	12.32%	33.86
RodD3_142.1	192	3.609	0.218	844.7	1431.4	838.8	1.50	840.8	965	362.07	110.21	30.44%	56.24
RodC4_88.4	233	2.245	-0.003	713.7	3844.6	682.3	1.50	692.8	1197	183.41	22.71	12.38%	37.70
RodC4_91.1	234	2.314	0.066	729.9	3917.3	693.9	1.50	705.9	1171	162.95	19.73	12.11%	32.60
RodC4_93.4	235	2.372	0.124	743.5	3975.9	703.6	1.50	716.9	1151	149.43	17.87	11.96%	29.23
RodC4_95.3	236	2.421	0.173	755.6	4024.6	711.5	1.50	726.2	1135	136.75	16.18	11.83%	26.26
RodC4_100.1	237	2.543	0.295	779.3	4144.5	730.9	1.50	747.0	1099	128.49	15.09	11.75%	23.68
RodC4_106.1	238	2.695	0.447	794.0	4305.4	753.8	1.50	767.2	1067	160.71	19.23	11.97%	28.50
RodC4_110	239	2.794	0.546	797.3	4171.6	767.8	1.50	777.6	1051	212.05	26.67	12.58%	36.87
RodC4_142.2	240	3.612	0.221	846.4	1558.1	838.9	1.50	841.4	964	311.07	77.21	24.82%	48.27
RodD4_88.3	241	2.243	-0.005	713.9	3842.0	681.9	1.50	692.5	1197	180.01	22.22	12.34%	37.02
RodD4_91.3	242	2.319	0.071	730.6	3921.1	694.7	1.50	706.7	1170	163.71	19.84	12.12%	32.70
RodD4_93.2	243	2.367	0.119	743.4	3969.1	702.7	1.50	716.3	1152	146.48	17.48	11.93%	28.69
RodD4_95.2	244	2.418	0.170	756.5	4017.7	711.1	1.50	726.2	1134	132.67	15.66	11.80%	25.47
RodD4_100.1	245	2.543	0.295	780.5	4140.4	730.9	1.50	747.4	1098	125.28	14.69	11.73%	23.07
RodD4_106.1	246	2.695	0.447	794.1	4298.6	753.8	1.50	767.2	1067	160.31	19.20	11.98%	28.42
RodD4_110	247	2.794	0.546	798.4	4155.1	767.8	1.50	778.0	1051	203.70	25.49	12.51%	35.40
RodD4_142.1	248	3.609	0.218	847.4	1508.5	838.8	1.50	841.7	964	263.47	59.43	22.56%	40.86
RodE4_88.4	201	2.245	-0.003	706.9	3797.2	682.3	1.50	690.5	1201	231.58	30.45	13.15%	47.82
RodE4_91.2	202	2.316	0.069	726.0	3864.4	694.3	1.50	704.9	1173	182.57	22.74	12.46%	36.60
RodE4_95.3	204	2.421	0.173	750.7	3964.3	711.5	1.50	724.6	1137	151.48	18.31	12.09%	29.18
RodE4_100.9	205	2.563	0.315	774.1	4096.5	734.1	1.50	747.4	1098	153.31	18.53	12.09%	28.23
RodE4_142.3	208	3.614	0.224	845.0	1519.0	838.9	1.50	840.9	965	376.85	112.02	29.72%	58.51
RodE3_63.4	193	1.610	0.417	621.1	3171.3	572.9	1.50	589.0	1444	98.78	11.56	11.70%	25.60
RodE3_113.6	194	2.885	0.022	808.2	3847.5	779.8	1.50	789.3	1034	203.53	25.93	12.74%	34.64
RodE3_115.5	195	2.934	0.070	815.1	3700.3	785.9	1.50	795.6	1025	190.18	24.08	12.66%	31.99
RodE3_118.5	196	3.010	0.146	822.8	3473.0	794.9	1.50	804.2	1013	186.90	23.85	12.76%	30.96
RodE3_122.7	197	3.117	0.253	829.1	3151.7	806.4	1.50	814.0	1000	208.43	27.98	13.42%	33.93
RodE3_126.5	198	3.213	0.349	832.2	2859.3	815.6	1.50	821.1	990	258.44	38.83	15.02%	41.54
RodE3_131.7	199	3.345	-0.046	837.1	2432.5	826.0	1.50	829.7	979	330.99	62.13	18.77%	52.40
RodE3_135.6	200	3.444	0.053	837.3	2155.0	832.2	1.50	833.9	974	627.81	213.57	34.02%	98.67

Table SC-3205-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	625.7	3066.5	574.2	1.50	591.4	1437	89.41	10.64	11.90%	23.04
RodC5_113.6	226	2.885	0.022	804.4	3728.1	779.8	1.50	788.0	1036	228.19	30.56	13.39%	38.93
RodC5_115.7	227	2.939	0.075	813.1	3580.5	786.5	1.50	795.4	1025	201.87	26.45	13.10%	33.98
RodC5_122.7	229	3.117	0.253	829.2	3071.6	806.4	1.50	814.0	1000	202.36	27.46	13.57%	32.94
RodC5_126.7	230	3.218	0.354	833.3	2785.0	816.0	1.50	821.8	989	242.46	36.13	14.90%	38.92
RodC5_131.6	231	3.343	-0.048	836.6	2440.8	825.9	1.50	829.4	979	341.89	65.39	19.12%	54.15
RodC5_135.7	232	3.447	0.056	841.0	2140.2	832.3	1.50	835.2	972	368.82	81.33	22.05%	57.84
RodE5_63.6	209	1.615	0.422	616.3	3160.1	573.8	1.50	588.0	1447	111.45	13.23	11.87%	28.95
RodE5_113.6	210	2.885	0.022	800.4	3854.1	779.8	1.50	786.7	1038	281.77	39.14	13.89%	48.18
RodE5_115.4	211	2.931	0.067	807.7	3716.8	785.6	1.50	792.9	1029	252.36	34.22	13.56%	42.66
RodE5_118.7	212	3.015	0.151	815.7	3469.2	795.5	1.50	802.2	1016	256.98	35.77	13.92%	42.72
RodE5_122.6	213	3.114	0.250	822.3	3179.4	806.1	1.50	811.5	1003	295.68	44.96	15.20%	48.34
RodE5_126.6	214	3.216	0.352	826.5	2884.5	815.8	1.50	819.4	992	404.95	77.29	19.09%	65.28
RodE5_131.6	215	3.343	-0.048	844.9	2520.6	825.9	1.50	832.2	976	198.22	27.83	14.04%	31.24
RodE5_135.6	216	3.444	0.053	839.5	2216.2	832.2	1.50	834.6	973	454.60	114.29	25.14%	71.36
RodC3_79.8	177	2.027	0.227	682.2	3562.1	644.7	1.50	657.2	1271	142.46	17.30	12.14%	31.59
RodC3_85.6	178	2.174	0.374	695.3	3716.9	670.2	1.50	678.6	1225	221.29	28.94	13.08%	46.86
RodC3_88.5	179	2.248	0.000	706.9	3790.8	682.7	1.50	690.8	1201	235.51	31.16	13.23%	48.61
RodC3_92.4	180	2.347	0.099	731.7	3888.3	699.4	1.50	710.1	1164	180.56	22.45	12.43%	35.81
RodC3_94.4	181	2.398	0.150	743.8	3937.1	707.7	1.50	719.8	1146	163.79	20.03	12.23%	31.85
RodC3_97.2	182	2.469	0.221	760.0	4002.7	719.3	1.50	732.8	1123	147.58	17.80	12.06%	27.97
RodC3_108.8	183	2.764	0.516	795.2	4208.4	763.6	1.50	774.1	1056	199.65	24.97	12.51%	34.95
RodD5_50	217	1.270	0.076	567.7	2771.9	519.0	1.50	535.2	1618	85.32	10.05	11.78%	25.23
RodD5_54.1	218	1.374	0.180	588.4	2886.4	534.7	1.50	552.6	1557	80.70	9.43	11.69%	22.85
RodD5_56.9	219	1.445	0.251	600.2	2960.6	545.9	1.50	564.0	1520	81.81	9.56	11.68%	22.52
RodD5_60	220	1.524	0.330	612.0	3044.4	558.7	1.50	576.4	1481	85.61	10.01	11.69%	22.86
RodD5_66.1	221	1.679	0.485	630.1	3207.6	584.5	1.50	599.7	1414	105.44	12.48	11.84%	26.64
RodD5_69.9	222	1.775	-0.025	632.7	3309.9	601.0	1.50	611.6	1382	156.73	19.43	12.40%	38.51
RodD5_72.9	223	1.852	0.051	649.8	3388.3	614.2	1.50	626.0	1345	142.83	17.44	12.21%	33.95
RodD5_74.9	224	1.902	0.102	661.6	3442.1	623.0	1.50	635.9	1321	133.91	16.17	12.08%	31.13

Table SC-3205-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	547.9	2520.5	493.7	1.50	511.7	1706.6	69.78	8.18	11.72%	21.89
RodB5_52.9	154	1.344	0.150	585.6	2848.8	533.3	1.50	550.8	1563.4	81.74	9.58	11.72%	23.25
RodB5_55	155	1.397	0.203	592.9	2905.3	540.8	1.50	558.2	1538.8	83.67	9.81	11.72%	23.36
RodB5_57.8	156	1.468	0.274	603.9	2980.8	550.9	1.50	568.6	1505.4	84.36	9.88	11.71%	22.96
RodB5_64	157	1.626	0.432	623.6	3147.9	574.0	1.50	590.5	1439.8	95.18	11.19	11.76%	24.57
RodB5_73.9	158	1.877	0.077	652.6	3412.8	611.9	1.50	625.5	1346.2	125.73	15.09	12.00%	29.93
RodB5_75.9	159	1.928	0.128	663.4	3466.3	619.6	1.50	634.2	1324.6	118.84	14.15	11.91%	27.73
RodB5_76.9	160	1.953	0.153	668.0	3492.8	623.5	1.50	638.3	1314.7	117.86	14.02	11.89%	27.25
RodF5_41	105	1.041	0.343	543.1	2508.3	493.7	1.50	510.1	1713.1	76.19	9.02	11.84%	24.00
RodF5_53.1	106	1.349	0.155	579.3	2841.7	534.1	1.50	549.1	1569.0	94.27	11.21	11.89%	26.92
RodF5_55	107	1.397	0.203	588.2	2893.8	540.8	1.50	556.6	1543.9	91.55	10.84	11.84%	25.66
RodF5_57.8	108	1.468	0.274	599.2	2969.2	550.9	1.50	567.0	1510.4	92.32	10.91	11.82%	25.22
RodF5_64	109	1.626	0.432	617.8	3137.6	574.0	1.50	588.6	1445.4	107.35	12.79	11.91%	27.84
RodF5_73.8	110	1.875	0.074	643.4	3400.9	611.5	1.50	622.2	1354.5	159.74	19.82	12.41%	38.31
RodF5_75.8	111	1.925	0.125	654.5	3454.3	619.3	1.50	631.0	1332.4	147.01	18.01	12.25%	34.55
RodF5_76.8	112	1.951	0.150	659.3	3479.4	623.1	1.50	635.2	1322.2	144.25	17.61	12.21%	33.58
RodC2_41	57	1.041	0.343	544.1	2517.9	493.7	1.50	510.5	1711.6	74.85	8.83	11.79%	23.56
RodC2_53.1	58	1.349	0.155	580.3	2852.0	534.1	1.50	549.5	1567.8	92.41	10.94	11.84%	26.36
RodC2_55	59	1.397	0.203	587.7	2903.6	540.8	1.50	556.4	1544.5	92.90	10.99	11.83%	26.05
RodC2_57.8	60	1.468	0.274	598.5	2980.1	550.9	1.50	566.8	1511.2	94.10	11.11	11.81%	25.73
RodC2_63.9	61	1.623	0.429	616.9	3146.3	573.6	1.50	588.1	1446.9	108.88	12.96	11.90%	28.28
RodC2_73.8	62	1.875	0.074	641.3	3407.8	611.5	1.50	621.4	1356.3	171.49	21.52	12.55%	41.19
RodC2_75.8	63	1.925	0.125	650.4	3458.1	619.3	1.50	629.7	1335.8	166.39	20.78	12.49%	39.23
RodC2_76.8	64	1.951	0.150	654.3	3483.3	623.1	1.50	633.5	1326.2	167.43	20.91	12.49%	39.13
RodC6_40.9	137	1.039	0.340	547.0	2501.5	493.4	1.50	511.3	1708.5	69.89	8.23	11.78%	21.96
RodC6_52.8	138	1.341	0.147	584.6	2845.6	533.0	1.50	550.2	1565.4	82.76	9.71	11.74%	23.57
RodC6_54.8	139	1.392	0.198	593.3	2899.7	540.1	1.50	557.8	1540.0	81.80	9.58	11.71%	22.86
RodC6_57.8	140	1.468	0.274	604.0	2983.1	550.9	1.50	568.6	1505.4	84.33	9.87	11.70%	22.95
RodC6_63.8	141	1.621	0.427	623.8	3153.8	573.2	1.50	590.1	1441.1	93.61	10.97	11.72%	24.20
RodC6_73.7	142	1.872	0.072	654.4	3432.3	611.1	1.50	625.6	1345.9	118.92	14.12	11.87%	28.30
RodC6_75.8	143	1.925	0.125	663.8	3488.6	619.3	1.50	634.1	1324.9	117.49	13.91	11.84%	27.42
RodC6_76.8	144	1.951	0.150	668.9	3516.4	623.1	1.50	638.4	1314.6	115.27	13.61	11.81%	26.65

Table SC-3205-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	705.4	3769.2	667.9	1.50	680.4	1221.5	150.72	18.36	12.18%	31.79
RodB4_91.3	162	2.319	0.071	722.3	3840.9	679.0	1.50	693.4	1195.4	132.91	15.93	11.99%	27.28
RodB4_93.3	163	2.370	0.122	731.8	3887.2	686.5	1.50	701.6	1179.6	128.74	15.38	11.95%	25.98
RodB4_95.1	164	2.416	0.168	739.8	3931.9	693.2	1.50	708.7	1166.1	126.53	15.08	11.92%	25.16
RodB4_100	165	2.540	0.292	757.7	4049.8	711.2	1.50	726.7	1133.7	130.43	15.58	11.94%	25.02
RodB4_106	166	2.692	0.445	779.7	4199.4	732.3	1.50	748.1	1097.3	132.83	15.86	11.94%	24.43
RodB4_109.9	167	2.791	0.544	785.1	4063.4	745.5	1.50	758.7	1080.3	153.79	18.77	12.20%	27.71
RodB4_142.3	168	3.614	0.224	832.8	1547.3	827.5	1.50	829.3	979.6	441.08	147.61	33.47%	69.89
RodF4_85.6	98	2.174	0.374	688.5	3730.6	657.2	1.50	667.6	1248.3	178.60	22.25	12.46%	38.72
RodF4_88.4	99	2.245	-0.003	695.1	3802.2	667.9	1.50	677.0	1228.6	210.16	26.96	12.83%	44.65
RodF4_92.4	100	2.347	0.099	719.3	3902.6	683.1	1.50	695.2	1192.0	161.86	19.73	12.19%	33.10
RodF4_94.3	101	2.395	0.147	730.6	3949.3	690.2	1.50	703.7	1175.6	146.68	17.64	12.03%	29.47
RodF4_97.2	102	2.469	0.221	746.8	4020.0	701.0	1.50	716.2	1152.3	131.67	15.65	11.88%	25.79
RodF4_108.8	103	2.764	0.516	784.6	4231.7	741.8	1.50	756.1	1084.4	148.23	17.73	11.96%	26.85
RodF4_111	104	2.819	-0.044	789.6	4057.9	749.1	1.50	762.6	1074.1	150.16	18.06	12.03%	26.86
RodD2_103.2	65	2.621	0.373	763.2	4192.6	722.6	1.50	736.1	1117.3	154.63	18.57	12.01%	29.11
RodD2_106	66	2.692	0.445	772.4	4264.8	732.3	1.50	745.7	1101.3	159.63	19.21	12.03%	29.50
RodD2_112.6	67	2.860	-0.004	790.6	3911.4	754.3	1.50	766.4	1068.2	161.50	19.76	12.23%	28.68
RodD2_114.9	68	2.918	0.055	800.2	3720.5	761.5	1.50	774.4	1055.9	144.55	17.57	12.15%	25.29
RodD2_117.4	69	2.982	0.118	805.9	3526.0	769.2	1.50	781.4	1045.4	144.11	17.62	12.23%	24.88
RodD2_120.8	70	3.068	0.204	813.8	3251.7	779.2	1.50	790.7	1032.0	140.99	17.41	12.35%	23.93
RodD2_124.8	71	3.170	0.306	819.0	2928.6	790.2	1.50	799.8	1019.1	152.18	19.43	12.77%	25.41
RodD2_128.6	72	3.266	0.403	822.2	2624.1	799.9	1.50	807.3	1008.7	176.42	24.03	13.62%	29.06
RodD6_103.1	129	2.619	0.371	764.2	4194.7	722.2	1.50	736.2	1117.2	149.83	17.91	11.96%	28.20
RodD6_106	130	2.692	0.445	773.8	4265.8	732.3	1.50	746.1	1100.6	154.39	18.50	11.98%	28.50
RodD6_112.9	131	2.868	0.004	792.9	3894.2	755.2	1.50	767.8	1066.0	155.11	18.87	12.16%	27.47
RodD6_114.9	132	2.918	0.055	799.7	3735.3	761.5	1.50	774.3	1056.2	146.88	17.84	12.14%	25.70
RodD6_116.8	133	2.967	0.103	804.5	3579.3	767.4	1.50	779.8	1047.9	144.66	17.65	12.20%	25.06
RodD6_120.9	134	3.071	0.207	843.3	1519.0	779.5	1.50	800.7	1017.8	35.68	7.48	20.96%	5.95
RodD6_124.8	135	3.170	0.306	814.7	2935.0	790.2	1.50	798.3	1021.1	179.64	23.79	13.24%	30.07
RodD6_128.7	136	3.269	0.405	819.5	2620.5	800.1	1.50	806.6	1009.7	202.58	28.86	14.25%	33.41

Table SC-3205-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	562.5	2795.6	523.6	1.50	536.5	1612.8	107.83	12.94	12.00%	31.77
RodE2_54	74	1.372	0.178	582.0	2906.1	537.2	1.50	552.2	1558.7	97.29	11.48	11.80%	27.57
RodE2_56.9	75	1.445	0.251	593.0	2985.0	547.7	1.50	562.8	1524.0	98.87	11.66	11.79%	27.30
RodE2_59.9	76	1.521	0.328	604.5	3068.2	558.7	1.50	573.9	1488.9	100.39	11.82	11.77%	26.97
RodE2_66	77	1.676	0.483	620.5	3237.1	581.6	1.50	594.5	1428.4	124.61	14.91	11.97%	31.87
RodE2_69.8	78	1.773	-0.027	622.6	3341.0	596.1	1.50	604.9	1399.7	189.16	24.18	12.78%	47.21
RodE2_72.9	79	1.852	0.051	637.0	3421.5	608.0	1.50	617.7	1365.9	177.18	22.23	12.54%	42.93
RodE2_74.9	80	1.902	0.102	647.3	3476.1	615.8	1.50	626.3	1344.2	165.60	20.45	12.35%	39.34
RodB3_50.2	169	1.275	0.081	563.2	2766.3	523.9	1.50	537.0	1611.1	105.59	12.74	12.06%	31.08
RodB3_54.1	170	1.374	0.180	579.7	2874.0	537.6	1.50	551.6	1560.5	102.36	12.24	11.96%	29.05
RodB3_56.9	171	1.445	0.251	591.5	2952.2	547.7	1.50	562.3	1525.5	101.04	12.03	11.90%	27.93
RodB3_60.1	172	1.527	0.333	603.6	3039.3	559.4	1.50	574.1	1488.3	103.10	12.26	11.89%	27.69
RodB3_66.1	173	1.679	0.485	623.1	3201.7	581.9	1.50	595.7	1425.2	116.62	13.96	11.97%	29.75
RodB3_69.9	174	1.775	-0.025	625.7	3303.5	596.5	1.50	606.2	1396.2	169.54	21.35	12.59%	42.19
RodB3_73	175	1.854	0.054	639.3	3387.3	608.4	1.50	618.7	1363.3	164.49	20.50	12.46%	39.76
RodB3_75	176	1.905	0.105	651.1	3439.9	616.2	1.50	627.8	1340.3	147.49	18.06	12.25%	34.92
RodF3_50.1	89	1.273	0.079	568.6	2776.9	523.6	1.50	538.6	1605.5	92.50	10.97	11.86%	27.12
RodF3_54	90	1.372	0.178	587.5	2885.4	537.2	1.50	554.0	1552.6	86.12	10.11	11.74%	24.30
RodF3_57	91	1.448	0.254	598.5	2970.7	548.0	1.50	564.9	1517.3	88.32	10.35	11.72%	24.26
RodF3_60	92	1.524	0.330	608.6	3054.2	559.0	1.50	575.6	1484.0	92.37	10.84	11.73%	24.72
RodF3_66.1	93	1.679	0.485	623.6	3226.1	581.9	1.50	595.8	1424.8	116.21	13.83	11.90%	29.63
RodF3_70	94	1.778	-0.022	627.0	3331.1	596.8	1.50	606.9	1394.4	165.78	20.68	12.47%	41.18
RodF3_73	95	1.854	0.054	643.0	3409.4	608.4	1.50	619.9	1360.2	148.04	18.05	12.19%	35.68
RodF3_75	96	1.905	0.105	655.2	3467.1	616.2	1.50	629.2	1337.0	133.25	16.01	12.01%	31.45
RodE6_50.2	121	1.275	0.081	563.5	2772.2	523.9	1.50	537.1	1610.8	105.20	12.67	12.04%	30.96
RodE6_54.1	122	1.374	0.180	581.3	2880.3	537.6	1.50	552.2	1558.7	98.89	11.77	11.90%	28.03
RodE6_57	123	1.448	0.254	591.8	2958.1	548.0	1.50	562.6	1524.4	101.39	12.06	11.90%	28.00
RodE6_60.2	124	1.529	0.335	604.0	3043.7	559.8	1.50	574.5	1487.2	103.30	12.28	11.89%	27.72
RodE6_66.1	125	1.679	0.485	620.6	3201.8	581.9	1.50	594.8	1427.6	124.13	14.97	12.06%	31.72
RodE6_70	126	1.778	-0.022	622.2	3305.6	596.8	1.50	605.3	1398.7	195.96	25.48	13.00%	48.86
RodE6_73.1	127	1.857	0.056	637.0	3386.5	608.8	1.50	618.2	1364.6	179.95	22.83	12.69%	43.55
RodE6_75	128	1.905	0.105	648.2	3430.9	616.2	1.50	626.9	1342.7	160.43	19.95	12.44%	38.06

RBHT Steam Cooling Test SC-3209-A

Matrix test # 6

Test date – 4/21/2005

Steady state time window: 10020 - 11100 sec

Inlet flow: 2.26 m³/min (79.9 ft³/min)

Inlet steam temperature: 410 K (279 °F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 50.0 kW

Outlet steam temperature: 805 K (990 °F)

Bundle inlet Reynolds number: 8971

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

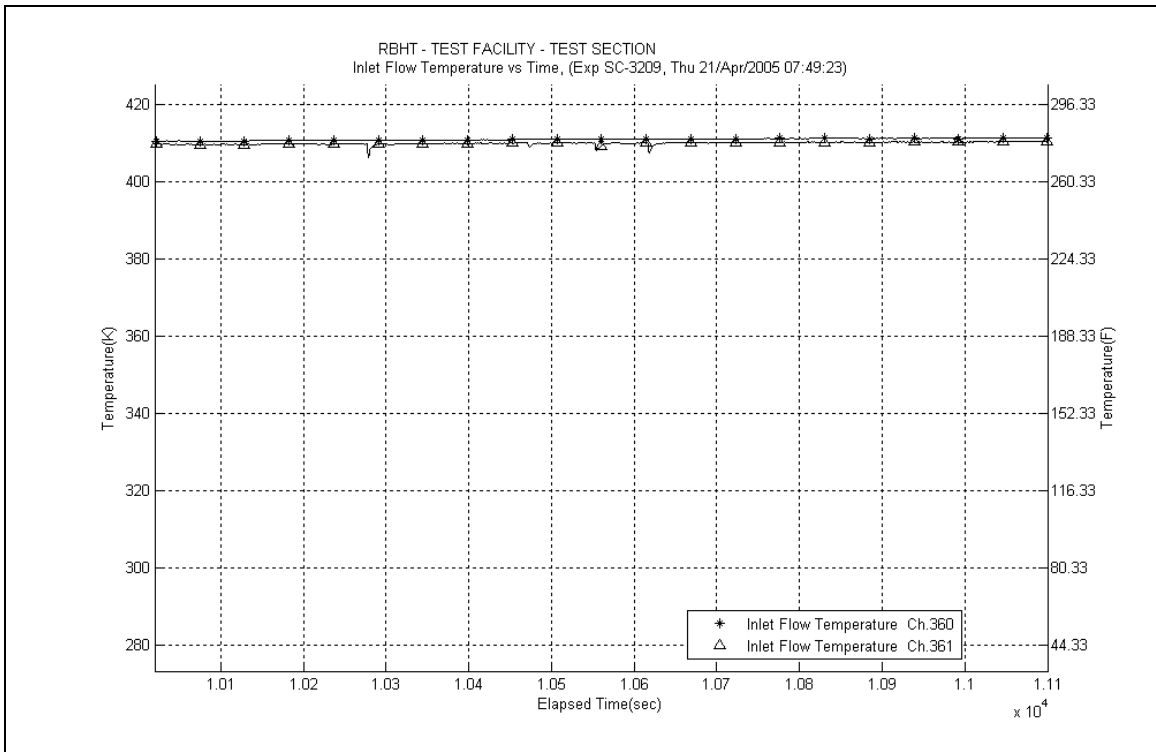
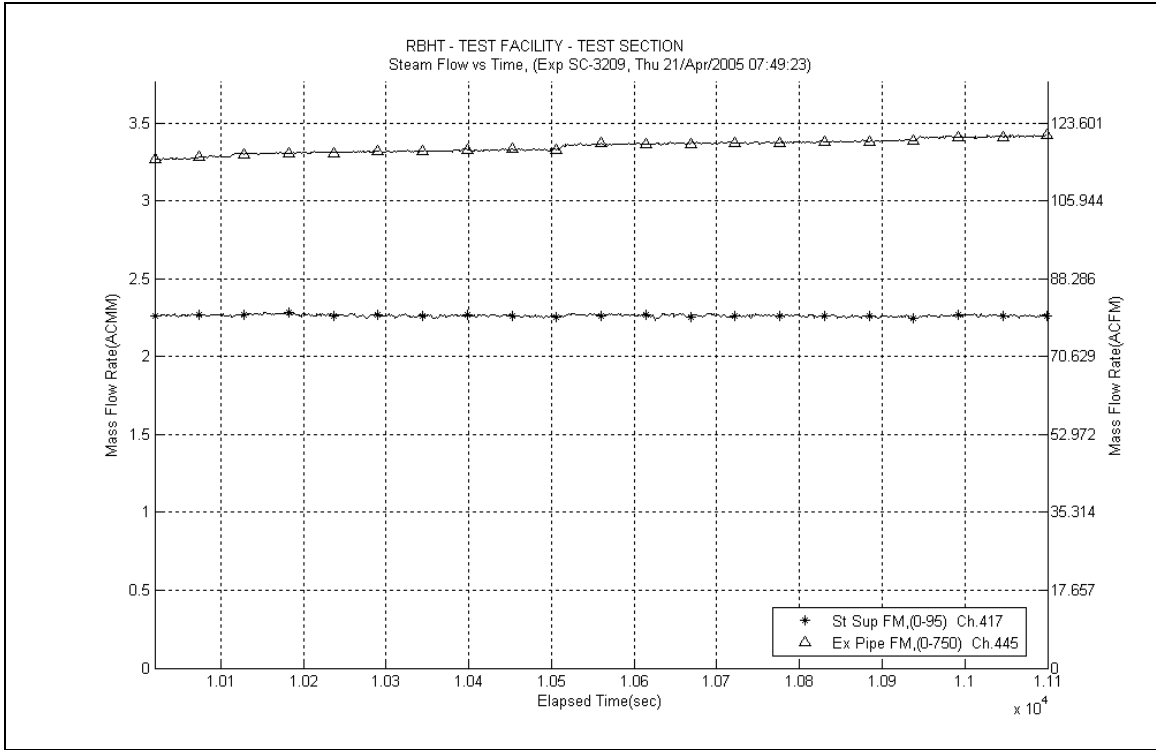
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

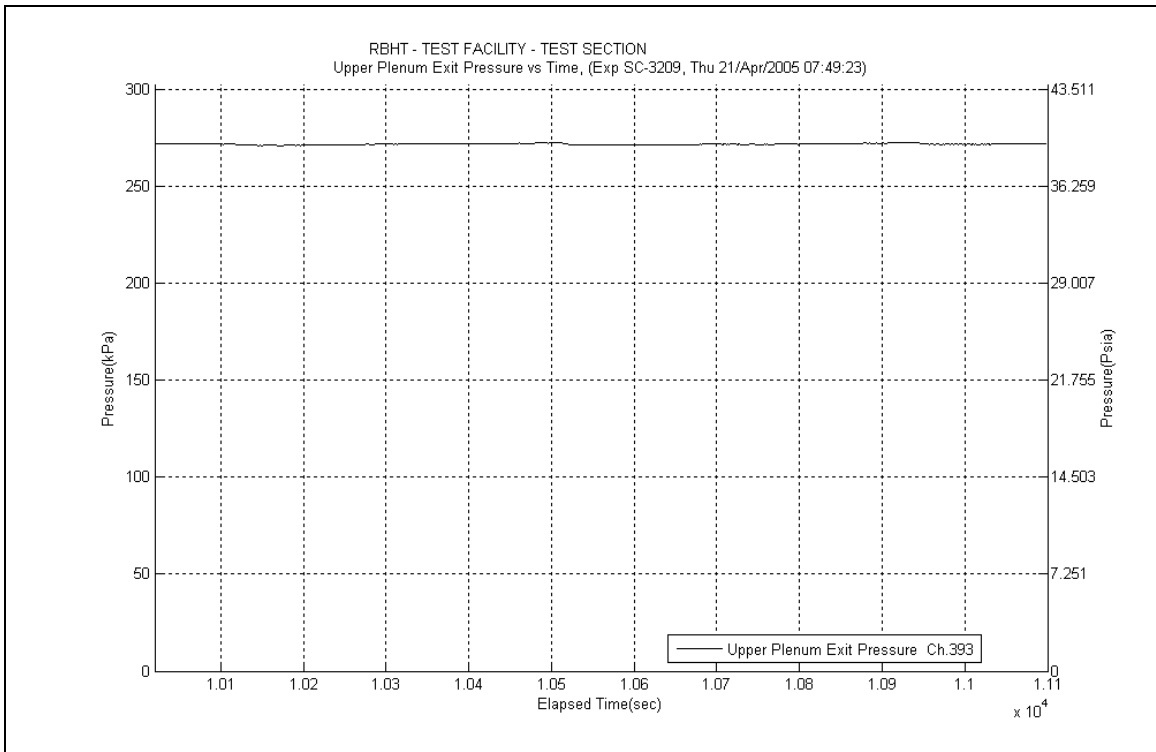
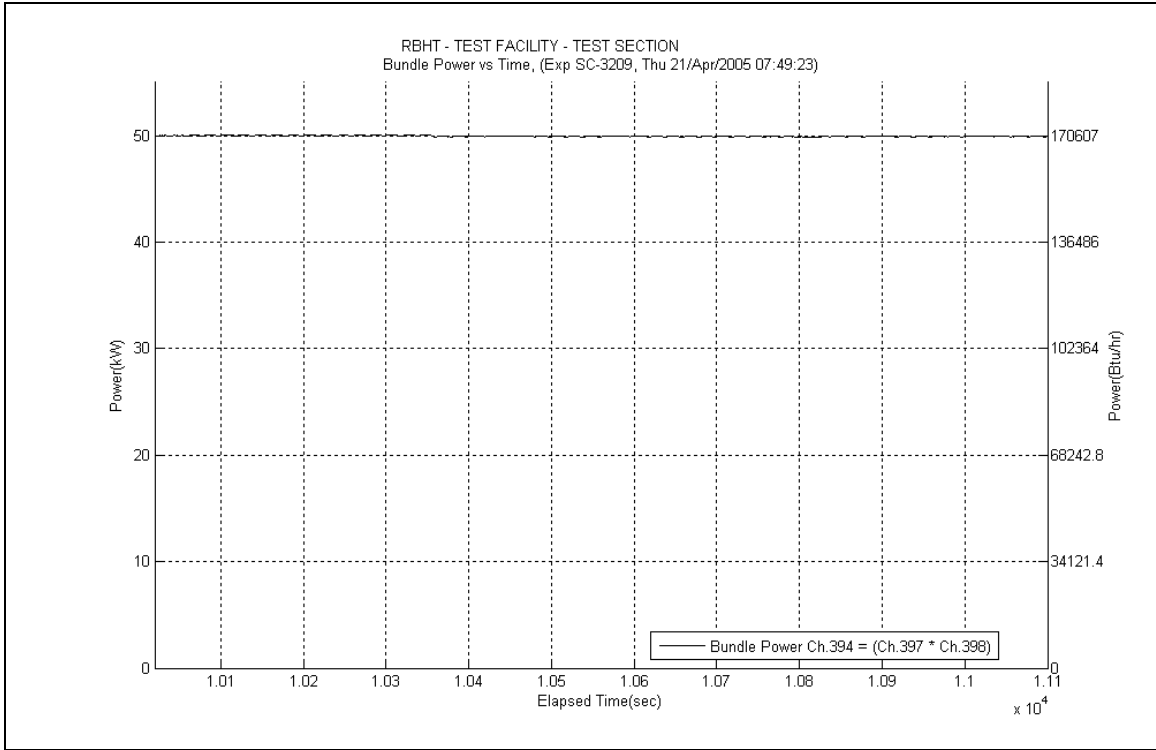
$$T_{cl} = -15.264x^3 + 96.728x^2 - 46.606x + 437.45$$

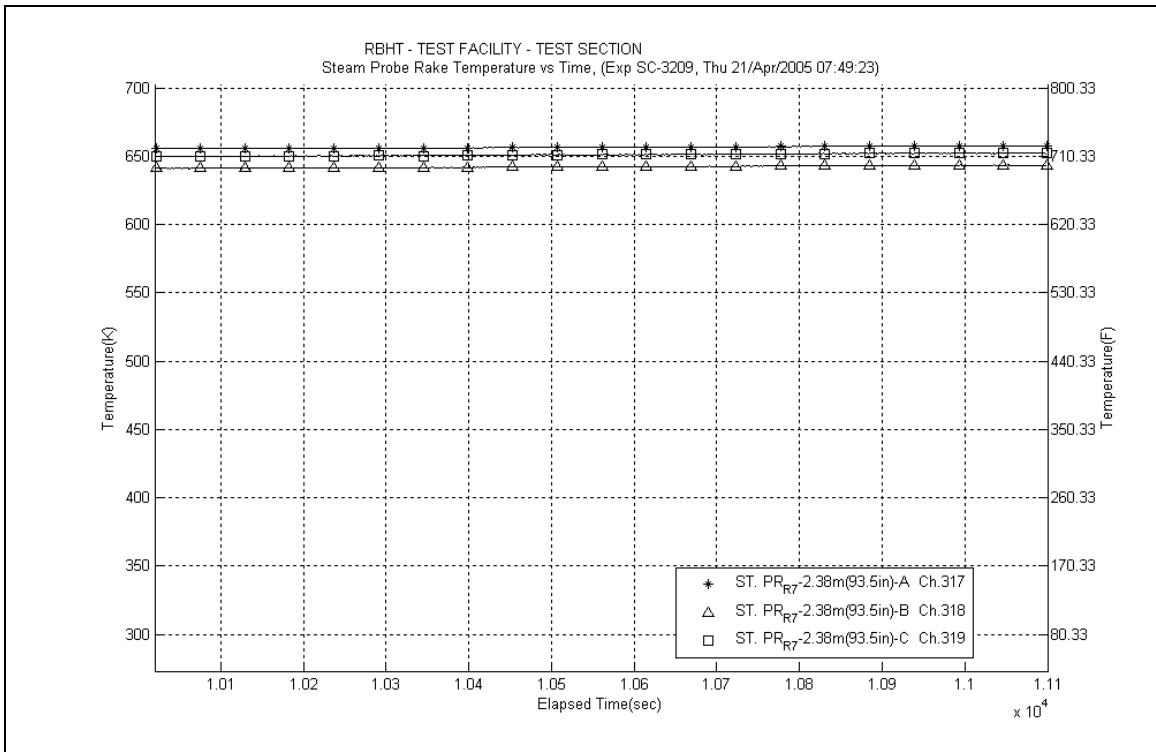
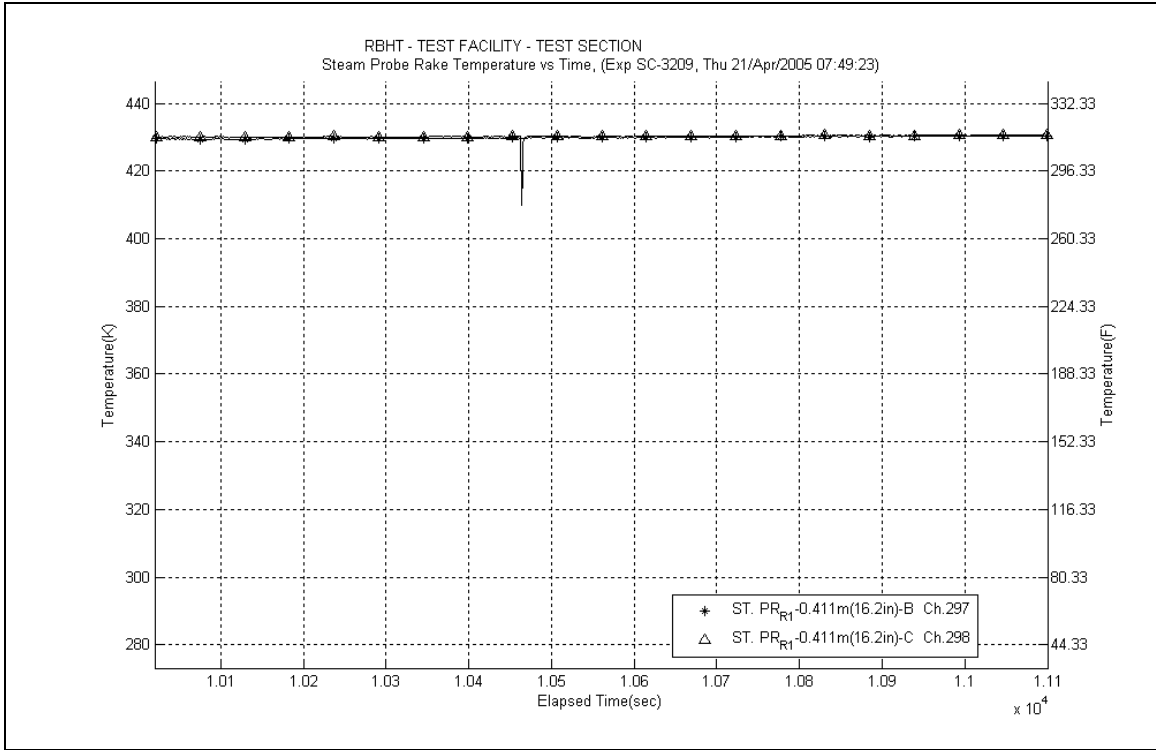
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

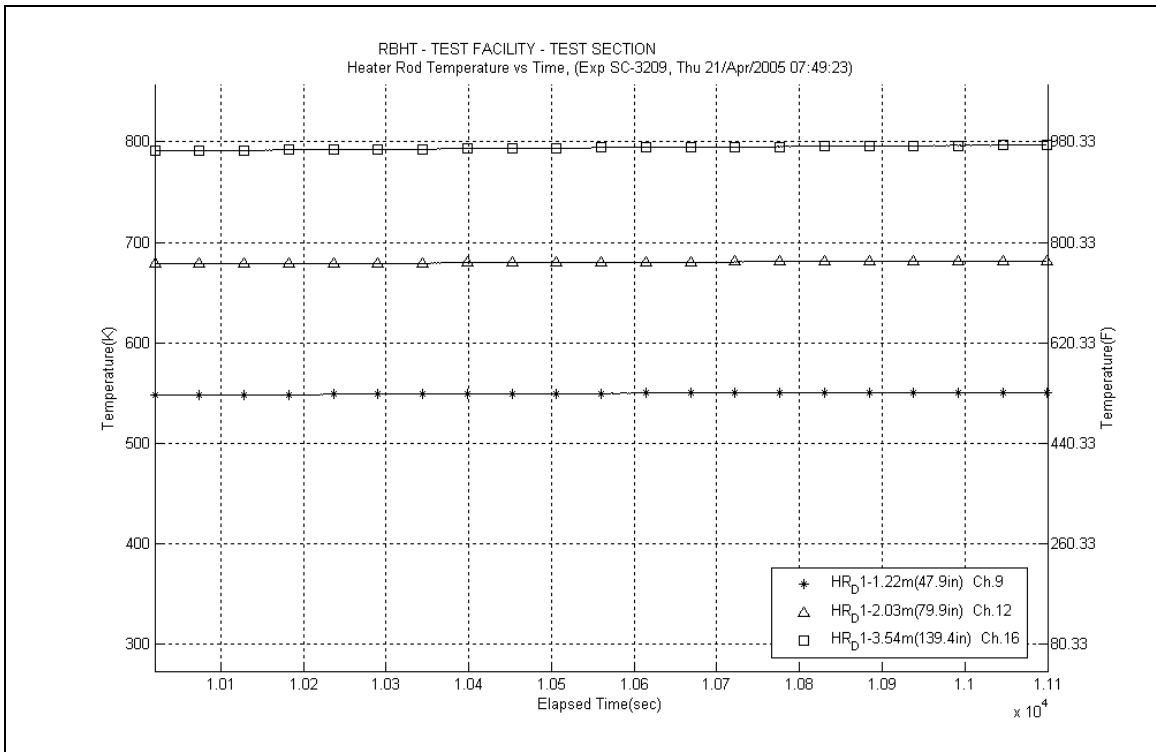
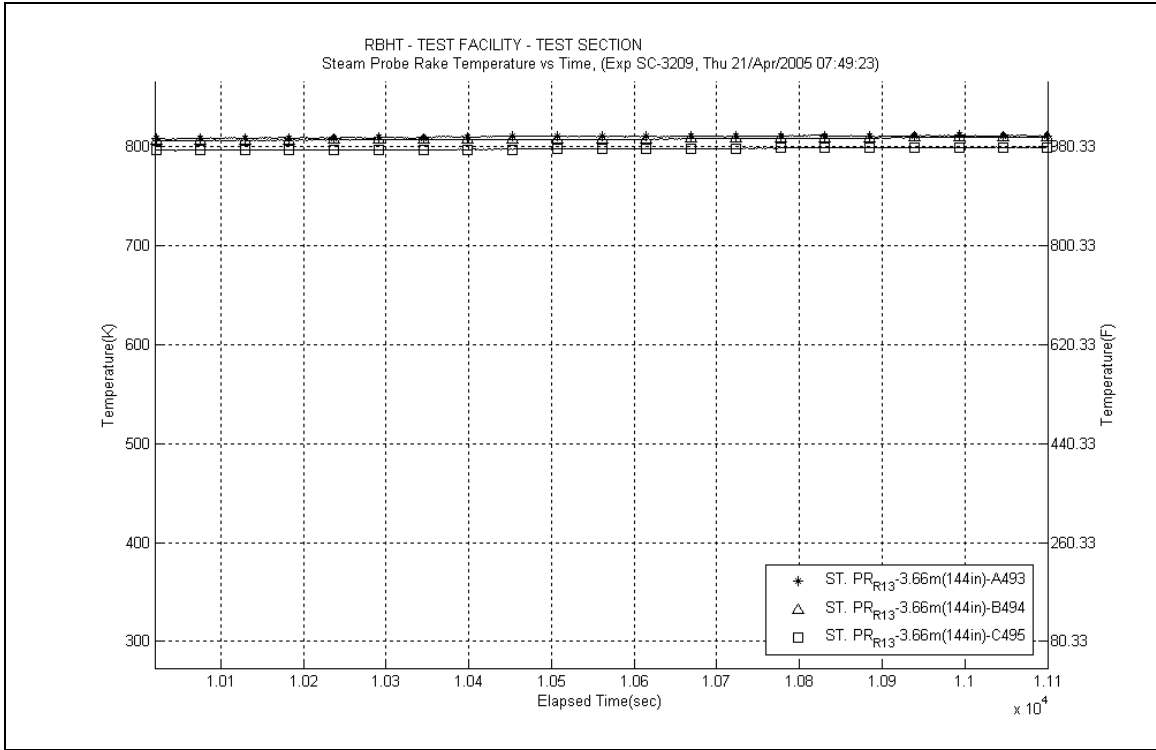
$$T_{cl} = -10.909x^3 + 72.459x^2 - 16.805x + 428.65$$

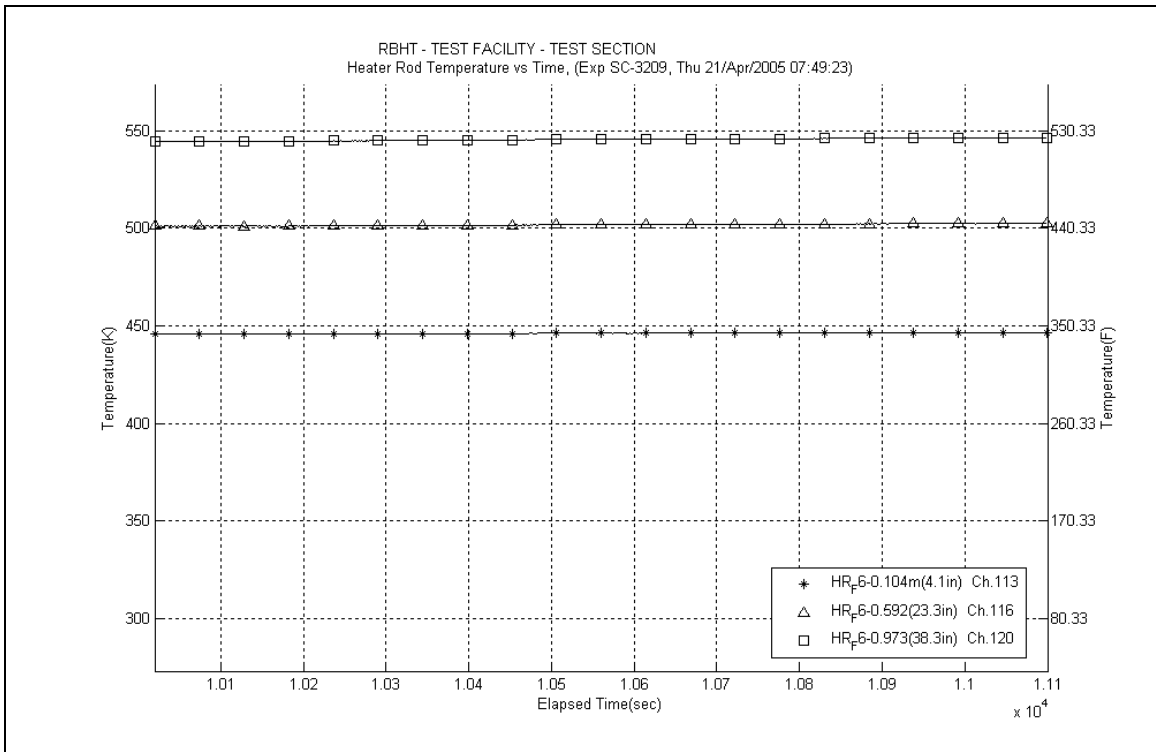
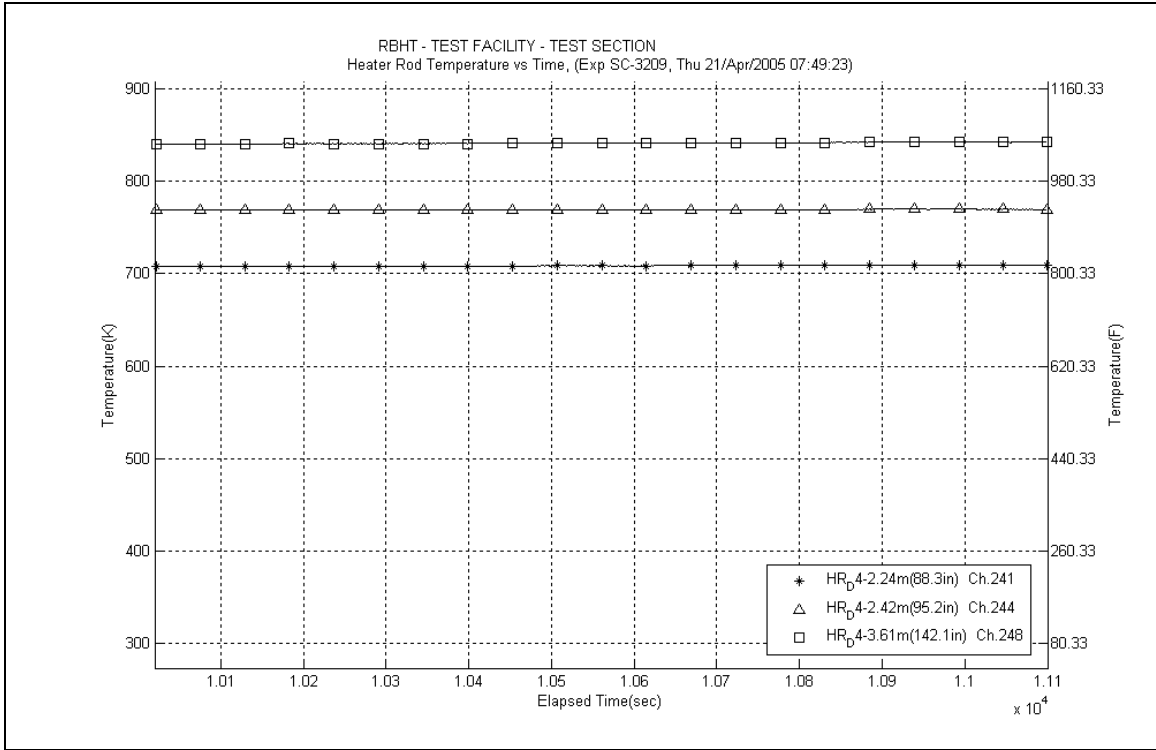
where x is the elevation (m) and T_{cl} is in (K)











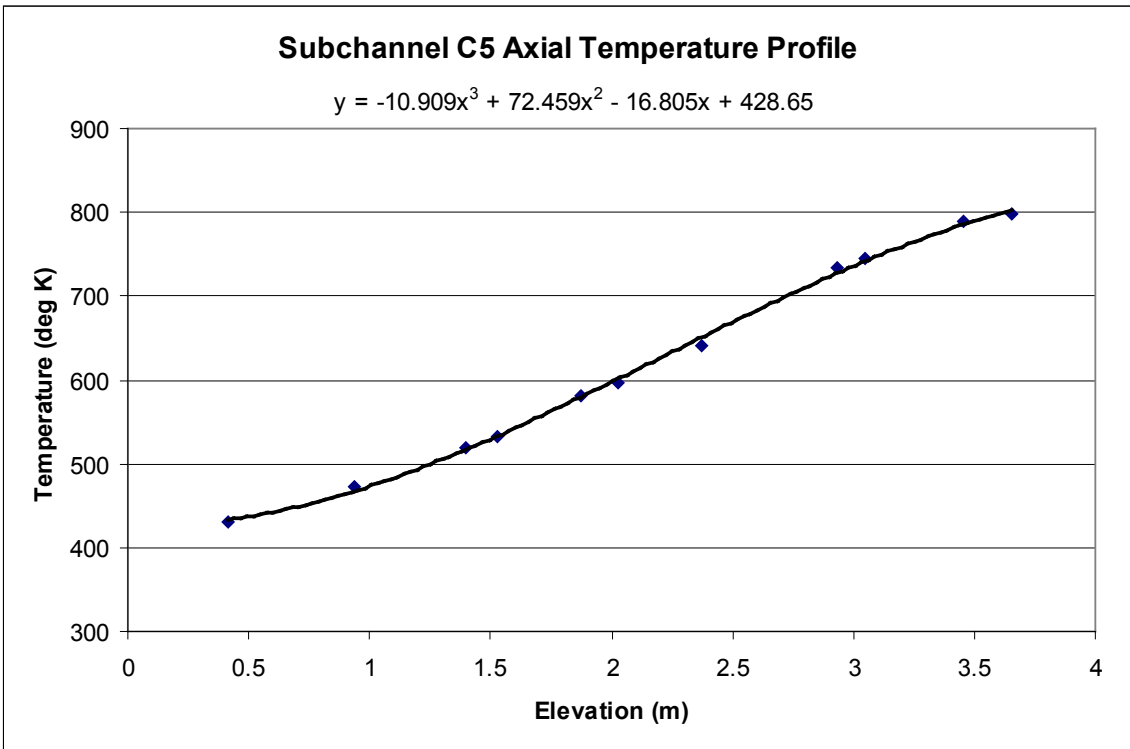
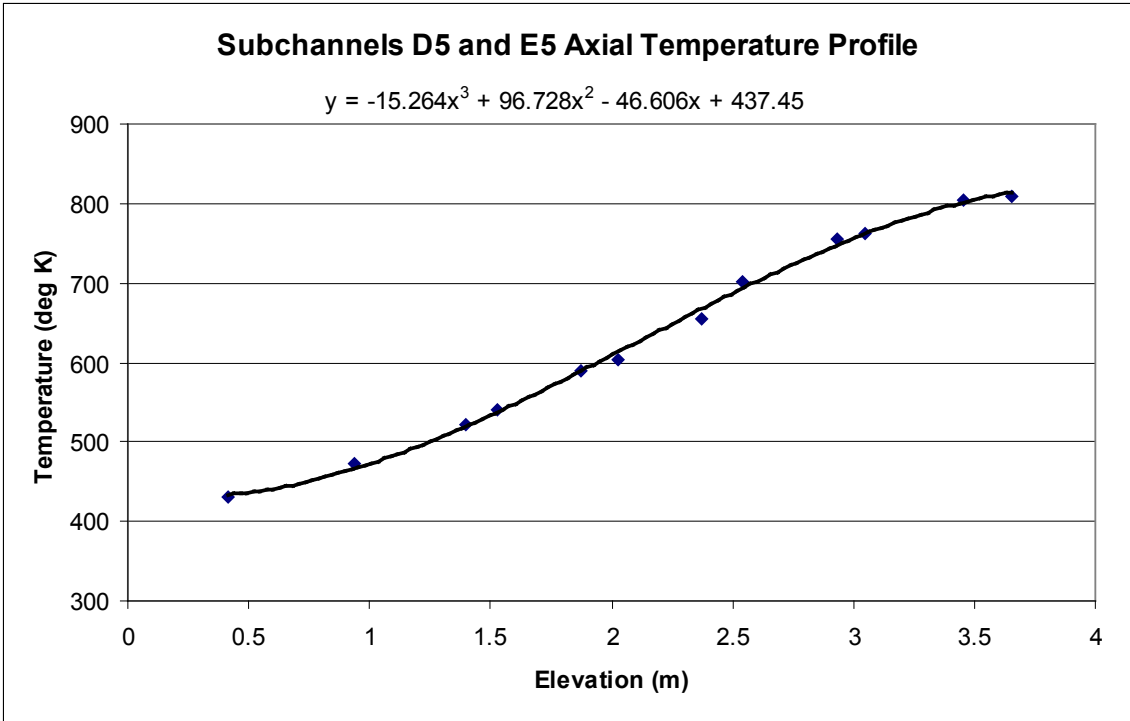


Table SC-3209-A.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	699.6	13353.3	647.3	1.20	656.0	5923	306.06	16.14	5.27%	68.04
RodD3_91.3	186	2.319	0.071	737.4	13638.7	659.2	1.20	672.2	5759	209.20	9.88	4.72%	44.90
RodD3_93.1	187	2.365	0.117	753.4	13809.0	666.3	1.20	680.8	5676	190.33	8.81	4.63%	40.12
RodD3_95.3	188	2.421	0.173	768.6	14017.8	674.9	1.20	690.5	5585	179.59	8.22	4.58%	37.08
RodD3_100.1	189	2.543	0.295	792.3	14470.6	693.4	1.20	709.9	5412	175.44	7.97	4.54%	34.81
RodD3_106.1	190	2.695	0.447	815.3	15036.0	715.6	1.20	732.2	5226	180.95	8.21	4.54%	34.33
RodD3_110	191	2.794	0.546	800.7	14848.0	729.4	1.20	741.3	5154	249.80	11.98	4.79%	46.55
RodD3_142.1	192	3.609	0.218	831.6	5162.5	811.6	1.27	815.9	4636	328.45	32.62	9.93%	53.28
RodC4_88.4	233	2.245	-0.003	705.7	13513.0	647.7	1.20	657.4	5909	279.33	14.19	5.08%	61.92
RodC4_91.1	234	2.314	0.066	738.5	13773.4	658.4	1.20	671.8	5763	206.29	9.66	4.68%	44.33
RodC4_93.4	235	2.372	0.124	752.4	13995.1	667.5	1.20	681.6	5668	197.65	9.16	4.63%	41.58
RodC4_95.3	236	2.421	0.173	766.7	14177.7	674.9	1.20	690.2	5588	185.42	8.48	4.57%	38.32
RodC4_100.1	237	2.543	0.295	788.2	14642.3	693.4	1.20	709.2	5418	185.21	8.43	4.55%	36.80
RodC4_106.1	238	2.695	0.447	813.1	15220.6	715.6	1.20	731.9	5229	187.30	8.49	4.53%	35.56
RodC4_110	239	2.794	0.546	795.3	14730.7	729.4	1.20	740.4	5162	268.41	13.15	4.90%	50.11
RodC4_142.2	240	3.612	0.221	846.6	5602.9	811.8	1.27	819.2	4615	204.51	14.67	7.17%	32.98
RodD4_88.3	241	2.243	-0.005	707.8	13469.7	647.3	1.20	657.4	5909	267.01	13.40	5.02%	59.19
RodD4_91.3	242	2.319	0.071	741.4	13758.0	659.2	1.20	672.9	5752	200.94	9.37	4.67%	43.07
RodD4_93.2	243	2.367	0.119	756.1	13939.3	666.7	1.20	681.6	5668	187.00	8.60	4.60%	39.35
RodD4_95.2	244	2.418	0.170	768.4	14129.9	674.5	1.20	690.2	5588	180.61	8.24	4.56%	37.32
RodD4_100.1	245	2.543	0.295	789.3	14599.0	693.4	1.20	709.4	5416	182.54	8.30	4.55%	36.26
RodD4_106.1	246	2.695	0.447	810.7	15171.8	715.6	1.20	731.5	5232	191.38	8.71	4.55%	36.36
RodD4_110	247	2.794	0.546	796.7	14651.6	729.4	1.20	740.6	5160	261.35	12.76	4.88%	48.77
RodD4_142.1	248	3.609	0.218	841.2	5422.4	811.6	1.27	818.0	4623	232.95	18.14	7.79%	37.65
RodE4_88.4	201	2.245	-0.003	700.6	13256.6	647.7	1.20	656.5	5918	300.33	15.81	5.26%	66.70
RodE4_91.2	202	2.316	0.069	733.3	13512.9	658.8	1.20	671.2	5769	217.67	10.41	4.78%	46.82
RodE4_95.3	204	2.421	0.173	764.3	13888.6	674.9	1.20	689.8	5591	186.49	8.62	4.62%	38.57
RodE4_100.9	205	2.563	0.315	790.4	14399.6	696.4	1.20	712.1	5393	183.75	8.43	4.59%	36.30
RodE4_142.3	208	3.614	0.224	832.3	5471.6	811.9	1.27	816.3	4634	341.49	33.29	9.75%	55.36
RodE3_63.4	193	1.610	0.417	639.4	10974.8	549.5	1.20	564.5	7060	146.52	6.74	4.60%	40.28
RodE3_113.6	194	2.885	0.022	806.2	13520.8	741.6	1.20	752.4	5070	251.00	12.41	4.94%	45.78
RodE3_115.5	195	2.934	0.070	820.8	13016.8	747.8	1.20	760.0	5013	214.14	10.27	4.80%	38.50
RodE3_118.5	196	3.010	0.146	832.9	12220.9	757.3	1.27	773.5	4916	205.51	11.94	5.81%	36.02
RodE3_122.7	197	3.117	0.253	840.1	11106.7	769.7	1.27	784.7	4838	200.72	11.77	5.87%	34.45
RodE3_126.5	198	3.213	0.349	839.3	10100.1	780.0	1.27	792.7	4785	216.77	13.11	6.05%	36.66
RodE3_131.7	199	3.345	-0.046	817.4	8731.5	792.6	1.27	797.9	4751	446.54	38.12	8.54%	74.81
RodE3_135.6	200	3.444	0.053	827.1	7693.6	800.7	1.27	806.4	4696	371.44	30.61	8.24%	61.28

Table SC-3209-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	643.4	10773.7	550.6	1.20	566.1	7037	139.29	6.42	4.61%	38.15
RodC5_113.6	226	2.885	0.022	805.4	13199.4	741.6	1.20	752.2	5071	248.40	12.41	5.00%	45.32
RodC5_115.7	227	2.939	0.075	823.6	12670.8	748.5	1.20	761.0	5006	202.24	9.71	4.80%	36.29
RodC5_122.7	229	3.117	0.253	844.3	10906.0	769.7	1.27	785.6	4832	186.04	10.85	5.83%	31.87
RodC5_126.7	230	3.218	0.354	843.0	9898.0	780.5	1.27	793.9	4777	201.47	12.09	6.00%	34.00
RodC5_131.6	231	3.343	-0.048	821.1	8665.6	792.3	1.27	798.5	4747	383.38	30.16	7.87%	64.16
RodC5_135.7	232	3.447	0.056	834.0	7635.1	800.9	1.27	808.0	4685	293.87	21.52	7.32%	48.34
RodE5_63.6	209	1.615	0.422	633.2	11031.6	550.2	1.20	564.1	7066	159.56	7.43	4.66%	43.91
RodE5_113.6	210	2.885	0.022	797.2	13611.1	741.6	1.20	750.9	5081	293.74	15.17	5.16%	53.74
RodE5_115.4	211	2.931	0.067	808.4	13139.8	747.5	1.20	757.6	5030	258.96	12.99	5.02%	46.76
RodE5_118.7	212	3.015	0.151	816.4	12275.7	757.9	1.27	770.4	4938	267.09	16.21	6.07%	47.08
RodE5_122.6	213	3.114	0.250	825.7	11257.4	769.4	1.27	781.4	4861	254.27	15.54	6.11%	43.90
RodE5_126.6	214	3.216	0.352	828.2	10215.3	780.2	1.27	790.5	4799	271.04	17.25	6.37%	46.02
RodE5_131.6	215	3.343	-0.048	806.5	8913.2	792.3	1.27	795.4	4767	800.97	102.88	12.84%	134.80
RodE5_135.6	216	3.444	0.053	820.8	7869.2	800.7	1.27	805.0	4704	499.09	48.96	9.81%	82.54
RodC3_79.8	177	2.027	0.227	687.5	12488.9	613.3	1.20	625.6	6257	201.94	9.66	4.78%	48.04
RodC3_85.6	178	2.174	0.374	694.0	13033.4	636.5	1.20	646.1	6028	272.16	13.93	5.12%	61.85
RodC3_88.5	179	2.248	0.000	700.3	13302.4	648.1	1.20	656.8	5915	305.68	16.16	5.29%	67.84
RodC3_92.4	180	2.347	0.099	741.8	13664.6	663.5	1.20	676.6	5716	209.40	9.90	4.73%	44.53
RodC3_94.4	181	2.398	0.150	749.5	13851.3	671.4	1.20	684.4	5642	212.91	10.08	4.73%	44.53
RodC3_97.2	182	2.469	0.221	771.7	14113.1	682.3	1.20	697.2	5524	189.28	8.74	4.62%	38.55
RodC3_108.8	183	2.764	0.516	810.6	14877.2	725.2	1.20	739.4	5169	209.12	9.73	4.65%	39.11
RodD5_50	217	1.270	0.076	586.3	9749.0	503.0	1.20	516.9	7840	140.43	6.53	4.65%	43.49
RodD5_54.1	218	1.374	0.180	610.0	10131.7	516.4	1.20	532.0	7575	130.01	5.94	4.57%	38.75
RodD5_56.9	219	1.445	0.251	622.1	10392.2	526.1	1.20	542.1	7408	129.82	5.91	4.55%	37.73
RodD5_60	220	1.524	0.330	631.0	10681.9	537.1	1.20	552.7	7239	136.38	6.23	4.57%	38.60
RodD5_66.1	221	1.679	0.485	646.5	11255.3	559.6	1.20	574.1	6921	155.41	7.18	4.62%	41.74
RodD5_69.9	222	1.775	-0.025	625.4	11614.7	574.2	1.20	582.7	6800	272.05	14.38	5.28%	71.56
RodD5_72.9	223	1.852	0.051	660.2	11893.5	585.9	1.20	598.3	6593	192.06	9.17	4.78%	48.69
RodD5_74.9	224	1.902	0.102	677.8	12079.7	593.8	1.20	607.8	6472	172.52	8.04	4.66%	42.77

Table SC-3209-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	565.6	8865.3	477.4	1.20	492.1	8316	120.60	5.57	4.62%	39.79
RodB5_52.9	154	1.344	0.150	607.0	9993.1	510.4	1.20	526.5	7670	124.23	5.65	4.55%	37.54
RodB5_55	155	1.397	0.203	615.9	10191.4	516.8	1.20	533.4	7552	123.41	5.60	4.54%	36.66
RodB5_57.8	156	1.468	0.274	627.4	10456.1	525.6	1.20	542.6	7399	123.25	5.57	4.52%	35.77
RodB5_64	157	1.626	0.432	642.1	11044.0	545.9	1.20	562.0	7098	137.81	6.27	4.55%	38.12
RodB5_73.9	158	1.877	0.077	669.9	11981.4	580.3	1.20	595.2	6633	160.39	7.40	4.61%	40.95
RodB5_75.9	159	1.928	0.128	684.2	12169.8	587.4	1.20	603.5	6525	150.78	6.87	4.56%	37.75
RodB5_76.9	160	1.953	0.153	690.2	12264.2	591.0	1.20	607.5	6475	148.39	6.74	4.54%	36.81
RodF5_41	105	1.041	0.343	558.5	8808.5	477.4	1.20	490.9	8340	130.30	6.11	4.69%	43.12
RodF5_53.1	106	1.349	0.155	597.1	9951.5	511.0	1.20	525.4	7689	138.77	6.44	4.64%	42.06
RodF5_55	107	1.397	0.203	605.8	10130.5	516.8	1.20	531.7	7581	136.71	6.31	4.62%	40.78
RodF5_57.8	108	1.468	0.274	615.8	10395.3	525.6	1.20	540.7	7431	138.32	6.37	4.60%	40.34
RodF5_64	109	1.626	0.432	631.1	10982.2	545.9	1.20	560.1	7125	154.74	7.19	4.65%	43.00
RodF5_73.8	110	1.875	0.074	653.9	11911.3	579.9	1.20	592.2	6672	193.07	9.24	4.79%	49.65
RodF5_75.8	111	1.925	0.125	668.3	12100.6	587.0	1.20	600.6	6563	178.73	8.40	4.70%	45.06
RodF5_76.8	112	1.951	0.150	673.8	12195.3	590.6	1.20	604.5	6513	175.89	8.23	4.68%	43.94
RodC2_41	57	1.041	0.343	560.3	8843.9	477.4	1.20	491.2	8334	128.09	5.98	4.67%	42.36
RodC2_53.1	58	1.349	0.155	604.0	9988.2	511.0	1.20	526.5	7669	128.95	5.91	4.58%	38.97
RodC2_55	59	1.397	0.203	611.4	10167.2	516.8	1.20	532.6	7565	129.08	5.90	4.57%	38.42
RodC2_57.8	60	1.468	0.274	621.6	10430.5	525.6	1.20	541.6	7415	130.45	5.95	4.56%	37.95
RodC2_63.9	61	1.623	0.429	634.0	11008.5	545.6	1.20	560.3	7122	149.44	6.89	4.61%	41.51
RodC2_73.8	62	1.875	0.074	656.3	11945.5	579.9	1.20	592.6	6666	187.58	8.91	4.75%	48.19
RodC2_75.8	63	1.925	0.125	668.1	12133.7	587.0	1.20	600.6	6563	179.56	8.43	4.70%	45.27
RodC2_76.8	64	1.951	0.150	672.9	12227.7	590.6	1.20	604.3	6515	178.40	8.35	4.68%	44.58
RodC6_40.9	137	1.039	0.340	562.4	8808.9	477.2	1.20	491.4	8331	124.05	5.77	4.65%	41.01
RodC6_52.8	138	1.341	0.147	605.6	9984.0	510.1	1.20	526.0	7678	125.46	5.72	4.56%	37.96
RodC6_54.8	139	1.392	0.198	615.1	10181.1	516.2	1.20	532.7	7563	123.56	5.60	4.54%	36.76
RodC6_57.8	140	1.468	0.274	627.5	10476.7	525.6	1.20	542.6	7399	123.46	5.58	4.52%	35.83
RodC6_63.8	141	1.621	0.427	644.1	11069.9	545.3	1.20	561.7	7101	134.45	6.09	4.53%	37.21
RodC6_73.7	142	1.872	0.072	669.9	12047.7	579.5	1.20	594.6	6640	159.96	7.35	4.59%	40.90
RodC6_75.8	143	1.925	0.125	680.9	12253.7	587.0	1.20	602.7	6536	156.58	7.15	4.57%	39.28
RodC6_76.8	144	1.951	0.150	687.7	12352.7	590.6	1.20	606.8	6484	152.68	6.94	4.54%	37.94

Table SC-3209-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	701.5	13249.3	632.7	1.20	644.2	6048	231.34	11.27	4.87%	52.79
RodB4_91.3	162	2.319	0.071	736.7	13514.3	643.3	1.20	658.9	5893	173.63	7.97	4.59%	38.36
RodB4_93.3	163	2.370	0.122	749.3	13696.4	650.6	1.20	667.0	5810	166.54	7.59	4.56%	36.15
RodB4_95.1	164	2.416	0.168	762.1	13861.0	657.1	1.20	674.6	5736	158.47	7.16	4.52%	33.84
RodB4_100	165	2.540	0.292	783.6	14308.1	674.7	1.20	692.8	5564	157.70	7.10	4.50%	32.41
RodB4_106	166	2.692	0.445	806.1	14856.5	695.7	1.20	714.1	5376	161.63	7.27	4.50%	31.79
RodB4_109.9	167	2.791	0.544	785.9	14381.8	709.1	1.20	721.9	5310	224.48	10.69	4.76%	43.47
RodB4_142.3	168	3.614	0.224	841.2	5558.5	799.4	1.27	808.3	4683	169.32	11.31	6.68%	27.84
RodF4_85.6	98	2.174	0.374	688.7	13072.3	622.5	1.20	633.6	6166	236.90	11.63	4.91%	55.36
RodF4_88.4	99	2.245	-0.003	693.7	13333.4	632.7	1.20	642.9	6063	262.53	13.19	5.02%	60.08
RodF4_92.4	100	2.347	0.099	735.1	13705.7	647.3	1.20	661.9	5862	187.23	8.66	4.63%	41.09
RodF4_94.3	101	2.395	0.147	749.5	13882.7	654.2	1.20	670.1	5780	174.72	7.98	4.57%	37.68
RodF4_97.2	102	2.469	0.221	766.7	14153.9	664.7	1.20	681.7	5668	166.39	7.53	4.53%	35.00
RodF4_108.8	103	2.764	0.516	797.3	14947.7	705.3	1.20	720.7	5321	195.15	8.95	4.59%	37.89
RodF4_111	104	2.819	-0.044	774.7	14338.0	712.8	1.20	723.1	5300	277.57	13.86	4.99%	53.62
RodD2_103.2	65	2.621	0.373	785.5	14786.6	686.0	1.20	702.6	5476	178.40	8.09	4.54%	35.93
RodD2_106	66	2.692	0.445	793.1	15051.0	695.7	1.20	712.0	5394	185.53	8.44	4.55%	36.66
RodD2_112.6	67	2.860	-0.004	781.7	13808.9	718.1	1.20	728.7	5255	260.66	12.94	4.97%	49.80
RodD2_114.9	68	2.918	0.055	802.3	13164.9	725.6	1.20	738.4	5177	205.86	9.77	4.75%	38.58
RodD2_117.4	69	2.982	0.118	811.6	12465.1	733.6	1.20	746.6	5114	191.71	9.07	4.73%	35.36
RodD2_120.8	70	3.068	0.204	822.6	11511.4	744.1	1.20	757.2	5034	176.12	8.33	4.73%	31.83
RodD2_124.8	71	3.170	0.306	824.5	10392.8	756.0	1.27	770.7	4936	193.18	11.41	5.91%	34.03
RodD2_128.6	72	3.266	0.403	822.6	9333.3	766.7	1.27	778.7	4880	212.27	13.05	6.15%	36.84
RodD6_103.1	129	2.619	0.371	783.1	14829.5	685.6	1.20	701.9	5482	182.68	8.30	4.54%	36.84
RodD6_106	130	2.692	0.445	789.4	15100.9	695.7	1.20	711.3	5399	193.59	8.85	4.57%	38.30
RodD6_112.9	131	2.868	0.004	780.5	13775.7	719.1	1.20	729.3	5250	268.89	13.47	5.01%	51.31
RodD6_114.9	132	2.918	0.055	799.9	13211.4	725.6	1.20	738.0	5180	213.34	10.19	4.78%	40.02
RodD6_116.8	133	2.967	0.103	810.4	12673.5	731.7	1.20	744.8	5127	193.33	9.12	4.72%	35.78
RodD6_120.9	134	3.071	0.207	818.6	11514.9	744.4	1.20	756.8	5037	186.36	8.91	4.78%	33.71
RodD6_124.8	135	3.170	0.306	821.0	10412.6	756.0	1.27	769.9	4941	203.67	12.13	5.96%	35.93
RodD6_128.7	136	3.269	0.405	820.2	9311.8	766.9	1.27	778.3	4882	222.52	13.84	6.22%	38.64

Table SC-3209-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	578.4	9779.8	502.1	1.20	514.8	7878	153.79	7.27	4.73%	47.88
RodE2_54	74	1.372	0.178	599.9	10152.0	513.8	1.20	528.1	7642	141.51	6.54	4.62%	42.59
RodE2_56.9	75	1.445	0.251	612.7	10429.1	522.8	1.20	537.8	7478	139.13	6.39	4.59%	40.87
RodE2_59.9	76	1.521	0.328	622.3	10714.9	532.4	1.20	547.4	7323	143.01	6.56	4.59%	41.01
RodE2_66	77	1.676	0.483	633.5	11298.6	552.7	1.20	566.2	7035	167.84	7.84	4.67%	45.95
RodE2_69.8	78	1.773	-0.027	613.3	11663.4	565.8	1.20	573.7	6926	294.73	16.01	5.43%	79.23
RodE2_72.9	79	1.852	0.051	645.3	11958.2	576.7	1.20	588.1	6726	209.34	10.13	4.84%	54.36
RodE2_74.9	80	1.902	0.102	658.8	12149.0	583.8	1.20	596.3	6618	194.41	9.25	4.76%	49.51
RodB3_50.2	169	1.275	0.081	581.0	9722.3	502.4	1.20	515.5	7865	148.44	6.99	4.71%	46.13
RodB3_54.1	170	1.374	0.180	595.2	10090.6	514.1	1.20	527.6	7651	149.31	6.99	4.68%	45.00
RodB3_56.9	171	1.445	0.251	605.4	10355.4	522.8	1.20	536.6	7499	150.32	7.01	4.67%	44.29
RodB3_60.1	172	1.527	0.333	612.0	10658.9	533.0	1.20	546.2	7341	162.03	7.62	4.70%	46.61
RodB3_66.1	173	1.679	0.485	637.4	11226.7	553.1	1.20	567.1	7021	159.67	7.42	4.65%	43.62
RodB3_69.9	174	1.775	-0.025	618.5	11588.6	566.2	1.20	574.9	6909	265.91	13.96	5.25%	71.28
RodB3_73	175	1.854	0.054	651.1	11881.6	577.1	1.20	589.4	6709	192.66	9.21	4.78%	49.88
RodB3_75	176	1.905	0.105	666.4	12070.2	584.2	1.20	597.9	6598	176.19	8.25	4.68%	44.71
RodF3_50.1	89	1.273	0.079	584.8	9725.8	502.1	1.20	515.9	7858	141.22	6.59	4.66%	43.84
RodF3_54	90	1.372	0.178	604.7	10102.4	513.8	1.20	528.9	7628	133.33	6.12	4.59%	40.05
RodF3_57	91	1.448	0.254	615.3	10391.6	523.1	1.20	538.5	7467	135.24	6.19	4.58%	39.66
RodF3_60	92	1.524	0.330	623.2	10681.5	532.7	1.20	547.8	7316	141.61	6.50	4.59%	40.57
RodF3_66.1	93	1.679	0.485	630.4	11272.1	553.1	1.20	565.9	7039	174.94	8.25	4.72%	47.93
RodF3_70	94	1.778	-0.022	617.6	11649.5	566.5	1.20	575.0	6907	273.89	14.48	5.29%	73.39
RodF3_73	95	1.854	0.054	650.2	11938.0	577.1	1.20	589.3	6711	195.75	9.37	4.79%	50.69
RodF3_75	96	1.905	0.105	650.2	11938.0	584.2	1.20	595.2	6633	216.82	10.69	4.93%	55.36
RodE6_50.2	121	1.275	0.081	579.7	9725.9	502.4	1.20	515.3	7870	151.07	7.14	4.73%	46.97
RodE6_54.1	122	1.374	0.180	599.9	10090.6	514.1	1.20	528.4	7637	141.16	6.54	4.64%	42.46
RodE6_57	123	1.448	0.254	611.0	10362.2	523.1	1.20	537.7	7479	141.45	6.53	4.62%	41.55
RodE6_60.2	124	1.529	0.335	619.8	10660.8	533.4	1.20	547.8	7316	147.96	6.85	4.63%	42.39
RodE6_66.1	125	1.679	0.485	634.2	11214.3	553.1	1.20	566.6	7029	165.88	7.77	4.68%	45.37
RodE6_70	126	1.778	-0.022	615.4	11579.2	566.5	1.20	574.7	6913	284.06	15.28	5.38%	76.18
RodE6_73.1	127	1.857	0.056	648.0	11867.7	577.4	1.20	589.2	6712	201.74	9.72	4.82%	52.25
RodE6_75	128	1.905	0.105	663.5	12044.0	584.2	1.20	597.4	6604	182.24	8.60	4.72%	46.29

RBHT Steam Cooling Test SC-3214-A

Matrix test # 7

Test date – 4/26/2005

Steady state time window: 11000 - 11500 sec

Inlet flow: 3.54 m³/min (125.0 ft³/min)

Inlet steam temperature: 417 K (291 °F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 70.0 kW

Outlet steam temperature: 775 K (936 °F)

Bundle inlet Reynolds number: 13508

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

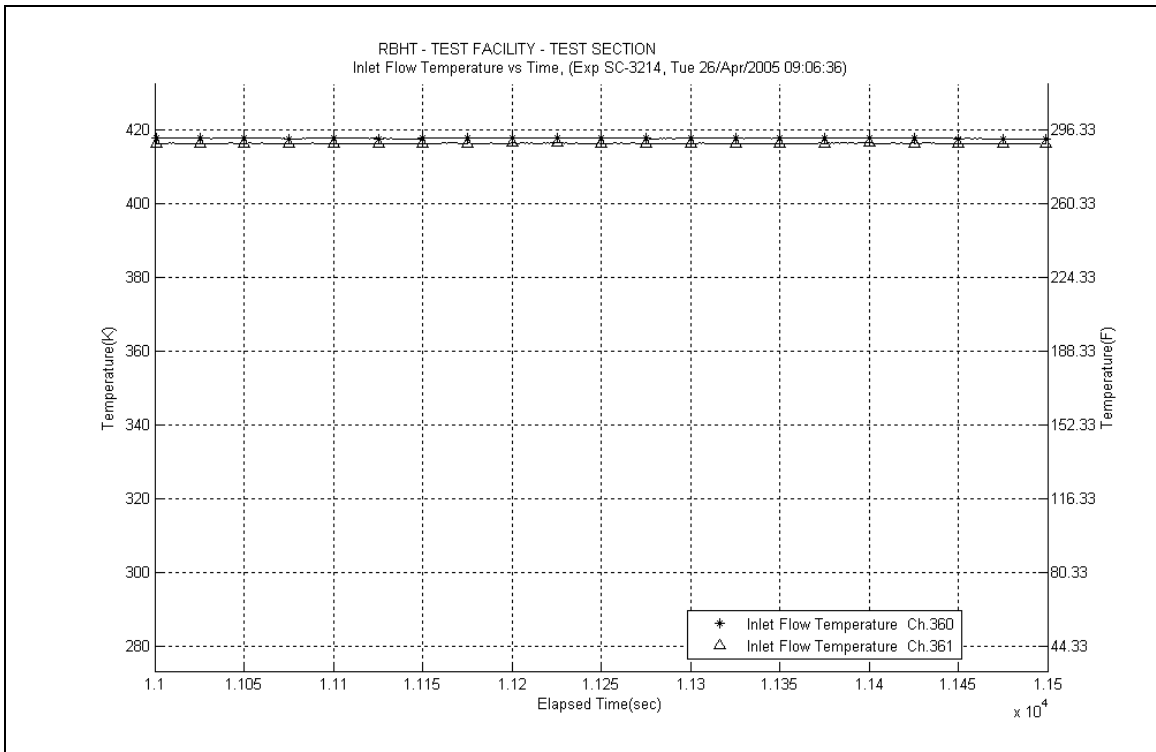
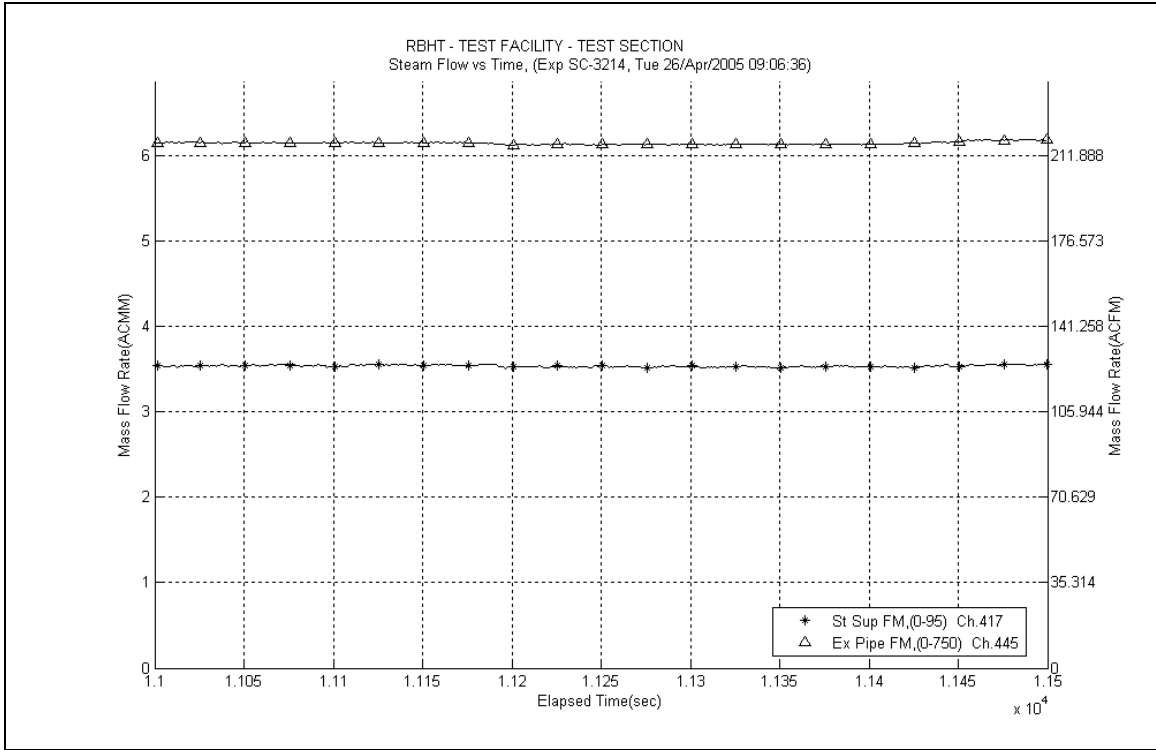
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

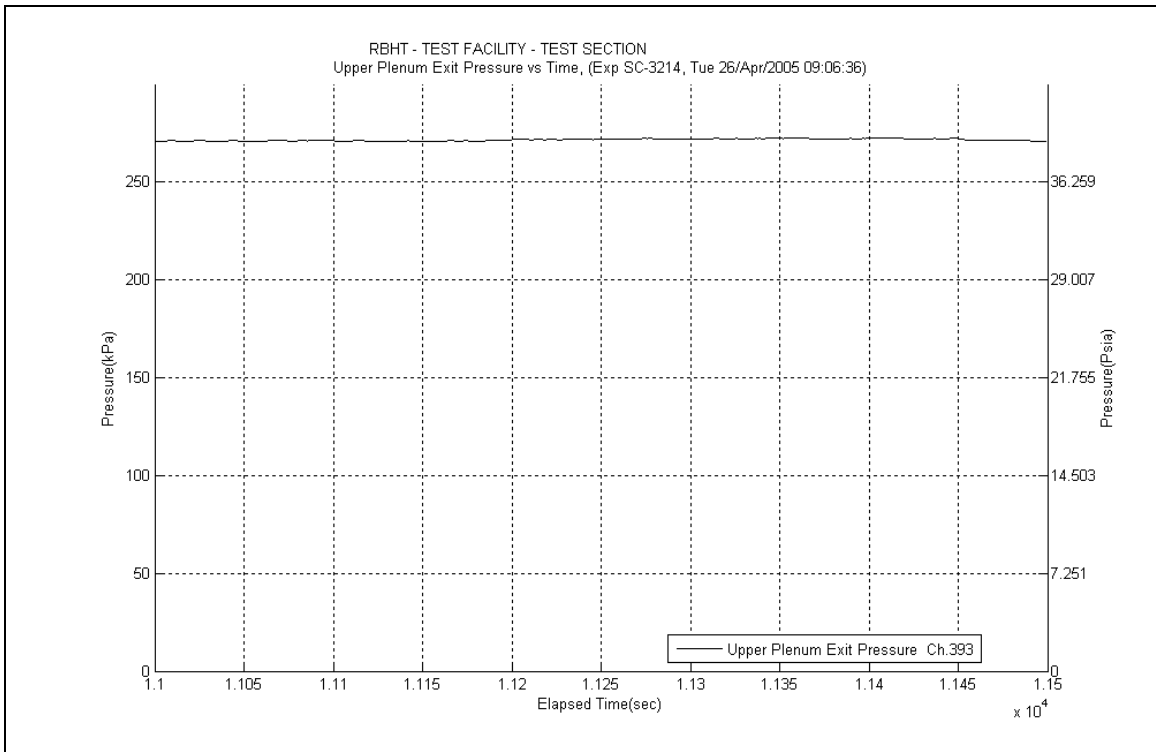
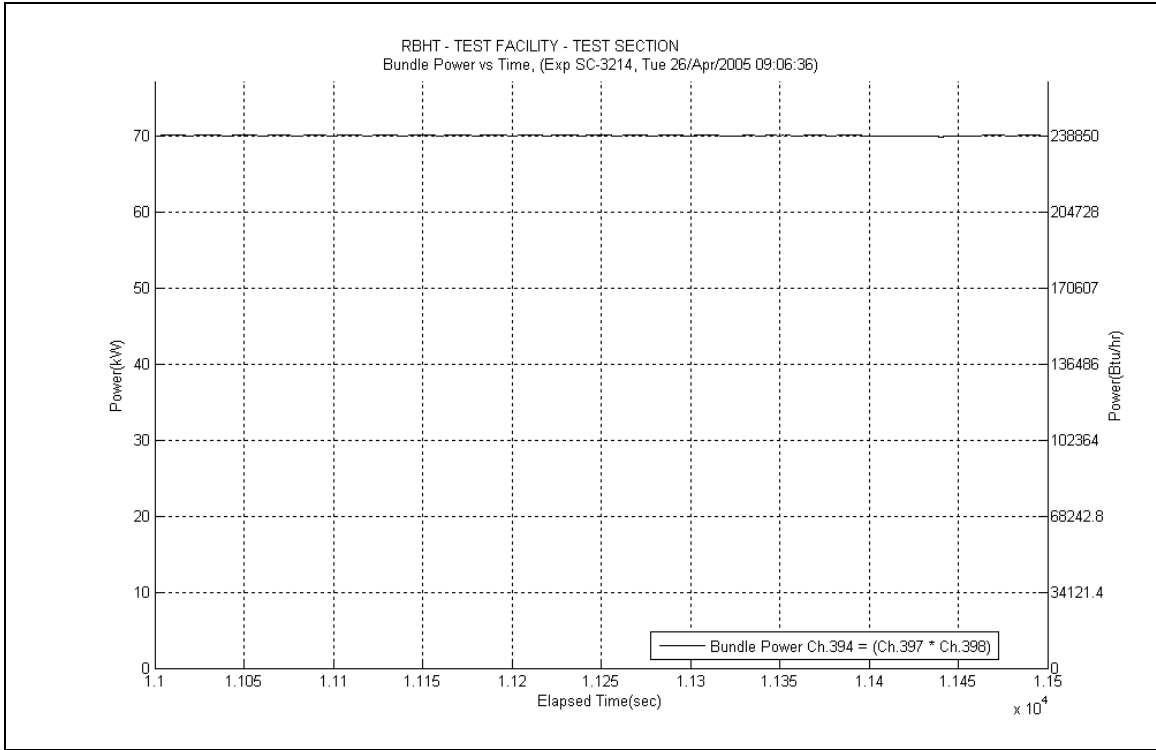
$$T_{cl} = -13.233x^3 + 84.376x^2 - 38.8x + 441.58$$

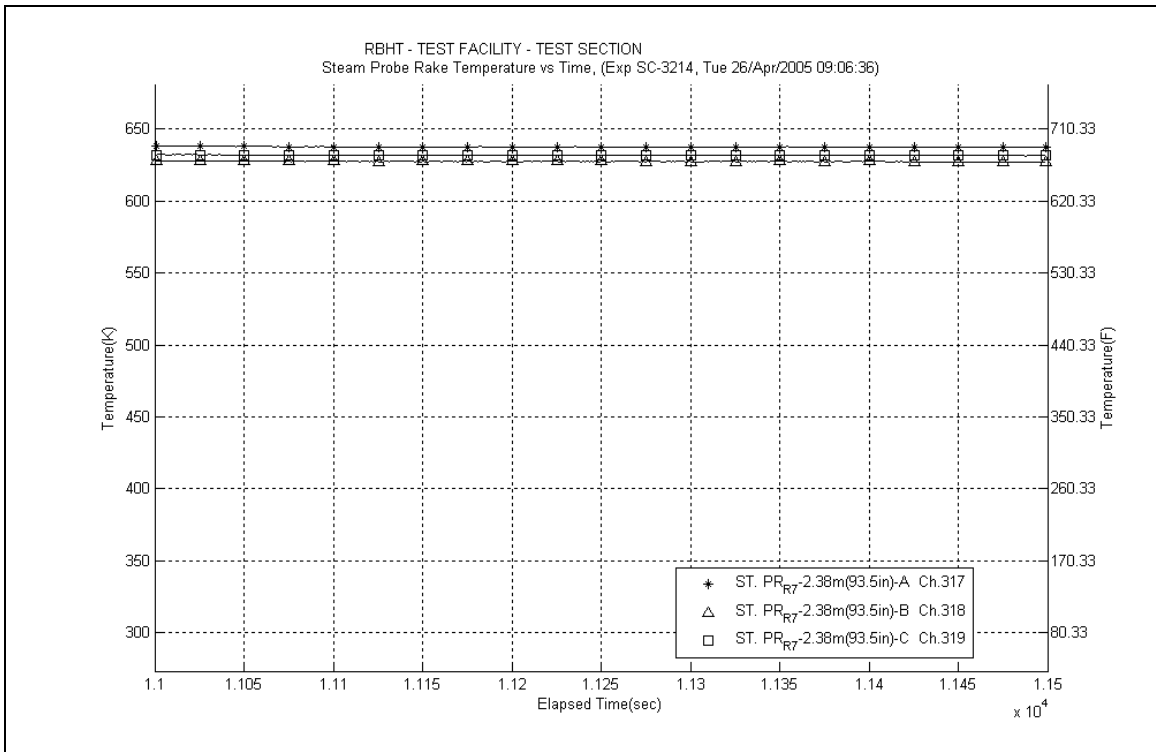
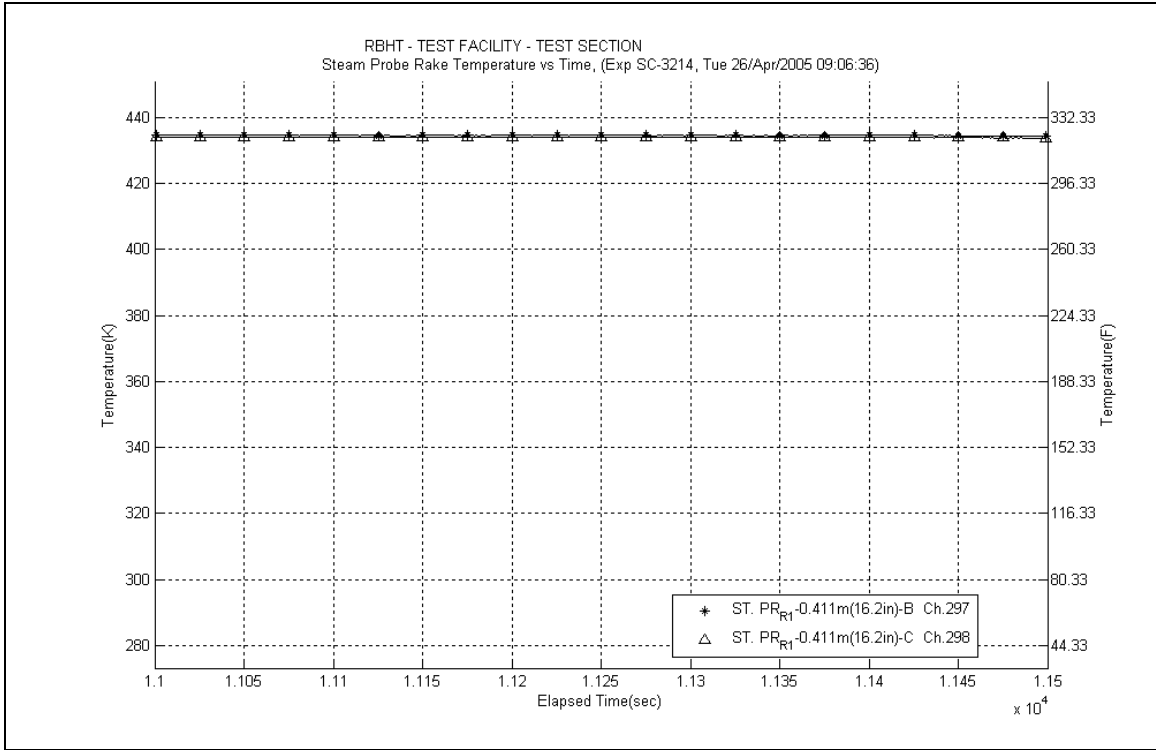
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

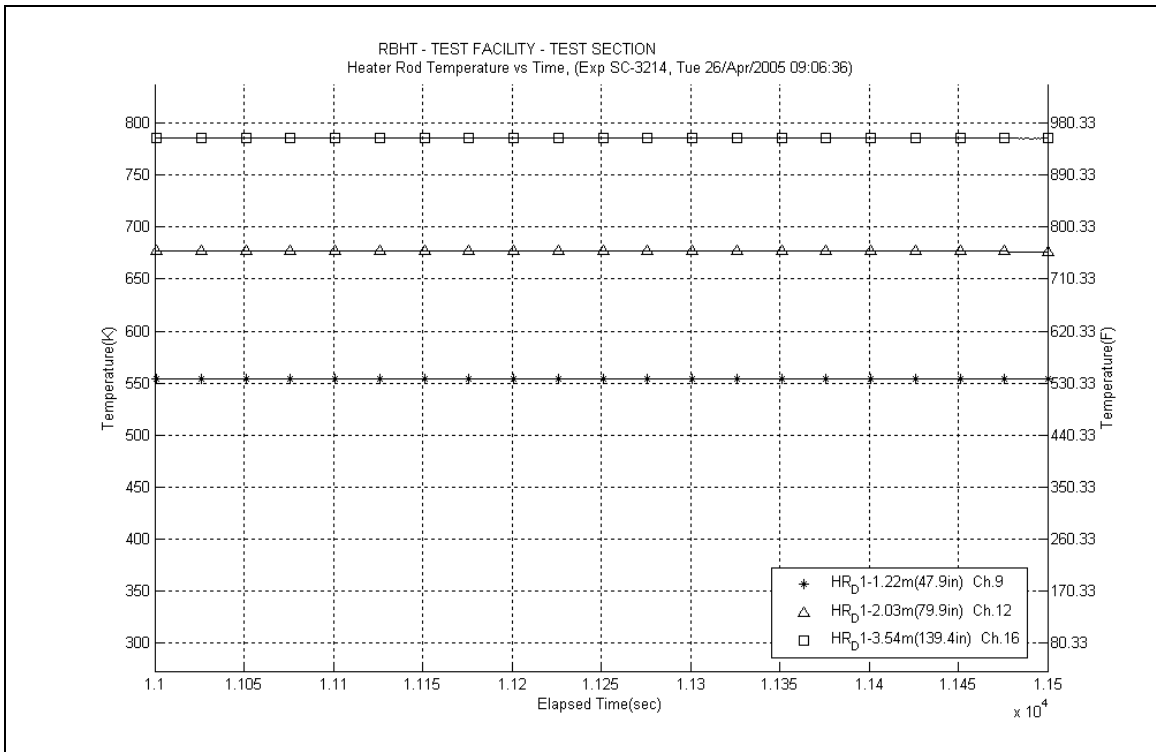
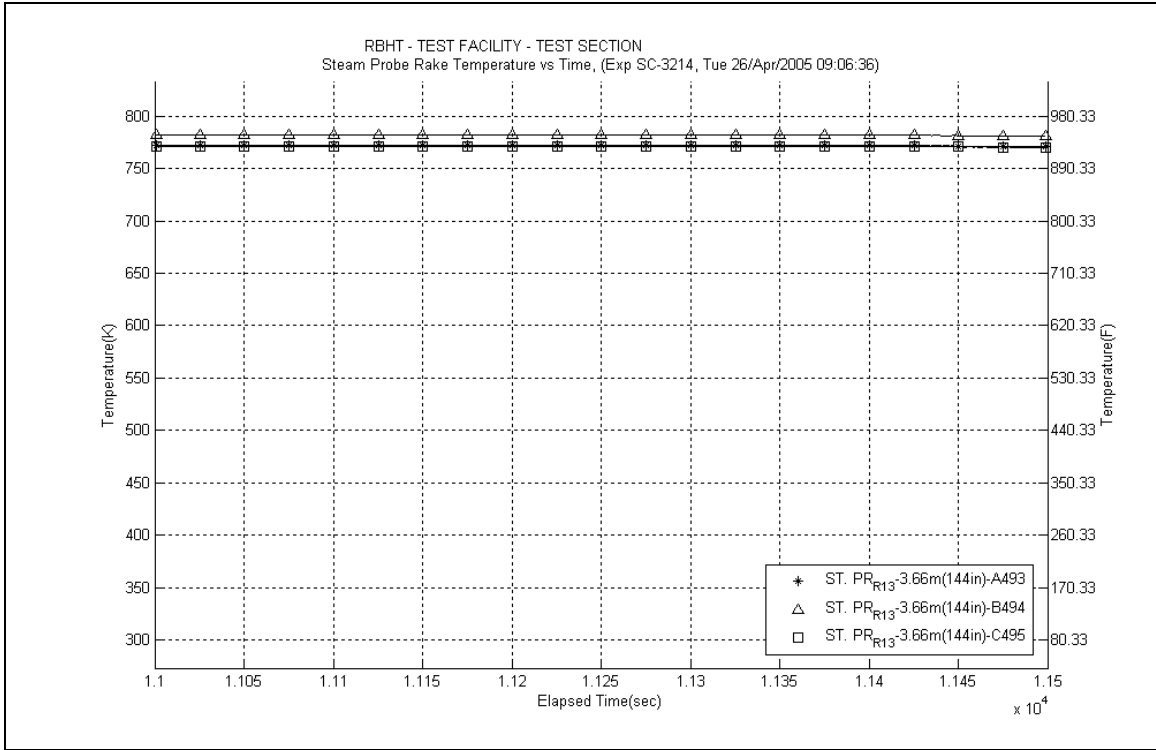
$$T_{cl} = -9.9912x^3 + 67.516x^2 - 20.267x + 434.51$$

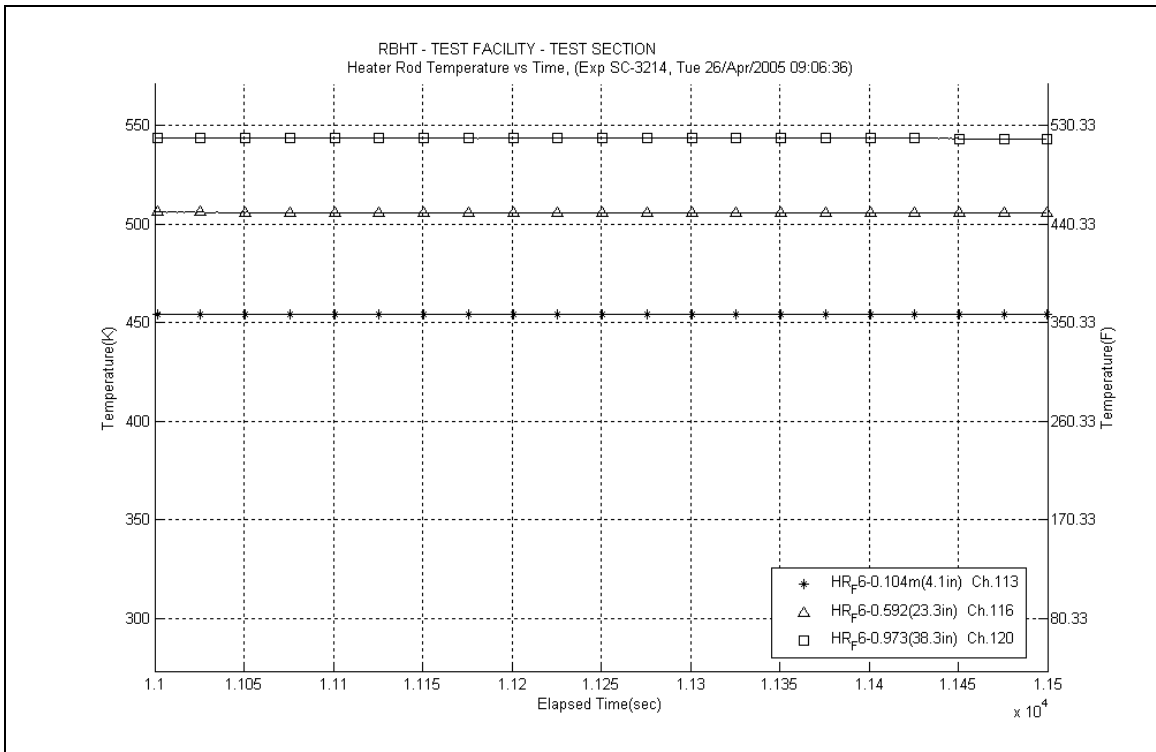
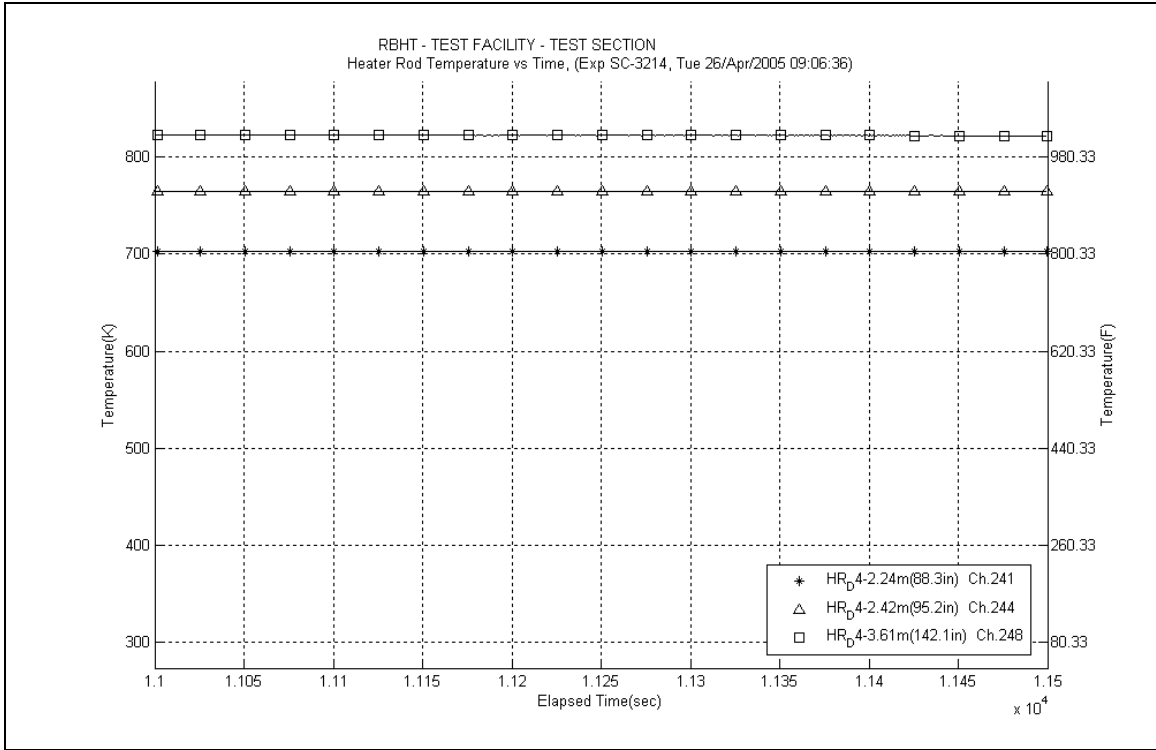
where x is the elevation (m) and T_{cl} is in (K)











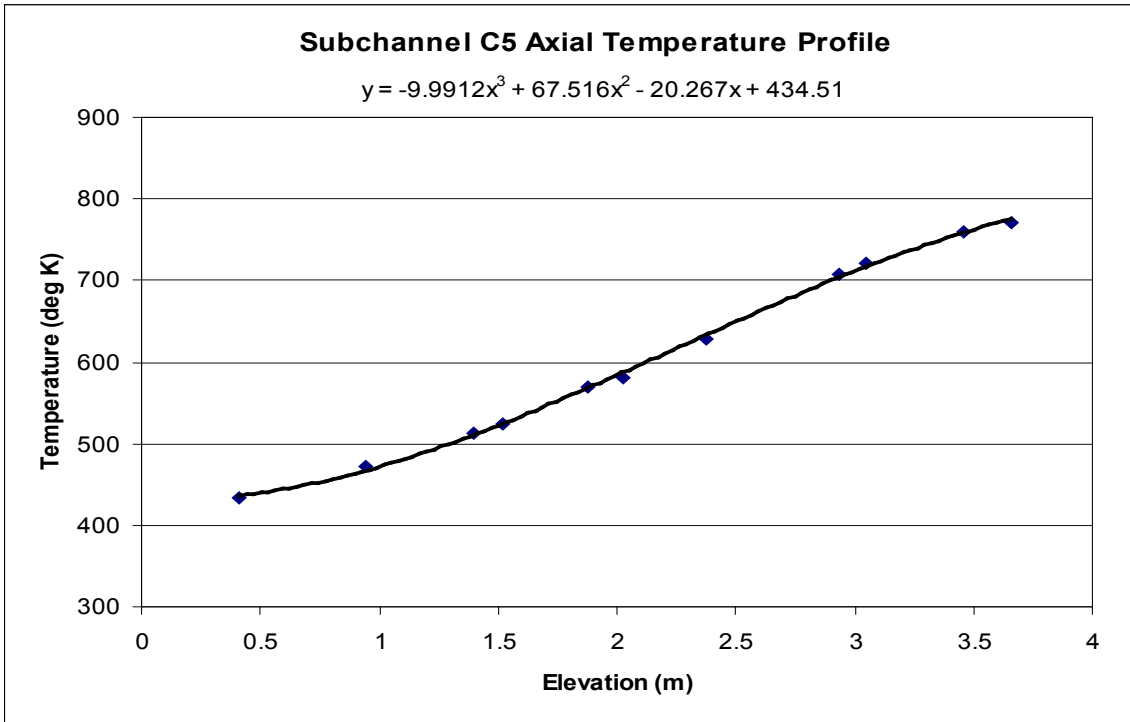
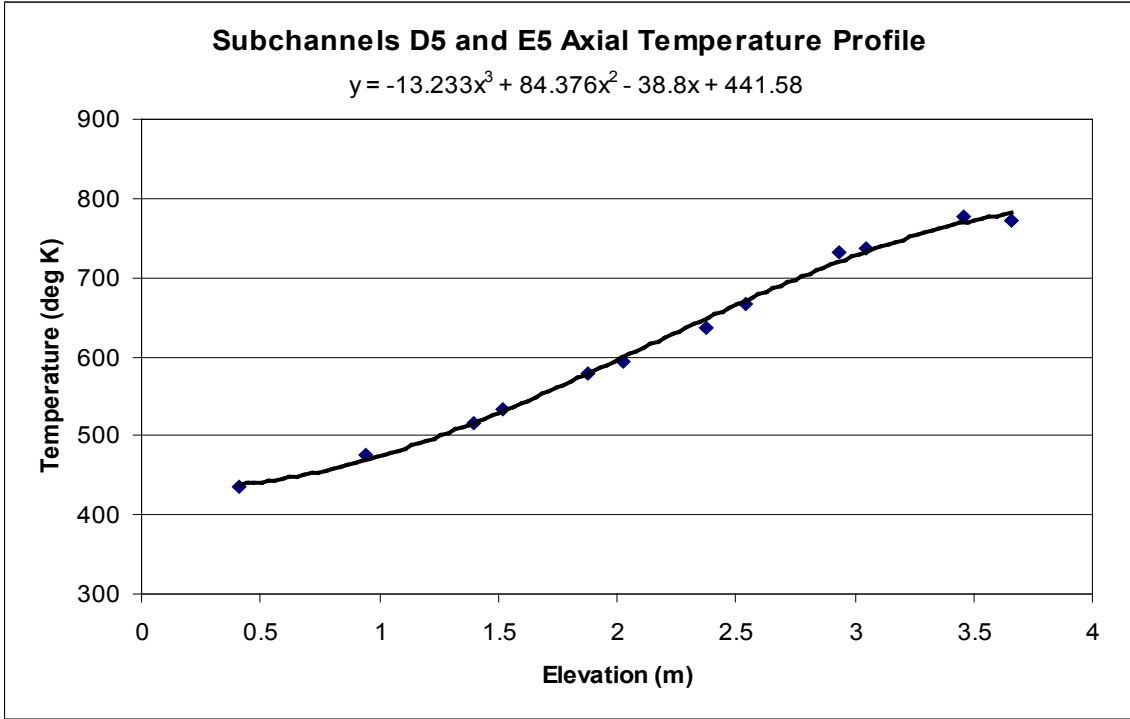


Table SC-3214-A.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h(z) (W/m ² -K)	±σ _{h,c} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	692.1	18761.1	629.7	1.20	640.1	9620	360.94	16.76	4.64%	83.12
RodD3_91.3	186	2.319	0.071	733.1	19161.2	640.3	1.20	655.8	9354	247.83	10.42	4.21%	55.12
RodD3_93.1	187	2.365	0.117	748.6	19398.5	646.7	1.20	663.7	9227	228.27	9.45	4.14%	49.91
RodD3_95.3	188	2.421	0.173	762.3	19693.5	654.4	1.20	672.4	9090	218.90	8.99	4.11%	46.97
RodD3_100.1	189	2.543	0.295	781.1	20328.5	670.9	1.20	689.3	8836	221.22	9.06	4.09%	45.80
RodD3_106.1	190	2.695	0.447	804.0	21127.6	690.8	1.20	709.7	8547	223.89	9.13	4.08%	44.44
RodD3_110	191	2.794	0.546	787.4	20862.5	703.2	1.20	717.2	8445	297.26	12.70	4.27%	58.11
RodD3_142.1	192	3.609	0.218	812.9	7299.3	778.5	1.20	784.2	7644	254.82	15.76	6.19%	43.77
RodC4_88.4	233	2.245	-0.003	697.2	18971.4	630.0	1.20	641.2	9600	339.08	15.36	4.53%	77.89
RodC4_91.1	234	2.314	0.066	733.9	19336.7	639.6	1.20	655.3	9362	246.25	10.31	4.19%	54.83
RodC4_93.4	235	2.372	0.124	748.1	19648.6	647.7	1.20	664.4	9214	234.91	9.73	4.14%	51.28
RodC4_95.3	236	2.421	0.173	762.5	19906.8	654.4	1.20	672.4	9089	220.91	9.05	4.10%	47.40
RodC4_100.1	237	2.543	0.295	777.4	20558.8	670.9	1.20	688.6	8845	231.62	9.51	4.10%	48.02
RodC4_106.1	238	2.695	0.447	798.5	21373.2	690.8	1.20	708.7	8560	238.24	9.76	4.10%	47.38
RodC4_110	239	2.794	0.546	779.5	20682.6	703.2	1.20	715.9	8463	325.16	14.23	4.38%	63.73
RodC4_142.2	240	3.612	0.221	826.5	7908.6	778.6	1.20	786.6	7619	198.38	10.20	5.14%	33.93
RodD4_88.3	241	2.243	-0.005	701.6	18903.0	629.7	1.20	641.7	9593	315.63	14.03	4.45%	72.43
RodD4_91.3	242	2.319	0.071	736.8	19304.5	640.3	1.20	656.4	9344	240.06	10.01	4.17%	53.32
RodD4_93.2	243	2.367	0.119	751.8	19559.5	647.0	1.20	664.5	9214	223.92	9.22	4.12%	48.67
RodD4_95.2	244	2.418	0.170	763.5	19829.2	654.0	1.20	672.3	9091	217.35	8.89	4.09%	46.65
RodD4_100.1	245	2.543	0.295	780.3	20485.2	670.9	1.20	689.1	8838	224.68	9.19	4.09%	46.53
RodD4_106.1	246	2.695	0.447	800.5	21290.2	690.8	1.20	709.1	8555	232.91	9.53	4.09%	46.29
RodD4_110	247	2.794	0.546	781.4	20564.4	703.2	1.20	716.3	8458	315.43	13.74	4.36%	61.78
RodD4_142.1	248	3.609	0.218	822.1	7643.7	778.5	1.20	785.8	7628	210.39	11.36	5.40%	36.04
RodE4_88.4	201	2.245	-0.003	695.7	18619.1	630.0	1.20	641.0	9604	340.29	15.57	4.57%	78.21
RodE4_91.2	202	2.316	0.069	732.0	18980.8	640.0	1.20	655.3	9362	247.47	10.44	4.22%	55.10
RodE4_95.3	204	2.421	0.173	760.8	19508.3	654.4	1.20	672.1	9094	219.92	9.07	4.12%	47.22
RodE4_100.9	205	2.563	0.315	780.7	20228.1	673.6	1.20	691.4	8804	226.56	9.33	4.12%	46.70
RodE4_142.3	208	3.614	0.224	817.3	7725.9	778.8	1.20	785.2	7634	240.84	13.85	5.75%	41.30
RodE3_63.4	193	1.610	0.417	635.4	15423.1	542.6	1.20	558.1	11298	199.58	8.38	4.20%	55.74
RodE3_113.6	194	2.885	0.022	798.5	19007.8	714.2	1.20	728.2	8302	270.76	11.62	4.29%	51.77
RodE3_115.5	195	2.934	0.070	814.0	18304.8	719.8	1.20	735.5	8210	233.32	9.79	4.20%	43.98
RodE3_118.5	196	3.010	0.146	826.0	17191.2	728.3	1.20	744.6	8097	211.31	8.81	4.17%	39.13
RodE3_122.7	197	3.117	0.253	827.5	15633.5	739.6	1.20	754.3	7982	213.45	9.06	4.24%	38.79
RodE3_126.5	198	3.213	0.349	823.5	14222.5	749.0	1.20	761.4	7898	229.11	10.08	4.40%	41.07
RodE3_131.7	199	3.345	-0.046	797.5	12290.7	760.6	1.20	766.7	7837	399.99	23.49	5.87%	70.99
RodE3_135.6	200	3.444	0.053	811.3	10845.2	768.2	1.20	775.4	7741	301.58	16.23	5.38%	52.66

Table SC-3214-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h(z) (W/m ² -K)	±σ _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	634.2	15122.1	543.6	1.20	558.7	11283	200.42	8.48	4.23%	55.89
RodC5_113.6	226	2.885	0.022	793.9	18536.2	714.2	1.20	727.5	8311	278.99	12.17	4.36%	53.43
RodC5_115.7	227	2.939	0.075	813.9	17796.8	720.4	1.20	736.0	8204	228.48	9.65	4.22%	43.03
RodC5_122.7	229	3.117	0.253	826.0	15329.3	739.6	1.20	754.0	7984	212.84	9.10	4.27%	38.70
RodC5_126.7	230	3.218	0.354	824.5	13920.3	749.5	1.20	762.0	7891	222.74	9.81	4.40%	39.89
RodC5_131.6	231	3.343	-0.048	802.0	12190.0	760.4	1.20	767.3	7830	351.41	19.32	5.50%	62.30
RodC5_135.7	232	3.447	0.056	818.2	10745.5	768.4	1.20	776.7	7726	258.88	13.03	5.03%	45.10
RodE5_63.6	209	1.615	0.422	627.7	15492.4	543.3	1.20	557.4	11315	220.28	9.41	4.27%	61.63
RodE5_113.6	210	2.885	0.022	795.7	19120.9	714.2	1.20	727.8	8307	281.41	12.14	4.32%	53.86
RodE5_115.4	211	2.931	0.067	806.4	18463.5	719.5	1.20	734.0	8228	254.91	10.85	4.26%	48.19
RodE5_118.7	212	3.015	0.151	813.4	17256.6	728.9	1.20	743.0	8117	244.94	10.47	4.28%	45.50
RodE5_122.6	213	3.114	0.250	817.8	15831.9	739.4	1.20	752.4	8003	242.12	10.51	4.34%	44.16
RodE5_126.6	214	3.216	0.352	815.3	14371.2	749.3	1.20	760.3	7911	260.99	11.85	4.54%	46.89
RodE5_131.6	215	3.343	-0.048	790.4	12543.2	760.4	1.20	765.4	7852	501.43	33.50	6.68%	89.22
RodE5_135.6	216	3.444	0.053	808.0	11082.0	768.2	1.20	774.8	7747	333.87	18.71	5.60%	58.36
RodC3_79.8	177	2.027	0.227	676.1	17540.5	599.4	1.20	612.2	10132	274.29	12.02	4.38%	67.31
RodC3_85.6	178	2.174	0.374	682.4	18300.9	620.1	1.20	630.5	9791	352.58	16.39	4.65%	82.97
RodC3_88.5	179	2.248	0.000	690.9	18683.9	630.4	1.20	640.5	9613	370.45	17.39	4.69%	85.23
RodC3_92.4	180	2.347	0.099	732.3	19196.5	644.2	1.20	658.9	9304	261.59	11.12	4.25%	57.79
RodC3_94.4	181	2.398	0.150	738.4	19459.5	651.2	1.20	665.7	9193	267.87	11.41	4.26%	58.30
RodC3_97.2	182	2.469	0.221	762.6	18826.0	660.9	1.20	677.9	9005	234.06	9.71	4.15%	49.64
RodC3_108.8	183	2.764	0.516	797.5	20901.8	699.4	1.20	715.8	8465	255.70	10.66	4.17%	50.13
RodD5_50	217	1.270	0.076	587.9	13688.9	501.3	1.20	515.7	12412	189.60	8.05	4.25%	58.89
RodD5_54.1	218	1.374	0.180	609.6	14228.2	513.3	1.20	529.3	12032	177.15	7.38	4.17%	53.16
RodD5_56.9	219	1.445	0.251	617.4	14597.1	521.8	1.20	537.7	11808	183.15	7.64	4.17%	53.81
RodD5_60	220	1.524	0.330	623.7	15004.3	531.6	1.20	546.9	11572	195.41	8.21	4.20%	56.11
RodD5_66.1	221	1.679	0.485	640.9	15806.0	551.7	1.20	566.5	11099	212.57	8.98	4.22%	58.15
RodD5_69.9	222	1.775	-0.025	621.2	16305.7	564.6	1.20	574.0	10928	345.95	16.52	4.77%	92.93
RodD5_72.9	223	1.852	0.051	657.7	16699.0	575.0	1.20	588.8	10606	242.40	10.44	4.31%	62.84
RodD5_74.9	224	1.902	0.102	674.1	16961.5	582.0	1.20	597.4	10427	221.00	9.31	4.21%	56.14

Table SC-3214-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h(z) (W/m ² -K)	±σ _{hic} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	564.6	12446.9	475.3	1.20	490.2	13189	167.37	7.08	4.23%	55.49
RodB5_52.9	154	1.344	0.150	603.0	14027.8	504.9	1.20	521.3	12254	171.69	7.14	4.16%	52.58
RodB5_55	155	1.397	0.203	610.4	14307.0	510.7	1.20	527.3	12086	172.25	7.14	4.15%	51.95
RodB5_57.8	156	1.468	0.274	617.0	14679.0	518.7	1.20	535.0	11879	179.19	7.45	4.16%	53.00
RodB5_64	157	1.626	0.432	633.7	15502.9	537.1	1.20	553.2	11417	192.56	8.03	4.17%	54.44
RodB5_73.9	158	1.877	0.077	664.6	16817.7	568.3	1.20	584.3	10701	209.53	8.76	4.18%	54.90
RodB5_75.9	159	1.928	0.128	677.1	17084.0	574.8	1.20	591.8	10542	200.44	8.30	4.14%	51.59
RodB5_76.9	160	1.953	0.153	681.9	17215.6	578.1	1.20	595.4	10468	199.04	8.22	4.13%	50.80
RodF5_41	105	1.041	0.343	556.8	12367.9	475.3	1.20	488.9	13231	182.10	7.85	4.31%	60.57
RodF5_53.1	106	1.349	0.155	594.8	13975.4	505.5	1.20	520.4	12279	187.68	7.94	4.23%	57.61
RodF5_55	107	1.397	0.203	601.9	14228.3	510.7	1.20	525.9	12125	187.24	7.89	4.21%	56.67
RodF5_57.8	108	1.468	0.274	609.8	14599.7	518.7	1.20	533.9	11910	192.25	8.10	4.21%	57.04
RodF5_64	109	1.626	0.432	626.5	15424.2	537.1	1.20	552.0	11447	207.04	8.76	4.23%	58.70
RodF5_73.8	110	1.875	0.074	651.3	16724.7	568.0	1.20	581.8	10755	240.86	10.36	4.30%	63.49
RodF5_75.8	111	1.925	0.125	662.9	16990.3	574.5	1.20	589.2	10597	230.64	9.80	4.25%	59.74
RodF5_76.8	112	1.951	0.150	666.5	17124.0	577.7	1.20	592.5	10527	231.39	9.83	4.25%	59.46
RodC2_41	57	1.041	0.343	555.9	12427.7	475.3	1.20	488.8	13236	185.05	7.99	4.32%	61.58
RodC2_53.1	58	1.349	0.155	597.5	14034.0	505.5	1.20	520.8	12267	183.04	7.70	4.20%	56.12
RodC2_55	59	1.397	0.203	602.9	14286.9	510.7	1.20	526.1	12120	186.01	7.82	4.20%	56.28
RodC2_57.8	60	1.468	0.274	608.7	14660.8	518.7	1.20	533.7	11915	195.39	8.25	4.22%	57.99
RodC2_63.9	61	1.623	0.429	624.8	15471.7	536.8	1.20	551.4	11460	210.96	8.94	4.24%	59.90
RodC2_73.8	62	1.875	0.074	652.1	16786.5	568.0	1.20	582.0	10752	239.37	10.27	4.29%	63.08
RodC2_75.8	63	1.925	0.125	662.6	17051.9	574.5	1.20	589.1	10598	232.15	9.87	4.25%	60.14
RodC2_76.8	64	1.951	0.150	666.7	17185.9	577.7	1.20	592.6	10526	231.79	9.83	4.24%	59.56
RodC6_40.9	137	1.039	0.340	559.0	12365.8	475.1	1.20	489.1	13225	176.82	7.57	4.28%	58.79
RodC6_52.8	138	1.341	0.147	600.9	14015.6	504.7	1.20	520.7	12270	174.73	7.29	4.17%	53.59
RodC6_54.8	139	1.392	0.198	608.5	14292.9	510.2	1.20	526.6	12107	174.46	7.25	4.16%	52.72
RodC6_57.8	140	1.468	0.274	617.4	14709.0	518.7	1.20	535.1	11877	178.84	7.43	4.15%	52.89
RodC6_63.8	141	1.621	0.427	635.7	15540.5	536.5	1.20	553.0	11421	187.84	7.79	4.15%	53.12
RodC6_73.7	142	1.872	0.072	665.1	16910.5	567.6	1.20	583.9	10711	208.11	8.67	4.17%	54.59
RodC6_75.8	143	1.925	0.125	674.5	17200.9	574.5	1.20	591.1	10556	206.26	8.56	4.15%	53.18
RodC6_76.8	144	1.951	0.150	680.2	17340.4	577.7	1.20	594.8	10480	203.11	8.40	4.13%	51.91

Table SC-3214-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h(z) (W/m ² -K)	±σ _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	690.4	18606.0	616.3	1.20	628.7	9823	301.10	13.32	4.42%	71.15
RodB4_91.3	162	2.319	0.071	728.8	18977.8	626.0	1.20	643.1	9567	221.44	9.18	4.14%	50.65
RodB4_93.3	163	2.370	0.122	740.2	19235.4	632.7	1.20	650.6	9440	214.69	8.84	4.12%	48.30
RodB4_95.1	164	2.416	0.168	754.1	19466.6	638.7	1.20	657.9	9319	202.39	8.26	4.08%	44.81
RodB4_100	165	2.540	0.292	769.8	20095.4	654.9	1.20	674.0	9064	209.81	8.56	4.08%	44.86
RodB4_106	166	2.692	0.445	792.5	20865.5	674.4	1.20	694.1	8766	211.97	8.62	4.07%	43.45
RodB4_109.9	167	2.791	0.544	770.0	20200.1	686.7	1.20	700.6	8673	291.03	12.54	4.31%	58.85
RodB4_142.3	168	3.614	0.224	821.0	7854.0	771.5	1.20	779.8	7692	190.55	9.66	5.07%	33.00
RodF4_85.6	98	2.174	0.374	686.1	18359.8	606.9	1.20	620.1	9981	278.36	12.10	4.35%	67.07
RodF4_88.4	99	2.245	-0.003	692.0	18727.5	616.3	1.20	628.9	9819	297.00	13.05	4.39%	70.14
RodF4_92.4	100	2.347	0.099	734.6	19253.3	629.7	1.20	647.2	9498	220.20	9.08	4.13%	49.92
RodF4_94.3	101	2.395	0.147	748.1	19503.9	636.0	1.20	654.7	9372	208.76	8.53	4.09%	46.54
RodF4_97.2	102	2.469	0.221	763.9	19884.2	645.7	1.20	665.4	9200	201.83	8.20	4.06%	43.97
RodF4_108.8	103	2.764	0.516	792.5	20997.8	683.3	1.20	701.5	8661	230.57	9.45	4.10%	46.54
RodF4_111	104	2.819	-0.044	764.3	20143.8	690.1	1.20	702.5	8646	326.01	14.39	4.41%	65.67
RodD2_103.2	65	2.621	0.373	775.5	20780.2	665.3	1.20	683.7	8918	226.44	9.27	4.09%	47.43
RodD2_106	66	2.692	0.445	784.8	21152.3	674.4	1.20	692.8	8784	229.77	9.40	4.09%	47.22
RodD2_112.6	67	2.860	-0.004	774.9	19407.1	695.1	1.20	708.4	8565	291.92	12.67	4.34%	58.10
RodD2_114.9	68	2.918	0.055	795.7	18510.0	702.1	1.20	717.7	8440	237.17	9.97	4.20%	46.32
RodD2_117.4	69	2.982	0.118	804.9	17532.2	709.5	1.20	725.4	8338	220.63	9.24	4.19%	42.43
RodD2_120.8	70	3.068	0.204	810.4	16202.8	719.3	1.20	734.5	8222	213.44	9.02	4.22%	40.31
RodD2_124.8	71	3.170	0.306	807.2	14637.7	730.4	1.20	743.2	8114	228.81	10.02	4.38%	42.48
RodD2_128.6	72	3.266	0.403	804.3	13150.7	740.5	1.20	751.1	8019	247.27	11.40	4.61%	45.21
RodD6_103.1	129	2.619	0.371	768.6	20807.2	665.0	1.20	682.3	8939	240.97	9.95	4.13%	50.63
RodD6_106	130	2.692	0.445	776.8	21187.2	674.4	1.20	691.4	8804	248.22	10.26	4.13%	51.16
RodD6_112.9	131	2.868	0.004	771.5	19335.3	696.0	1.20	708.6	8562	307.38	13.51	4.40%	61.15
RodD6_114.9	132	2.918	0.055	793.4	18544.9	702.1	1.20	717.3	8445	243.58	10.28	4.22%	47.61
RodD6_116.8	133	2.967	0.103	803.5	17793.8	707.7	1.20	723.7	8360	222.86	9.33	4.18%	43.00
RodD6_120.9	134	3.071	0.207	806.6	16174.5	719.6	1.20	734.1	8227	223.19	9.51	4.26%	42.18
RodD6_124.8	135	3.170	0.306	804.8	14629.6	730.4	1.20	742.8	8119	236.23	10.43	4.42%	43.89
RodD6_128.7	136	3.269	0.405	805.4	13090.2	740.7	1.20	751.5	8014	242.94	11.16	4.59%	44.39

Table SC-3214-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h(z) (W/m ² -K)	±σ _{hic} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	582.0	13734.8	497.5	1.20	511.6	12533	194.96	8.32	4.27%	61.20
RodE2_54	74	1.372	0.178	599.8	14258.7	508.0	1.20	523.3	12199	186.33	7.83	4.20%	56.78
RodE2_56.9	75	1.445	0.251	609.9	14648.7	516.1	1.20	531.7	11967	187.43	7.84	4.18%	55.90
RodE2_59.9	76	1.521	0.328	616.1	15051.5	524.8	1.20	540.0	11749	197.78	8.31	4.20%	57.78
RodE2_66	77	1.676	0.483	631.0	15870.5	543.2	1.20	557.8	11304	216.96	9.19	4.23%	60.63
RodE2_69.8	78	1.773	-0.027	611.4	16380.7	555.1	1.20	564.5	11146	349.35	16.70	4.78%	96.05
RodE2_72.9	79	1.852	0.051	647.4	16796.6	565.0	1.20	578.8	10822	244.67	10.49	4.29%	64.97
RodE2_74.9	80	1.902	0.102	662.2	17066.1	571.5	1.20	586.6	10651	225.78	9.53	4.22%	58.84
RodB3_50.2	169	1.275	0.081	578.2	13655.6	497.7	1.20	511.1	12545	203.58	8.79	4.32%	63.98
RodB3_54.1	170	1.374	0.180	589.0	14173.4	508.2	1.20	521.7	12242	210.50	9.08	4.31%	64.40
RodB3_56.9	171	1.445	0.251	598.0	14546.0	516.1	1.20	529.7	12020	212.99	9.16	4.30%	63.85
RodB3_60.1	172	1.527	0.333	603.8	14970.2	525.4	1.20	538.4	11790	229.06	9.94	4.34%	67.18
RodB3_66.1	173	1.679	0.485	626.7	15767.4	543.5	1.20	557.4	11315	227.38	9.74	4.29%	63.61
RodB3_69.9	174	1.775	-0.025	609.5	16271.6	555.4	1.20	564.5	11147	360.98	17.53	4.86%	99.25
RodB3_73	175	1.854	0.054	643.9	16684.6	565.4	1.20	578.5	10829	254.86	11.06	4.34%	67.73
RodB3_75	176	1.905	0.105	658.9	16950.7	571.8	1.20	586.4	10658	233.74	9.96	4.26%	60.95
RodF3_50.1	89	1.273	0.079	586.0	13658.7	497.5	1.20	512.2	12513	185.09	7.84	4.23%	58.00
RodF3_54	90	1.372	0.178	602.6	14187.8	508.0	1.20	523.7	12186	179.92	7.53	4.18%	54.76
RodF3_57	91	1.448	0.254	610.4	14595.6	516.4	1.20	532.0	11959	186.30	7.80	4.19%	55.52
RodF3_60	92	1.524	0.330	617.6	15000.6	525.1	1.20	540.5	11736	194.60	8.17	4.20%	56.78
RodF3_66.1	93	1.679	0.485	627.1	15830.3	543.5	1.20	557.5	11313	227.16	9.72	4.28%	63.54
RodF3_70	94	1.778	-0.022	616.5	16358.1	555.8	1.20	565.9	11114	323.02	15.04	4.66%	88.51
RodF3_73	95	1.854	0.054	652.8	16766.2	565.4	1.20	579.9	10796	230.02	9.78	4.25%	60.91
RodF3_75	96	1.905	0.105	670.9	17036.8	571.8	1.20	588.4	10615	206.49	8.59	4.16%	53.59
RodE6_50.2	121	1.275	0.081	582.3	13648.0	497.7	1.20	511.8	12525	193.75	8.28	4.27%	60.78
RodE6_54.1	122	1.374	0.180	599.2	14161.4	508.2	1.20	523.4	12195	186.80	7.87	4.21%	56.90
RodE6_57	123	1.448	0.254	607.0	14543.5	516.4	1.20	531.5	11974	192.54	8.12	4.22%	57.46
RodE6_60.2	124	1.529	0.335	613.9	14964.3	525.7	1.20	540.4	11739	203.49	8.62	4.24%	59.39
RodE6_66.1	125	1.679	0.485	631.5	15738.8	543.5	1.20	558.2	11296	214.75	9.10	4.24%	59.96
RodE6_70	126	1.778	-0.022	612.7	16250.1	555.8	1.20	565.3	11129	342.29	16.31	4.77%	93.93
RodE6_73.1	127	1.857	0.056	648.8	16658.5	565.7	1.20	579.5	10805	240.56	10.35	4.30%	63.76
RodE6_75	128	1.905	0.105	662.8	16908.2	571.8	1.20	587.0	10644	223.16	9.43	4.23%	58.10

RBHT Steam Cooling Test SC-3214-B

Matrix test # 8

Test date – 4/26/2005

Steady state time window: 12800 - 13800 sec

Inlet flow: 4.81 m³/min (169.8 ft³/min)

Inlet steam temperature: 419 K (294 °F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 95.0 kW

Outlet steam temperature: 770 K (927 °F)

Bundle inlet Reynolds number: 18198

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

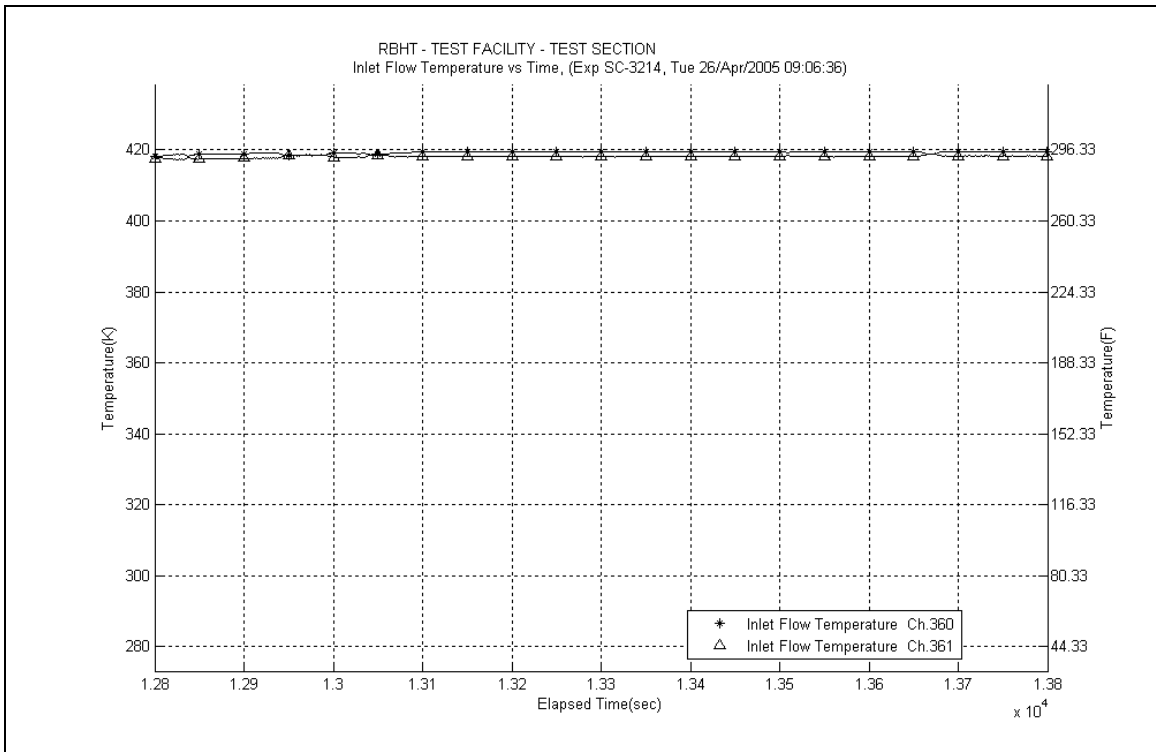
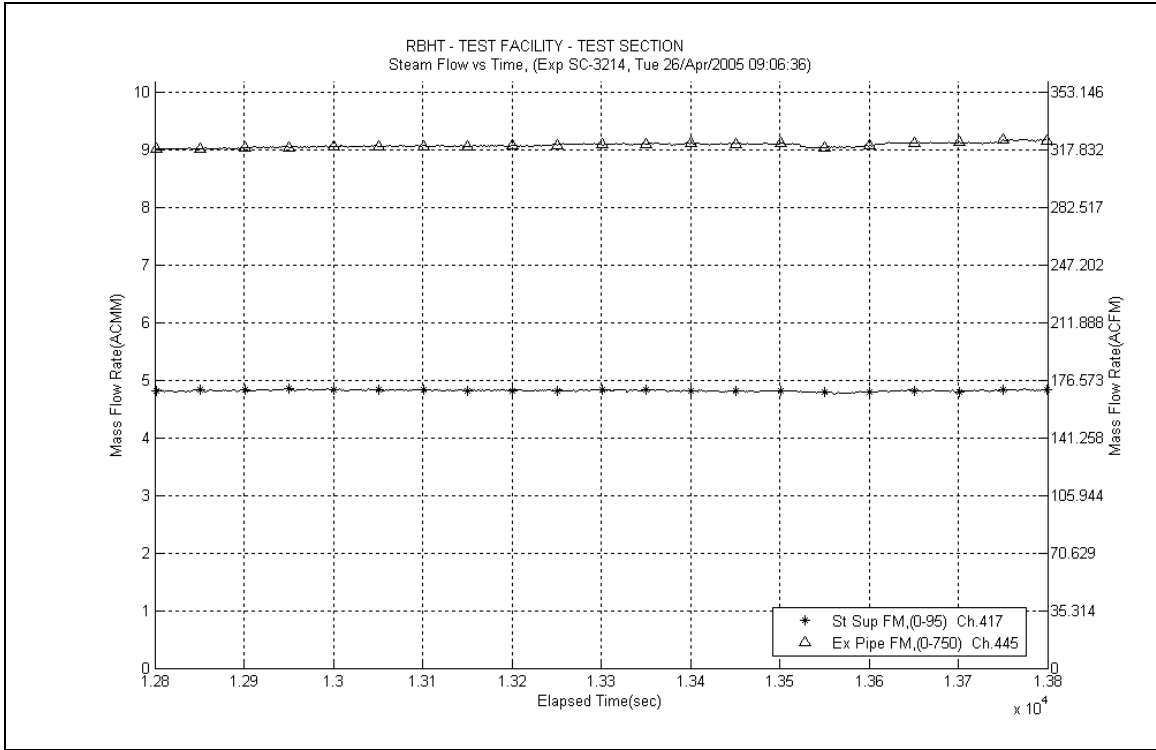
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

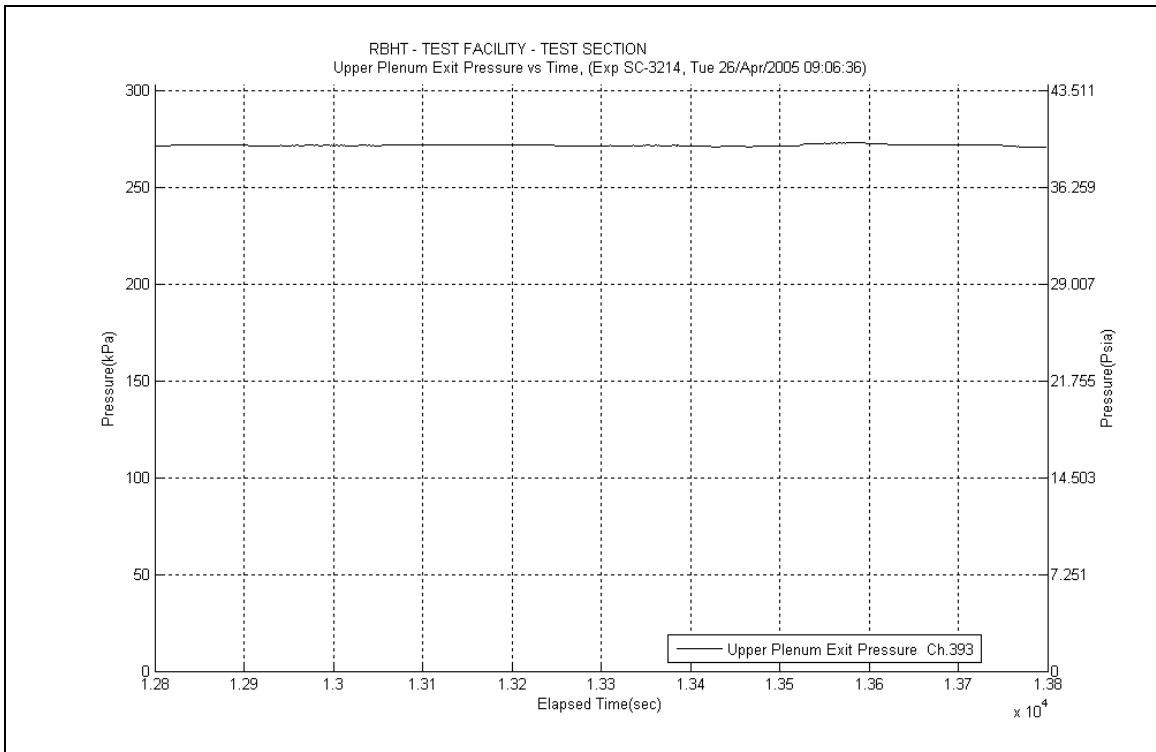
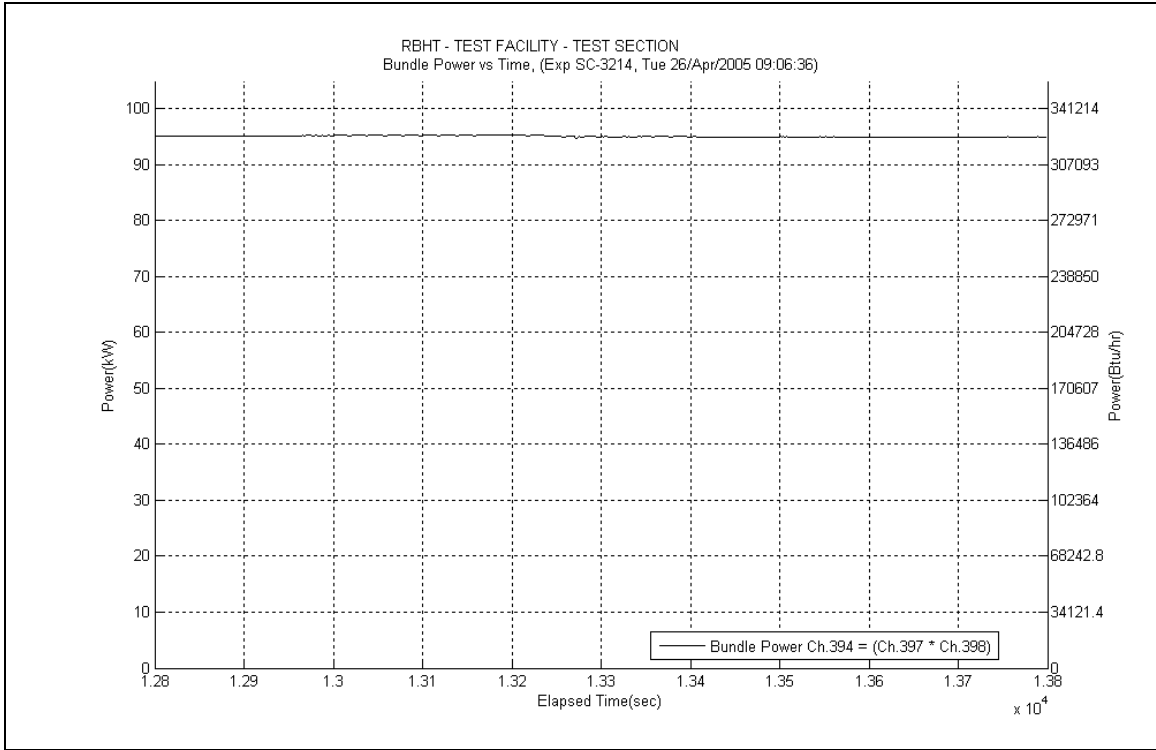
$$T_{cl} = -13.119x^3 + 83.696x^2 - 39.122x + 442.54$$

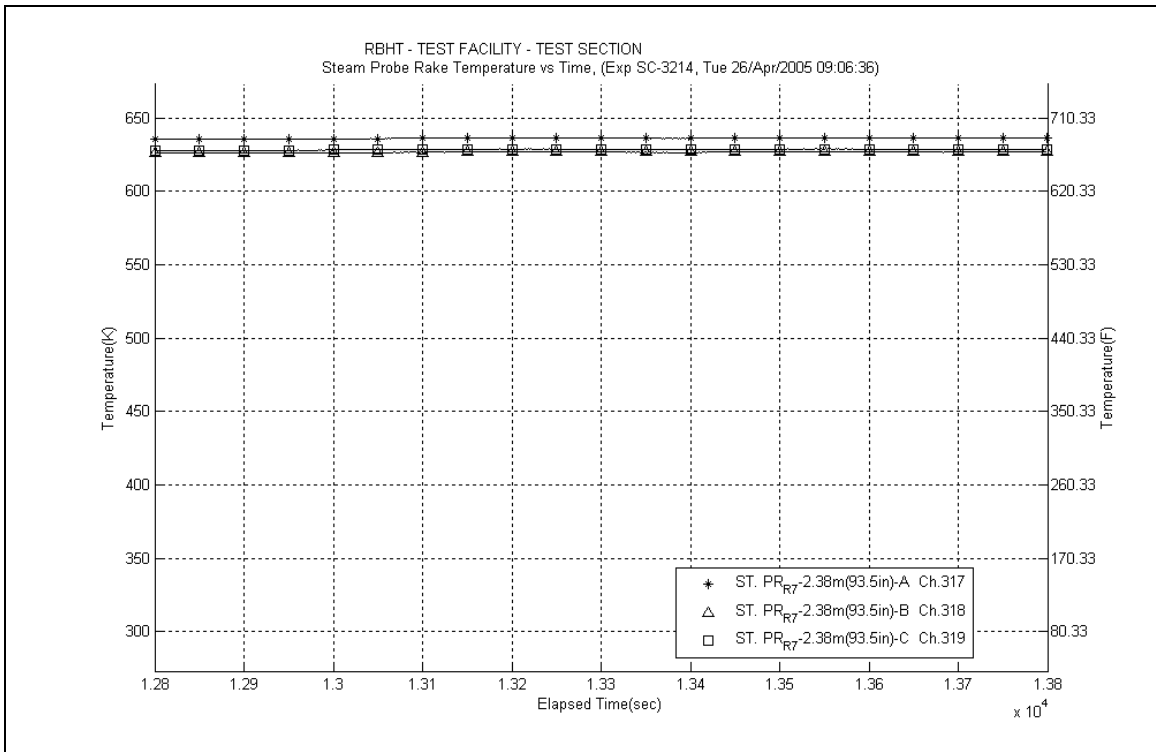
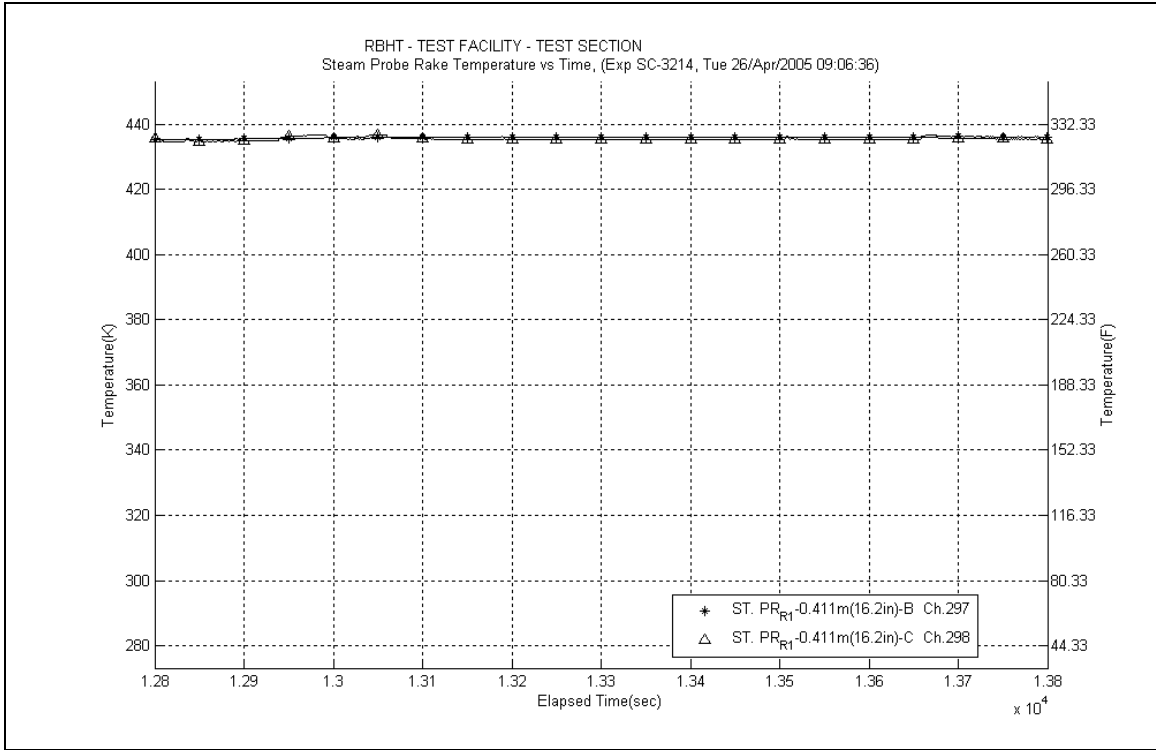
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

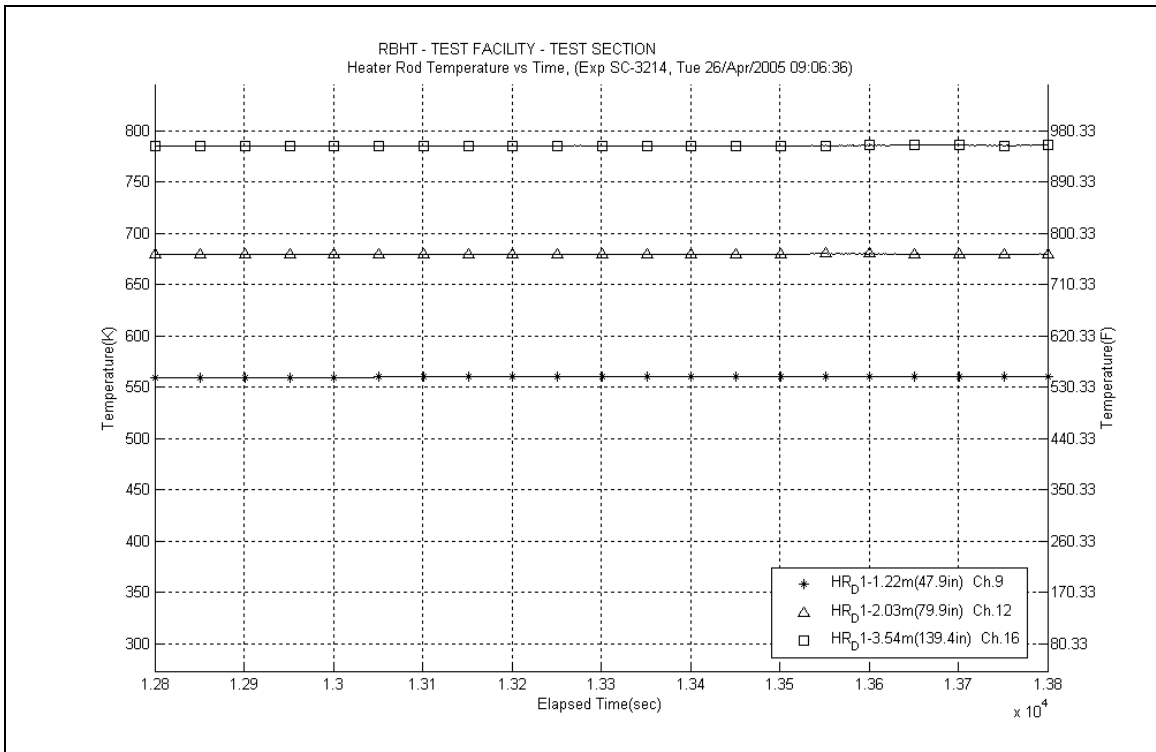
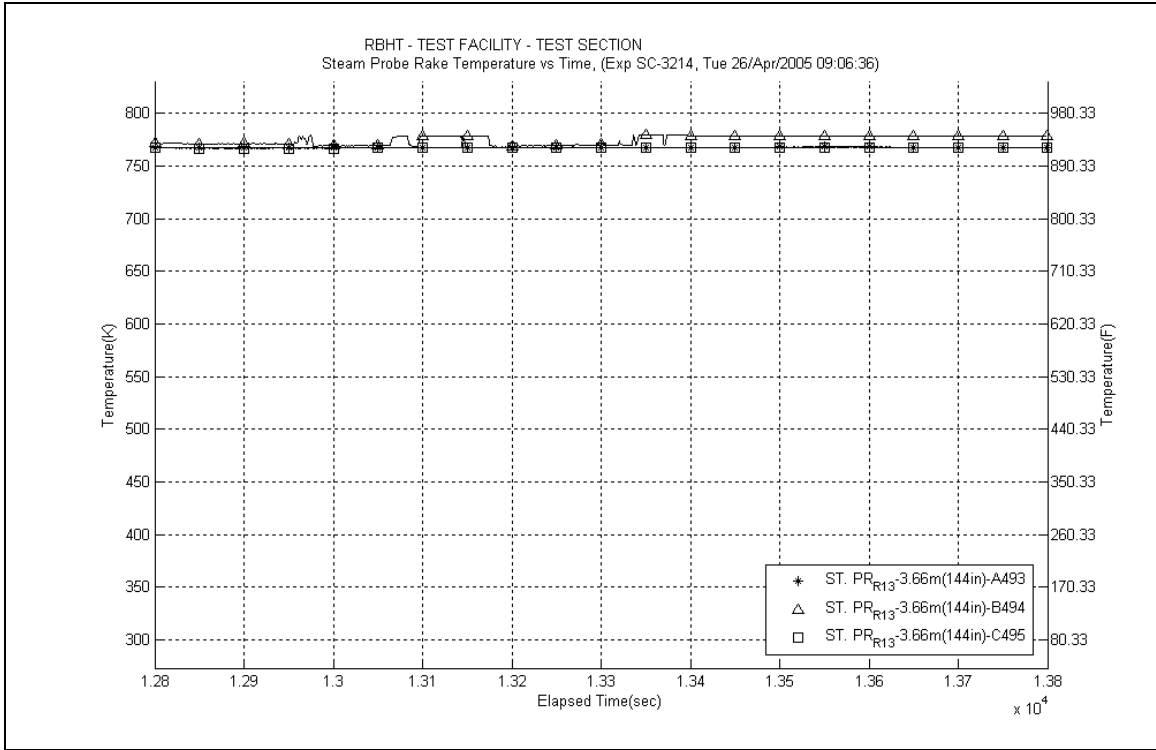
$$T_{cl} = -8.1355x^3 + 57.708x^2 - 7.379x + 431.3$$

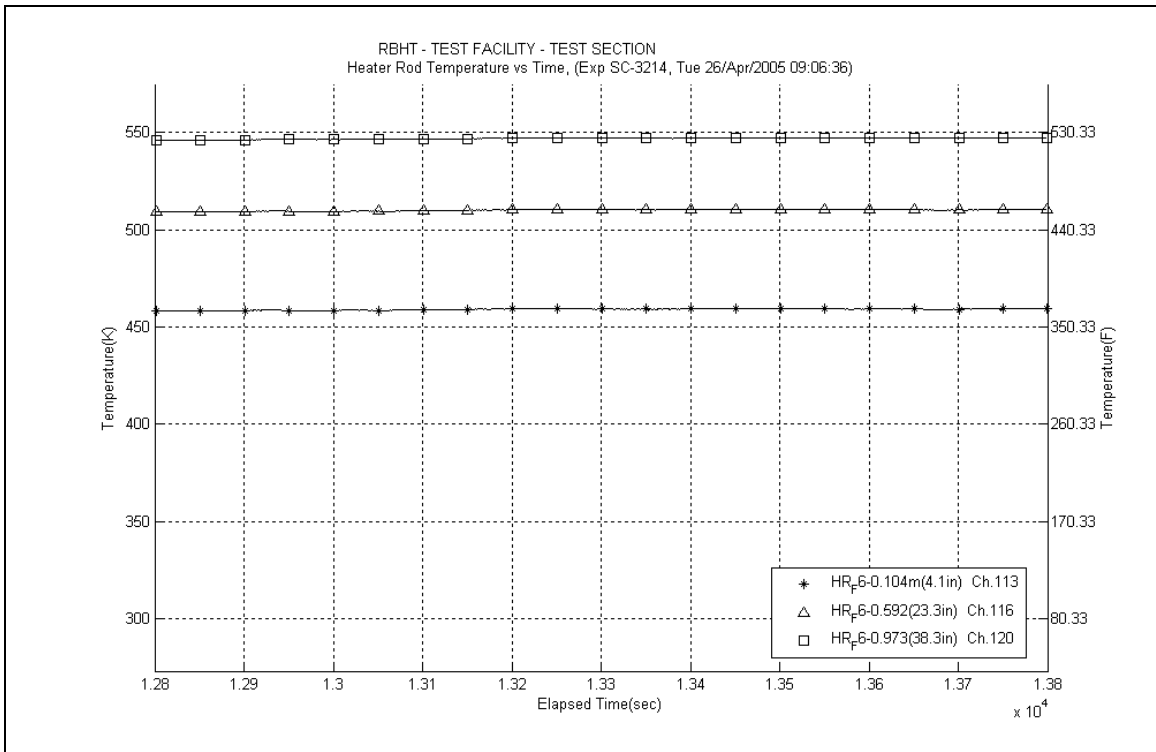
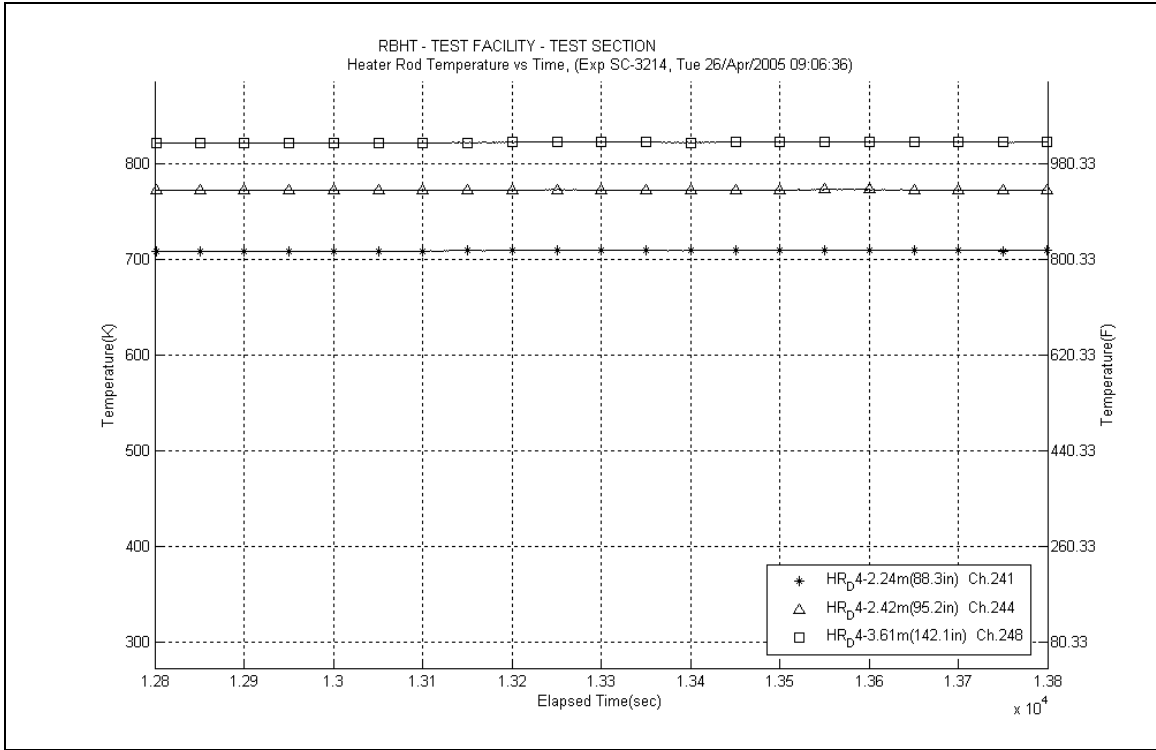
where x is the elevation (m) and T_{cl} is in (K)











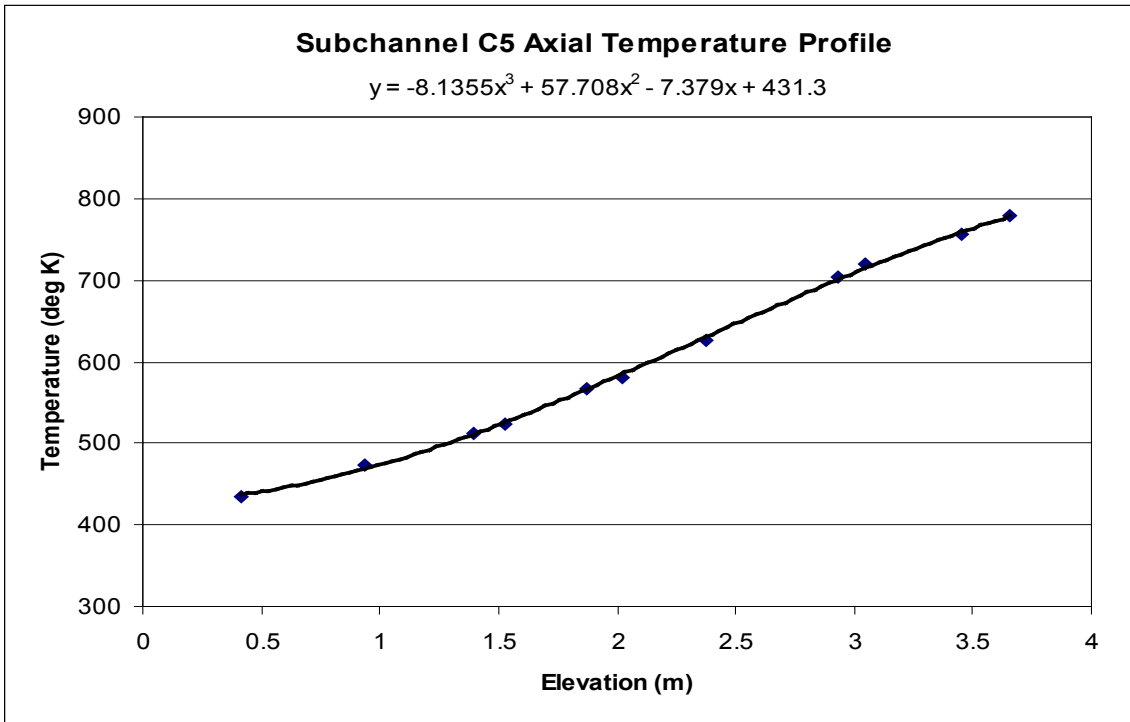
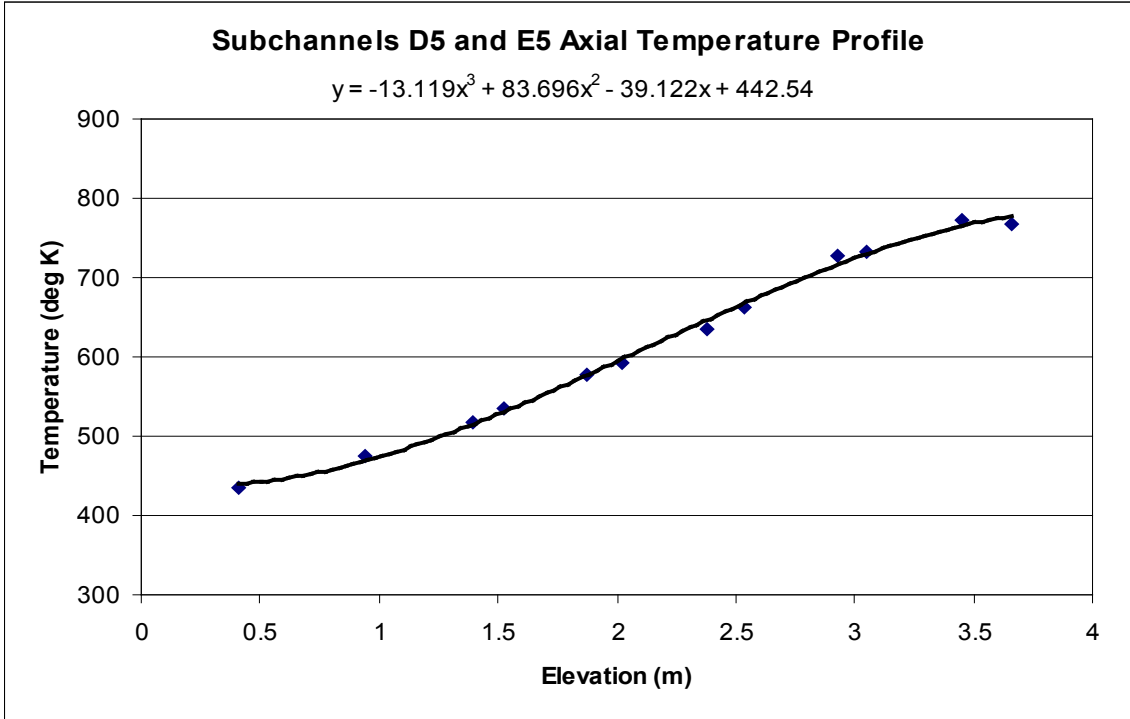


Table SC-3214-B.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h(z) (W/m ² -K)	±σ _{h,c} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	697.4	25436.9	627.8	1.20	639.4	13626	438.45	18.92	4.31%	101.13
RodD3_91.3	186	2.319	0.071	741.4	25976.4	638.3	1.20	655.5	13240	302.48	11.92	3.94%	67.32
RodD3_93.1	187	2.365	0.117	757.5	26300.4	644.6	1.20	663.4	13068	279.43	10.86	3.89%	61.13
RodD3_95.3	188	2.421	0.173	770.0	26697.6	652.2	1.20	671.8	12871	271.83	10.50	3.86%	58.40
RodD3_100.1	189	2.543	0.295	786.7	27564.1	668.5	1.20	688.2	12521	279.80	10.81	3.86%	58.06
RodD3_106.1	190	2.695	0.447	809.2	28644.1	688.2	1.20	708.4	12117	284.08	10.94	3.85%	56.54
RodD3_110	191	2.794	0.546	793.0	28288.4	700.5	1.20	715.9	11973	366.97	14.72	4.01%	71.93
RodD3_142.1	192	3.609	0.218	812.6	9872.2	774.8	1.20	781.1	10861	313.36	17.85	5.70%	54.14
RodC4_88.4	233	2.245	-0.003	702.8	25731.1	628.2	1.20	640.6	13596	413.65	17.47	4.22%	95.15
RodC4_91.1	234	2.314	0.066	742.3	26227.8	637.6	1.20	655.1	13250	300.61	11.80	3.93%	66.97
RodC4_93.4	235	2.372	0.124	757.9	26651.3	645.6	1.20	664.3	13037	284.83	11.07	3.88%	62.19
RodC4_95.3	236	2.421	0.173	772.2	27001.4	652.2	1.20	672.2	12863	269.96	10.39	3.85%	57.95
RodC4_100.1	237	2.543	0.295	783.4	27884.9	668.5	1.20	687.6	12532	291.21	11.28	3.87%	60.50
RodC4_106.1	238	2.695	0.447	804.2	28989.5	688.2	1.20	707.5	12133	299.88	11.60	3.87%	59.79
RodC4_110	239	2.794	0.546	785.4	28056.2	700.5	1.20	714.6	11997	396.45	16.21	4.09%	77.91
RodC4_142.2	240	3.612	0.221	826.0	10704.9	775.0	1.20	783.5	10825	251.67	12.19	4.84%	43.29
RodD4_88.3	241	2.243	-0.005	707.3	25634.9	627.8	1.20	641.0	13585	387.05	16.08	4.16%	88.94
RodD4_91.3	242	2.319	0.071	743.7	26180.9	638.3	1.20	655.9	13231	298.08	11.70	3.92%	66.29
RodD4_93.2	243	2.367	0.119	759.5	26527.8	644.9	1.20	664.0	13044	277.77	10.76	3.88%	60.69
RodD4_95.2	244	2.418	0.170	770.5	26892.2	651.8	1.20	671.6	12875	271.90	10.49	3.86%	58.44
RodD4_100.1	245	2.543	0.295	785.9	27785.0	668.5	1.20	688.1	12524	283.96	10.97	3.86%	58.94
RodD4_106.1	246	2.695	0.447	804.4	28878.0	688.2	1.20	707.6	12132	298.12	11.53	3.87%	59.43
RodD4_110	247	2.794	0.546	786.1	27891.4	700.5	1.20	714.7	11995	391.02	15.97	4.09%	76.83
RodD4_142.1	248	3.609	0.218	821.4	10345.8	774.8	1.20	782.6	10839	266.45	13.51	5.07%	45.91
RodE4_88.4	201	2.245	-0.003	700.8	25249.3	628.2	1.20	640.3	13605	417.17	17.79	4.26%	96.03
RodE4_91.2	202	2.316	0.069	738.5	25736.8	638.0	1.20	654.7	13258	307.20	12.17	3.96%	68.49
RodE4_95.3	204	2.421	0.173	766.2	26451.8	652.2	1.20	671.2	12885	278.39	10.82	3.89%	59.89
RodE4_100.9	205	2.563	0.315	782.4	27429.4	671.2	1.20	689.7	12490	295.92	11.54	3.90%	61.21
RodE4_142.3	208	3.614	0.224	816.6	10453.9	775.1	1.20	782.0	10848	302.29	16.25	5.38%	52.14
RodE3_63.4	193	1.610	0.417	636.3	20907.3	541.8	1.20	557.5	16001	265.60	10.60	3.99%	74.28
RodE3_113.6	194	2.885	0.022	803.7	25772.3	711.3	1.20	726.7	11771	334.78	13.47	4.02%	64.21
RodE3_115.5	195	2.934	0.070	820.3	24814.3	716.9	1.20	734.1	11639	288.01	11.35	3.94%	54.44
RodE3_118.5	196	3.010	0.146	831.4	23301.0	725.3	1.20	743.0	11483	263.56	10.34	3.92%	48.96
RodE3_122.7	197	3.117	0.253	827.0	21184.4	736.4	1.20	751.5	11337	280.63	11.32	4.03%	51.27
RodE3_126.5	198	3.213	0.349	823.0	19270.1	745.7	1.20	758.6	11219	299.10	12.51	4.18%	53.91
RodE3_131.7	199	3.345	-0.046	797.1	16651.9	757.2	1.20	763.8	11134	500.01	27.39	5.48%	89.23
RodE3_135.6	200	3.444	0.053	811.7	14687.5	764.6	1.20	772.5	10995	374.22	18.78	5.02%	65.70

Table SC-3214-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h(z) (W/m ² -K)	±σ _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	637.2	20507.0	542.8	1.20	558.5	15968	260.67	10.44	4.00%	72.73
RodC5_113.6	226	2.885	0.022	801.7	25139.1	711.3	1.20	726.4	11778	333.91	13.53	4.05%	64.09
RodC5_115.7	227	2.939	0.075	821.5	24132.8	717.4	1.20	734.8	11627	278.41	10.99	3.95%	52.55
RodC5_122.7	229	3.117	0.253	827.4	20780.7	736.4	1.20	751.6	11336	274.13	11.07	4.04%	50.08
RodC5_126.7	230	3.218	0.354	827.5	18866.1	746.2	1.20	759.8	11200	278.49	11.52	4.14%	50.09
RodC5_131.6	231	3.343	-0.048	803.8	16519.0	757.0	1.20	764.8	11119	423.06	21.31	5.04%	75.36
RodC5_135.7	232	3.447	0.056	820.9	14557.9	764.8	1.20	774.2	10969	311.39	14.46	4.64%	54.50
RodE5_63.6	209	1.615	0.422	629.9	21011.4	542.5	1.20	557.0	16019	288.33	11.68	4.05%	80.74
RodE5_113.6	210	2.885	0.022	802.3	25932.0	711.3	1.20	726.5	11776	341.91	13.79	4.03%	65.61
RodE5_115.4	211	2.931	0.067	813.8	25038.9	716.6	1.20	732.8	11662	309.11	12.30	3.98%	58.58
RodE5_118.7	212	3.015	0.151	820.8	23401.7	725.8	1.20	741.7	11505	295.61	11.81	3.99%	55.05
RodE5_122.6	213	3.114	0.250	819.5	21465.2	736.2	1.20	750.1	11362	308.99	12.68	4.10%	56.61
RodE5_126.6	214	3.216	0.352	815.2	19479.8	746.0	1.20	757.5	11237	337.85	14.56	4.31%	61.02
RodE5_131.6	215	3.343	-0.048	790.6	16998.8	757.0	1.20	762.6	11154	607.01	36.95	6.09%	108.59
RodE5_135.6	216	3.444	0.053	810.0	15014.5	764.6	1.20	772.2	11000	397.25	20.28	5.11%	69.78
RodC3_79.8	177	2.027	0.227	677.9	23785.5	597.9	1.20	611.2	14360	356.51	14.81	4.15%	87.68
RodC3_85.6	178	2.174	0.374	686.7	24820.9	618.3	1.20	629.7	13870	435.70	18.91	4.34%	102.71
RodC3_88.5	179	2.248	0.000	696.1	25337.0	628.5	1.20	639.8	13617	449.63	19.58	4.36%	103.62
RodC3_92.4	180	2.347	0.099	737.9	26031.8	642.1	1.20	658.1	13179	326.05	13.03	4.00%	72.16
RodC3_94.4	181	2.398	0.150	743.6	26388.7	649.1	1.20	664.8	13026	335.01	13.42	4.01%	73.06
RodC3_97.2	182	2.469	0.221	767.4	26888.0	658.7	1.20	676.8	12762	296.73	11.61	3.91%	63.07
RodC3_108.8	183	2.764	0.516	804.2	28349.6	696.7	1.20	714.7	11996	316.50	12.40	3.92%	62.19
RodD5_50	217	1.270	0.076	593.5	18565.9	501.0	1.20	516.4	17531	240.84	9.65	4.01%	74.68
RodD5_54.1	218	1.374	0.180	612.2	19296.3	512.8	1.20	529.4	17020	232.89	9.21	3.96%	69.88
RodD5_56.9	219	1.445	0.251	617.9	19796.7	521.2	1.20	537.3	16719	245.69	9.76	3.97%	72.25
RodD5_60	220	1.524	0.330	626.2	20349.0	530.9	1.20	546.8	16377	256.24	10.21	3.99%	73.60
RodD5_66.1	221	1.679	0.485	645.4	21437.3	550.7	1.20	566.5	15703	271.62	10.84	3.99%	74.32
RodD5_69.9	222	1.775	-0.025	624.6	22115.1	563.5	1.20	573.7	15470	434.49	19.46	4.48%	116.81
RodD5_72.9	223	1.852	0.051	663.2	22650.4	573.8	1.20	588.7	15006	303.92	12.30	4.05%	78.81
RodD5_74.9	224	1.902	0.102	678.5	23005.8	580.7	1.20	597.0	14761	282.18	11.23	3.98%	71.74

Table SC-3214-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h(z) (W/m ² -K)	±σ _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	568.0	16879.3	477.0	1.20	492.2	18569	222.54	8.95	4.02%	73.41
RodB5_52.9	154	1.344	0.150	604.7	19024.3	505.8	1.20	522.3	17293	230.85	9.14	3.96%	70.51
RodB5_55	155	1.397	0.203	611.4	19402.5	511.4	1.20	528.1	17068	232.99	9.21	3.95%	70.13
RodB5_57.8	156	1.468	0.274	617.5	19907.2	519.1	1.20	535.5	16787	242.88	9.63	3.96%	71.76
RodB5_64	157	1.626	0.432	636.7	21025.8	536.9	1.20	553.5	16140	252.69	9.99	3.95%	71.38
RodB5_73.9	158	1.877	0.077	669.8	22809.9	567.0	1.20	584.1	15145	266.31	10.51	3.94%	69.82
RodB5_75.9	159	1.928	0.128	680.7	23170.4	573.3	1.20	591.2	14932	258.87	10.14	3.92%	66.73
RodB5_76.9	160	1.953	0.153	685.0	23350.4	576.4	1.20	594.5	14833	258.10	10.09	3.91%	66.01
RodF5_41	105	1.041	0.343	559.3	16772.6	477.0	1.20	490.7	18635	244.54	10.06	4.11%	80.96
RodF5_53.1	106	1.349	0.155	596.3	18953.6	506.4	1.20	521.4	17332	252.84	10.20	4.03%	77.42
RodF5_55	107	1.397	0.203	602.7	19296.3	511.4	1.20	526.6	17124	253.86	10.21	4.02%	76.70
RodF5_57.8	108	1.468	0.274	610.6	19801.8	519.1	1.20	534.4	16830	259.70	10.44	4.02%	76.95
RodF5_64	109	1.626	0.432	628.6	20919.6	536.9	1.20	552.1	16187	273.66	10.99	4.02%	77.56
RodF5_73.8	110	1.875	0.074	654.2	22685.7	566.7	1.20	581.2	15233	311.09	12.66	4.07%	82.12
RodF5_75.8	111	1.925	0.125	664.0	23045.4	572.9	1.20	588.1	15023	303.61	12.25	4.04%	78.83
RodF5_76.8	112	1.951	0.150	666.7	23226.3	576.1	1.20	591.2	14931	307.85	12.44	4.04%	79.35
RodC2_41	57	1.041	0.343	559.5	16850.2	477.0	1.20	490.8	18633	245.07	10.07	4.11%	81.13
RodC2_53.1	58	1.349	0.155	599.6	19030.4	506.4	1.20	521.9	17310	244.83	9.80	4.00%	74.86
RodC2_55	59	1.397	0.203	604.2	19373.3	511.4	1.20	526.9	17114	250.52	10.04	4.01%	75.63
RodC2_57.8	60	1.468	0.274	608.6	19878.4	519.1	1.20	534.0	16843	266.70	10.76	4.04%	79.09
RodC2_63.9	61	1.623	0.429	626.8	20977.8	536.6	1.20	551.6	16206	278.86	11.23	4.03%	79.14
RodC2_73.8	62	1.875	0.074	656.0	22762.8	566.7	1.20	581.6	15223	305.69	12.38	4.05%	80.63
RodC2_75.8	63	1.925	0.125	665.2	23123.8	572.9	1.20	588.3	15017	300.79	12.10	4.02%	78.07
RodC2_76.8	64	1.951	0.150	668.3	23304.0	576.1	1.20	591.5	14923	303.28	12.20	4.02%	78.12
RodC6_40.9	137	1.039	0.340	563.4	16768.7	476.8	1.20	491.2	18612	232.48	9.45	4.07%	76.88
RodC6_52.8	138	1.341	0.147	604.0	19006.5	505.6	1.20	522.0	17307	231.66	9.18	3.96%	70.82
RodC6_54.8	139	1.392	0.198	611.0	19382.7	510.9	1.20	527.6	17088	232.35	9.18	3.95%	70.03
RodC6_57.8	140	1.468	0.274	619.5	19946.6	519.1	1.20	535.8	16774	238.32	9.41	3.95%	70.35
RodC6_63.8	141	1.621	0.427	639.2	21075.4	536.3	1.20	553.4	16142	245.65	9.66	3.93%	69.40
RodC6_73.7	142	1.872	0.072	669.9	22935.1	566.3	1.20	583.6	15160	265.72	10.46	3.94%	69.75
RodC6_75.8	143	1.925	0.125	677.9	23330.6	572.9	1.20	590.4	14954	266.71	10.48	3.93%	68.87
RodC6_76.8	144	1.951	0.150	682.9	23518.0	576.1	1.20	593.9	14851	264.27	10.35	3.92%	67.68

Table SC-3214-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h(z) (W/m ² -K)	±σ _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	695.6	25234.3	613.6	1.20	627.3	13933	369.18	15.25	4.13%	87.51
RodB4_91.3	162	2.319	0.071	735.9	25737.7	623.1	1.20	641.9	13565	273.86	10.66	3.89%	62.82
RodB4_93.3	163	2.370	0.122	746.3	26088.1	629.6	1.20	649.1	13391	268.29	10.39	3.87%	60.56
RodB4_95.1	164	2.416	0.168	760.4	26400.8	635.5	1.20	656.3	13220	253.74	9.75	3.84%	56.37
RodB4_100	165	2.540	0.292	773.0	27256.9	651.6	1.20	671.8	12871	269.26	10.38	3.85%	57.85
RodB4_106	166	2.692	0.445	798.8	28304.2	671.0	1.20	692.3	12437	265.71	10.18	3.83%	54.67
RodB4_109.9	167	2.791	0.544	776.7	27400.3	683.4	1.20	699.0	12302	352.46	14.17	4.02%	71.52
RodB4_142.3	168	3.614	0.224	819.9	10632.0	774.4	1.20	782.0	10848	280.07	14.32	5.11%	48.31
RodF4_85.6	98	2.174	0.374	690.1	24902.5	604.4	1.20	618.7	14157	348.97	14.26	4.09%	84.35
RodF4_88.4	99	2.245	-0.003	697.1	25402.3	613.6	1.20	627.5	13926	364.80	14.99	4.11%	86.43
RodF4_92.4	100	2.347	0.099	740.1	26113.9	626.7	1.20	645.6	13475	276.18	10.73	3.89%	62.83
RodF4_94.3	101	2.395	0.147	752.9	26453.2	632.9	1.20	652.9	13300	264.46	10.20	3.86%	59.19
RodF4_97.2	102	2.469	0.221	767.0	26971.0	642.4	1.20	663.2	13063	259.69	9.97	3.84%	56.84
RodF4_108.8	103	2.764	0.516	799.1	28484.0	679.9	1.20	699.8	12285	286.81	11.07	3.86%	58.10
RodF4_111	104	2.819	-0.044	767.0	27323.2	686.9	1.20	700.3	12276	409.10	16.98	4.15%	82.79
RodD2_103.2	65	2.621	0.373	782.5	28223.7	661.9	1.20	682.0	12650	280.96	10.82	3.85%	59.06
RodD2_106	66	2.692	0.445	791.8	28728.1	671.0	1.20	691.1	12460	285.24	10.98	3.85%	58.83
RodD2_112.6	67	2.860	-0.004	780.5	26357.9	691.9	1.20	706.7	12149	356.86	14.48	4.06%	71.27
RodD2_114.9	68	2.918	0.055	799.9	25132.4	699.1	1.20	715.9	11973	299.01	11.83	3.96%	58.61
RodD2_117.4	69	2.982	0.118	808.6	23803.1	706.7	1.20	723.7	11827	280.41	11.08	3.95%	54.11
RodD2_120.8	70	3.068	0.204	808.3	21995.3	716.9	1.20	732.2	11673	288.84	11.64	4.03%	54.80
RodD2_124.8	71	3.170	0.306	804.7	19864.4	728.6	1.20	741.3	11511	313.49	13.19	4.21%	58.42
RodD2_128.6	72	3.266	0.403	800.6	17842.4	739.4	1.20	749.6	11370	349.89	15.76	4.50%	64.17
RodD6_103.1	129	2.619	0.371	770.3	28222.8	661.6	1.20	679.7	12699	311.72	12.18	3.91%	65.85
RodD6_106	130	2.692	0.445	779.7	28740.8	671.0	1.20	689.1	12502	317.26	12.39	3.91%	65.71
RodD6_112.9	131	2.868	0.004	777.8	26227.5	692.9	1.20	707.0	12143	370.50	15.17	4.09%	73.94
RodD6_114.9	132	2.918	0.055	801.0	25150.7	699.1	1.20	716.0	11970	296.15	11.70	3.95%	58.03
RodD6_116.8	133	2.967	0.103	809.0	24129.9	704.9	1.20	722.2	11854	278.21	10.95	3.94%	53.84
RodD6_120.9	134	3.071	0.207	806.2	21927.2	717.2	1.20	732.1	11675	295.93	12.00	4.05%	56.16
RodD6_124.8	135	3.170	0.306	804.7	19833.2	728.6	1.20	741.3	11511	312.85	13.17	4.21%	58.30
RodD6_128.7	136	3.269	0.405	805.7	17739.4	739.7	1.20	750.7	11351	322.21	14.14	4.39%	58.97

Table SC-3214-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h(z) (W/m ² -K)	±σ _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	585.4	18625.0	498.6	1.20	513.1	17667	257.43	10.45	4.06%	80.50
RodE2_54	74	1.372	0.178	601.5	19334.6	508.8	1.20	524.2	17219	250.22	10.02	4.00%	76.06
RodE2_56.9	75	1.445	0.251	609.7	19863.1	516.6	1.20	532.1	16913	256.00	10.24	4.00%	76.28
RodE2_59.9	76	1.521	0.328	617.3	20410.3	525.0	1.20	540.4	16606	265.31	10.63	4.01%	77.43
RodE2_66	77	1.676	0.483	634.2	21522.2	542.8	1.20	558.0	15985	282.45	11.34	4.01%	78.90
RodE2_69.8	78	1.773	-0.027	614.2	22215.3	554.3	1.20	564.3	15775	444.52	20.03	4.51%	122.28
RodE2_72.9	79	1.852	0.051	652.6	22780.6	563.9	1.20	578.6	15314	308.08	12.49	4.05%	81.84
RodE2_74.9	80	1.902	0.102	667.1	23143.4	570.1	1.20	586.3	15079	286.42	11.41	3.98%	74.70
RodB3_50.2	169	1.275	0.081	582.0	18518.6	498.9	1.20	512.7	17682	267.25	10.96	4.10%	83.65
RodB3_54.1	170	1.374	0.180	592.3	19222.1	509.0	1.20	522.9	17270	276.86	11.35	4.10%	84.44
RodB3_56.9	171	1.445	0.251	600.8	19726.1	516.6	1.20	530.7	16970	281.03	11.49	4.09%	84.05
RodB3_60.1	172	1.527	0.333	607.5	20303.9	525.6	1.20	539.2	16649	297.40	12.23	4.11%	87.05
RodB3_66.1	173	1.679	0.485	630.2	21385.9	543.1	1.20	557.6	15999	294.71	11.96	4.06%	82.41
RodB3_69.9	174	1.775	-0.025	613.7	22071.7	554.6	1.20	564.4	15770	448.12	20.31	4.53%	123.22
RodB3_73	175	1.854	0.054	649.3	22629.8	564.2	1.20	578.4	15322	318.84	13.05	4.09%	84.76
RodB3_75	176	1.905	0.105	663.5	22990.4	570.4	1.20	585.9	15089	296.42	11.91	4.02%	77.37
RodF3_50.1	89	1.273	0.079	589.8	18522.5	498.6	1.20	513.8	17637	243.60	9.79	4.02%	76.03
RodF3_54	90	1.372	0.178	605.6	19240.5	508.8	1.20	524.9	17192	238.53	9.48	3.97%	72.38
RodF3_57	91	1.448	0.254	611.5	19792.2	516.9	1.20	532.7	16893	251.00	10.02	3.99%	74.69
RodF3_60	92	1.524	0.330	619.4	20344.9	525.3	1.20	541.0	16585	259.51	10.37	3.99%	75.63
RodF3_66.1	93	1.679	0.485	630.2	21468.9	543.1	1.20	557.6	15999	295.74	11.99	4.06%	82.70
RodF3_70	94	1.778	-0.022	619.6	22187.3	554.9	1.20	565.7	15729	411.62	18.07	4.39%	112.84
RodF3_73	95	1.854	0.054	658.2	22740.7	564.2	1.20	579.8	15276	290.24	11.63	4.01%	76.88
RodF3_75	96	1.905	0.105	676.6	23107.1	570.4	1.20	588.1	15023	261.21	10.25	3.92%	67.83
RodE6_50.2	121	1.275	0.081	586.3	18510.1	498.9	1.20	513.4	17652	253.88	10.29	4.05%	79.32
RodE6_54.1	122	1.374	0.180	601.1	19206.2	509.0	1.20	524.4	17213	250.26	10.04	4.01%	76.04
RodE6_57	123	1.448	0.254	606.7	19723.1	516.9	1.20	531.9	16924	263.61	10.63	4.03%	78.60
RodE6_60.2	124	1.529	0.335	614.6	20294.3	525.9	1.20	540.7	16597	274.36	11.09	4.04%	80.02
RodE6_66.1	125	1.679	0.485	634.7	21346.6	543.1	1.20	558.4	15973	279.48	11.23	4.02%	78.00
RodE6_70	126	1.778	-0.022	615.8	22042.4	554.9	1.20	565.0	15750	434.10	19.47	4.48%	119.19
RodE6_73.1	127	1.857	0.056	653.0	22594.0	564.5	1.20	579.2	15295	306.38	12.44	4.06%	81.27
RodE6_75	128	1.905	0.105	665.9	22930.8	570.4	1.20	586.3	15077	288.16	11.52	4.00%	75.14

RBHT Steam Cooling Test SC-3214-C

Matrix test # 9

Test date – 4/26/2005

Steady state time window: 16600 - 17100 sec

Inlet flow: 6.66 m³/min (235.2 ft³/min)

Inlet steam temperature: 422 K (299 °F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 140.2 kW

Outlet steam temperature: 785 K (954 °F)

Bundle inlet Reynolds number: 24776

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

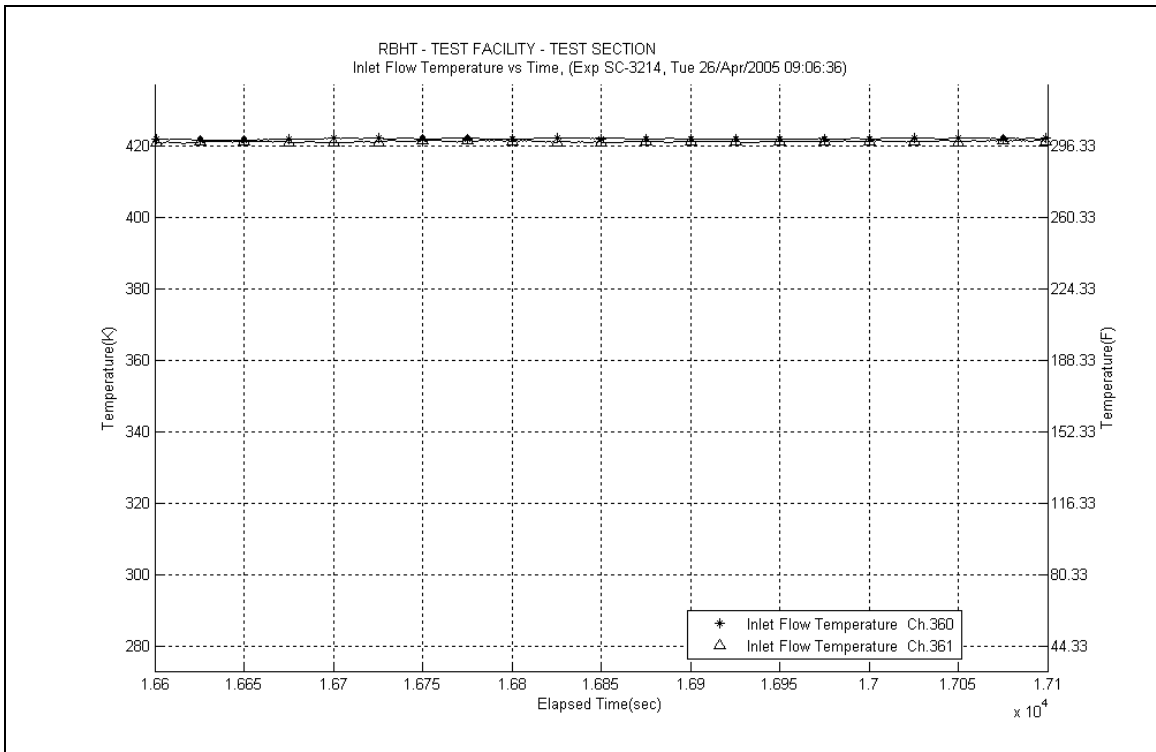
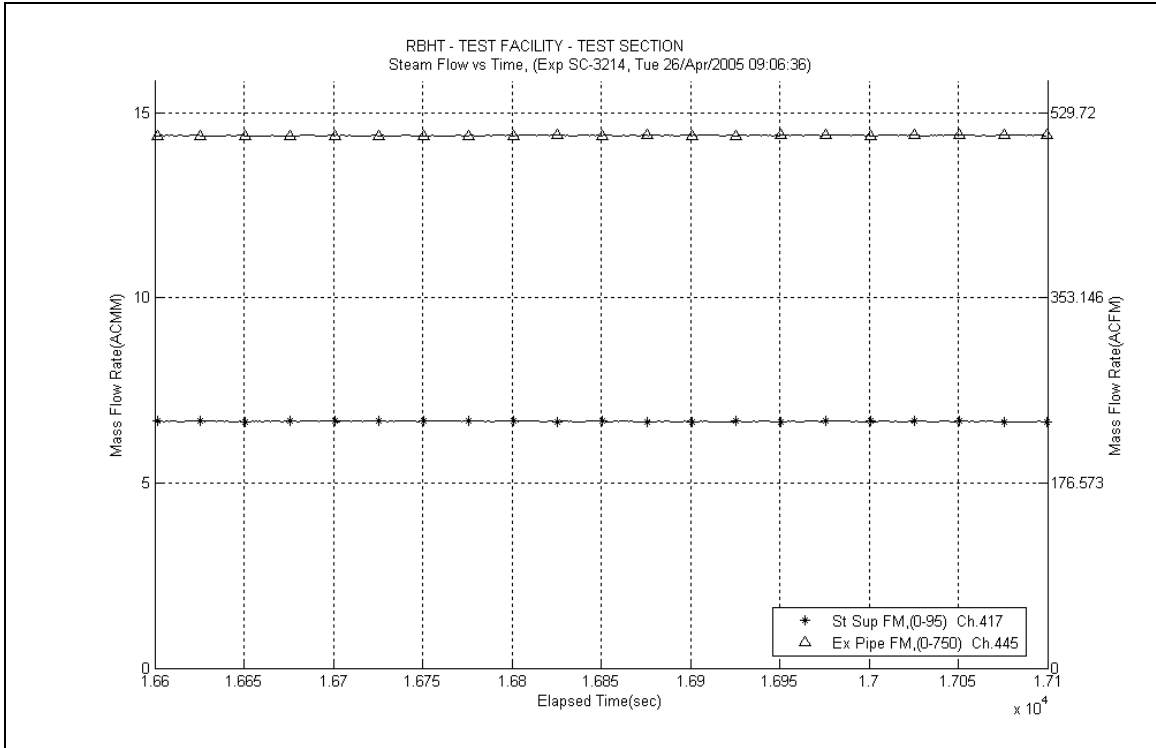
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

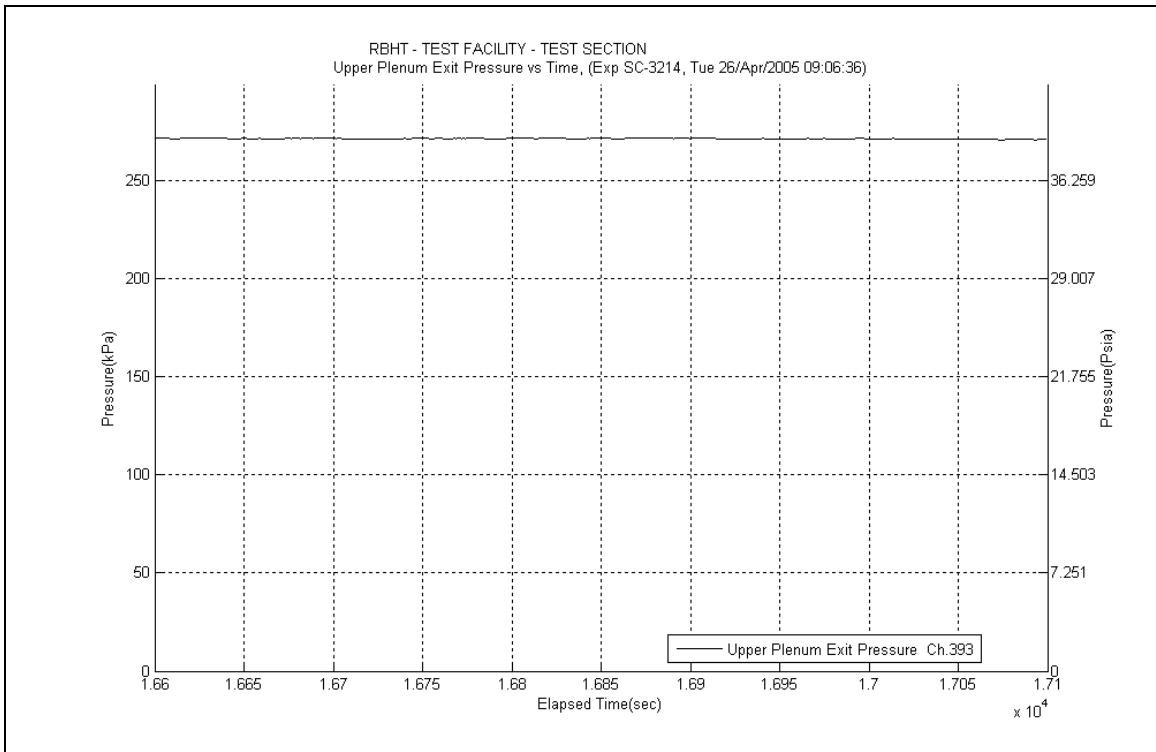
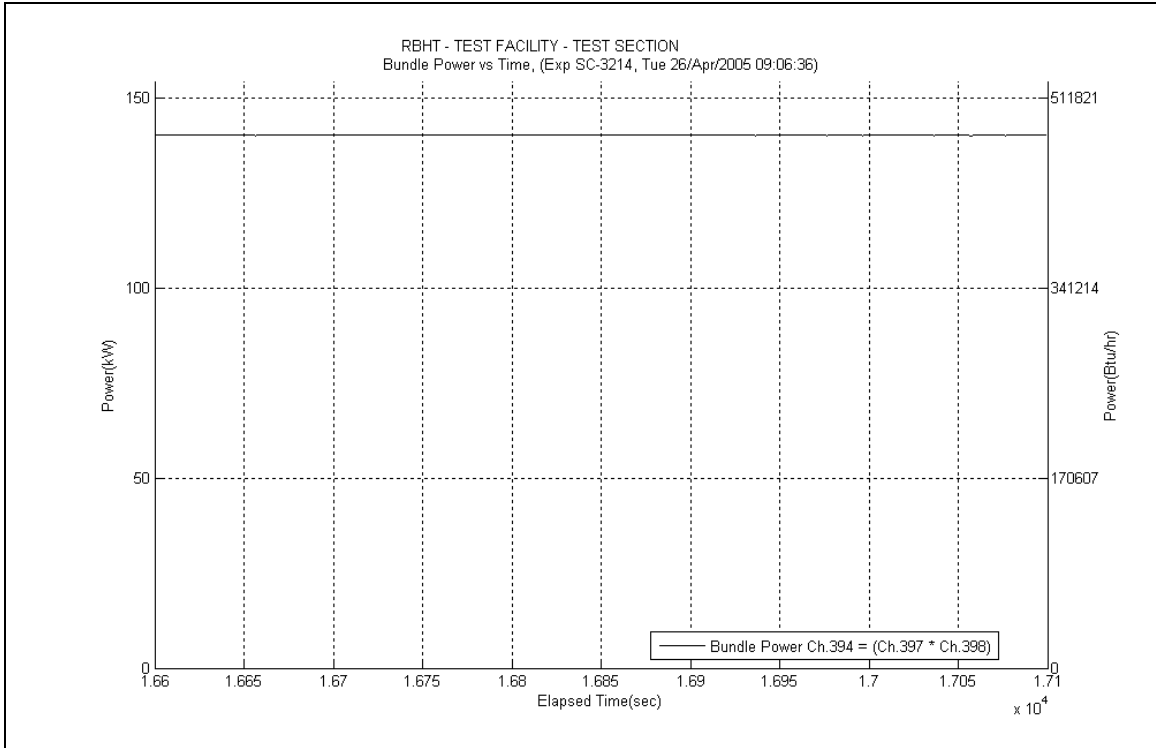
$$T_{cl} = -13.358x^3 + 84.94x^2 - 38.965x + 445.15$$

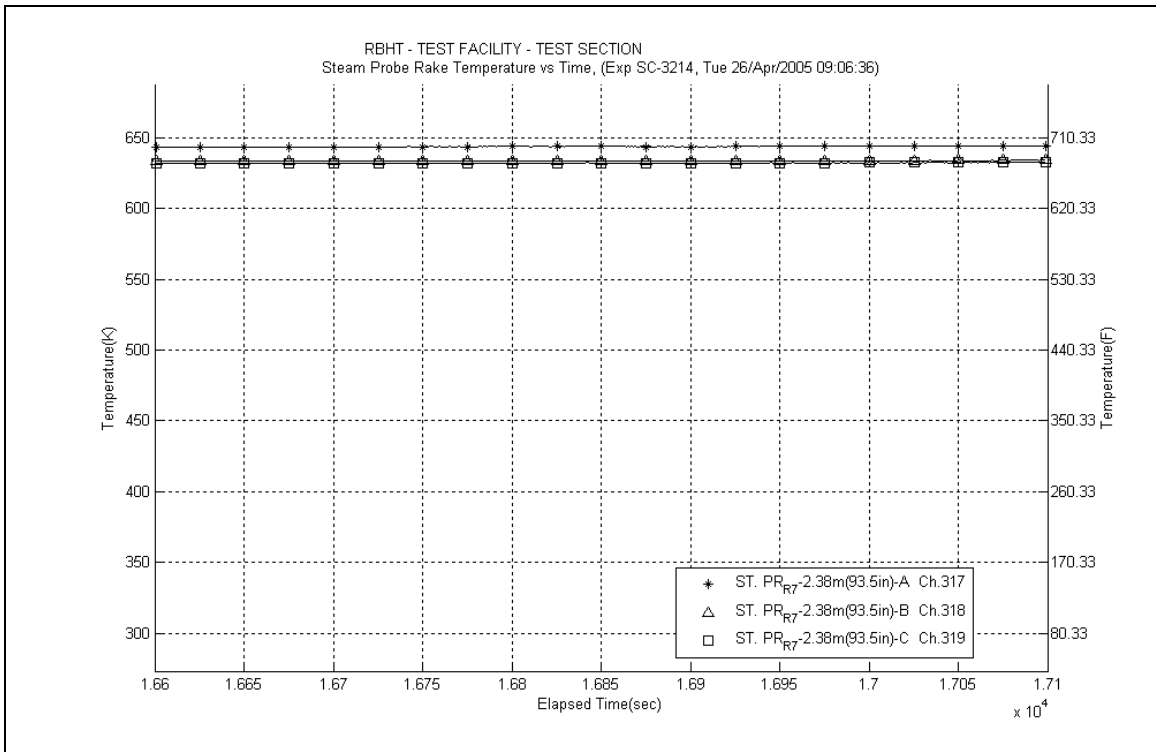
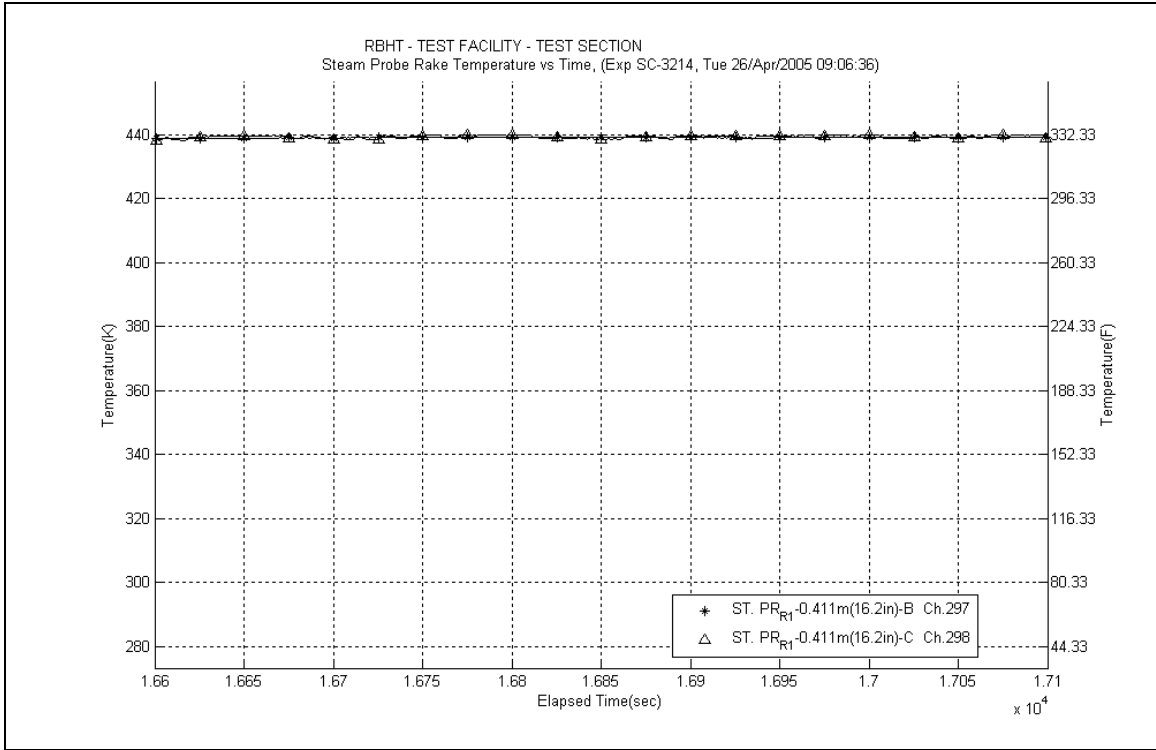
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

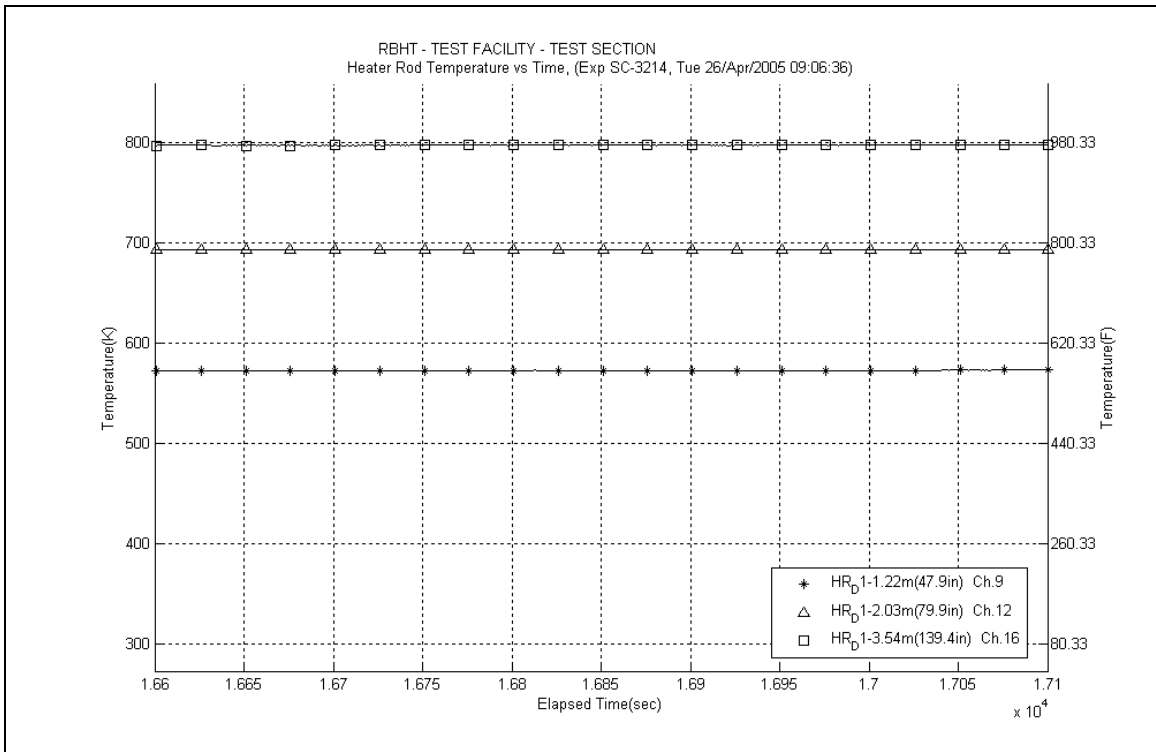
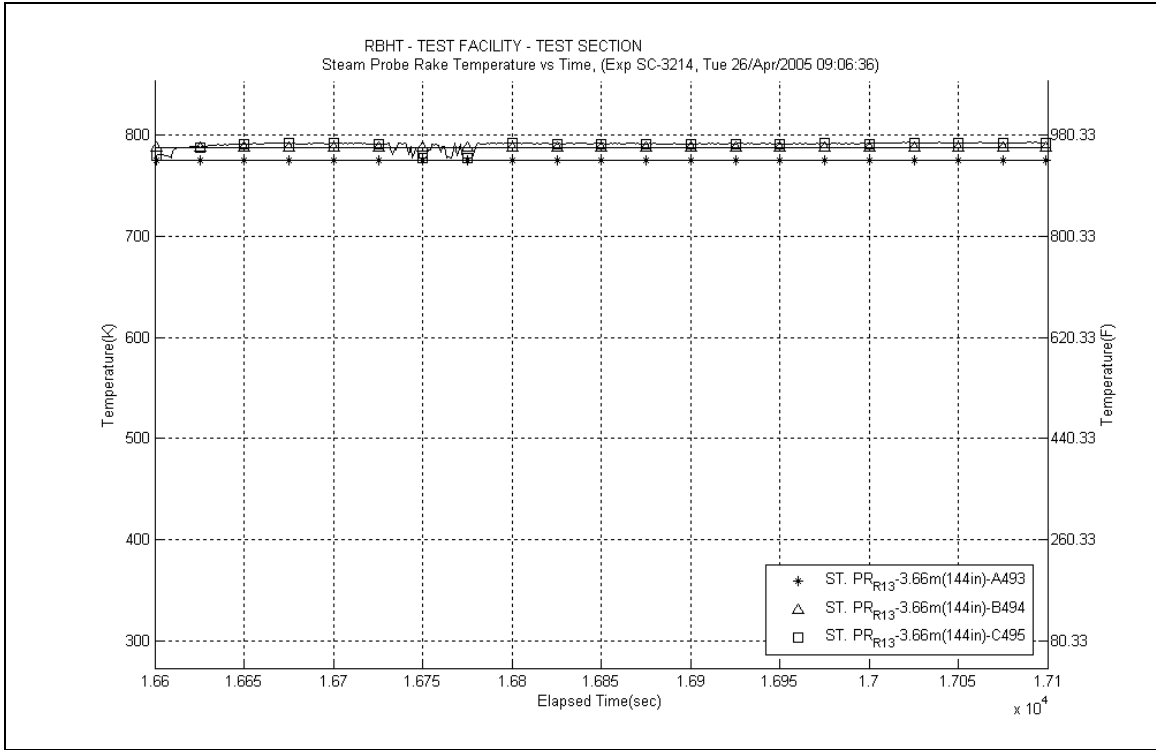
$$T_{cl} = -7.4673x^3 + 54.417x^2 - 1.5846x + 432.97$$

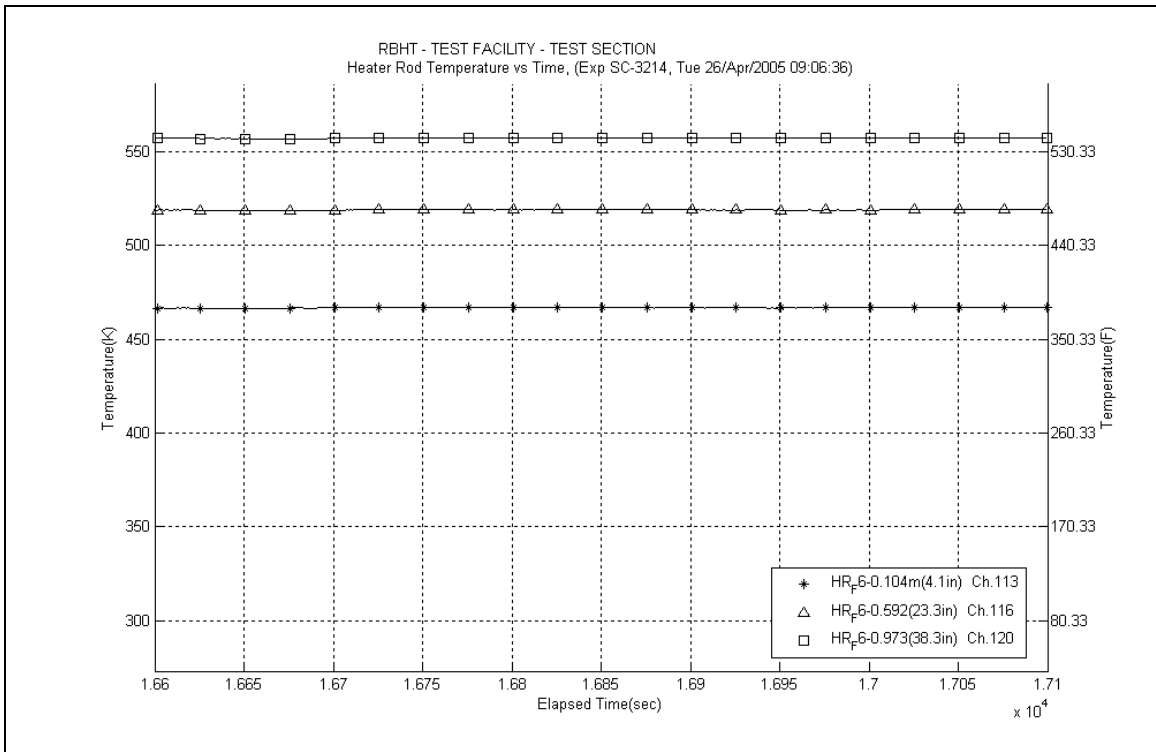
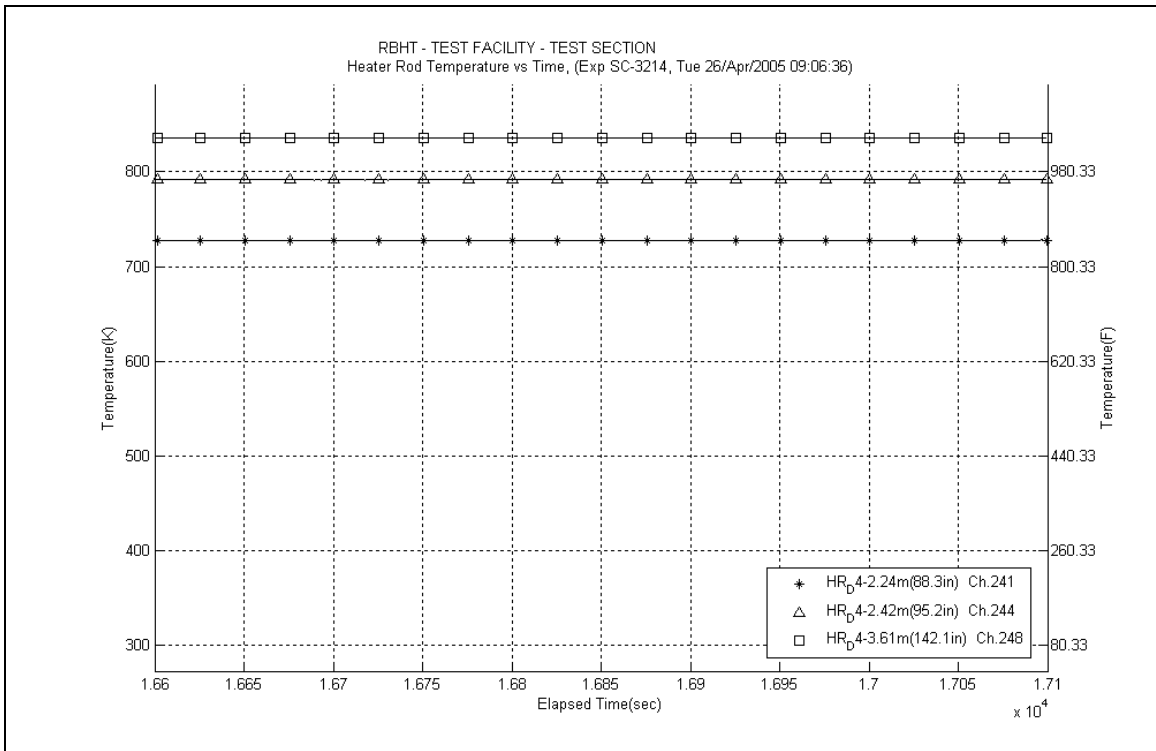
where x is the elevation (m) and T_{cl} is in (K)











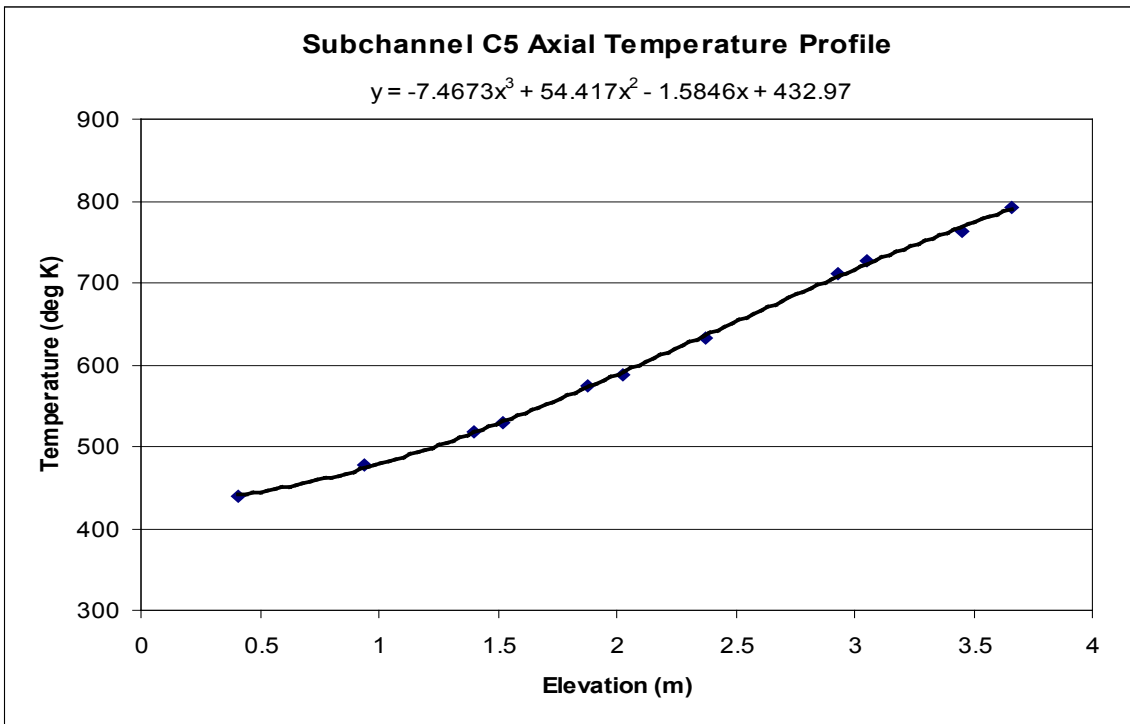
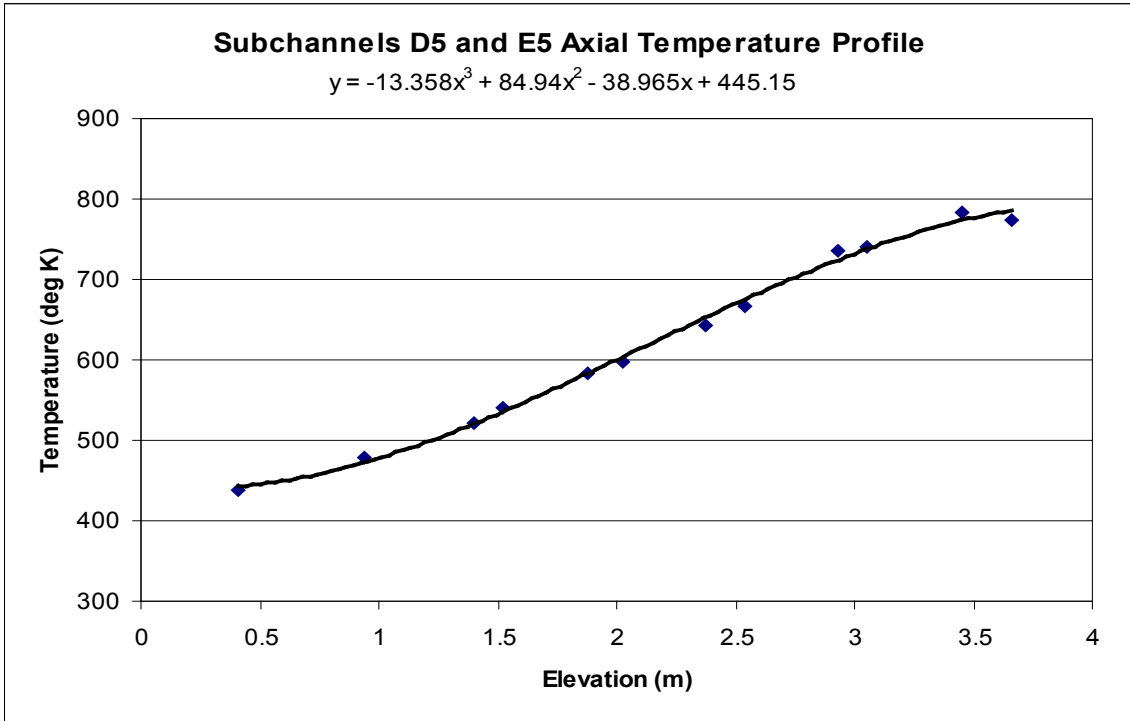


Table SC-3214-C.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tci (K)	Correction Factor	Tbulk (K)	Re (z)	h(z) (W/m ² -K)	±σ _{h,c} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	714.6	37523.6	634.3	1.20	647.7	17146	561.20	22.60	8.90%	127.07
RodD3_91.3	186	2.319	0.071	762.0	38312.4	645.0	1.20	664.5	16647	392.85	14.68	8.19%	85.74
RodD3_93.1	187	2.365	0.117	778.3	38789.6	651.4	1.20	672.5	16420	366.73	13.56	8.37%	78.67
RodD3_95.3	188	2.421	0.173	789.8	39372.2	659.1	1.20	680.9	16190	361.36	13.31	8.84%	76.15
RodD3_100.1	189	2.543	0.295	807.8	40651.9	675.6	1.20	697.6	15746	369.17	13.58	9.53%	75.11
RodD3_106.1	190	2.695	0.447	829.6	42246.8	695.6	1.20	717.9	15243	378.21	13.89	9.53%	73.83
RodD3_110	191	2.794	0.546	815.2	41725.7	708.0	1.20	725.9	15055	467.06	17.67	9.17%	89.73
RodD3_142.1	192	3.609	0.218	825.1	14557.9	783.0	1.20	790.0	13701	414.33	21.73	10.75%	70.42
RodC4_88.4	233	2.245	-0.003	720.5	37962.8	634.7	1.20	649.0	17107	531.11	21.02	8.48%	119.92
RodC4_91.1	234	2.314	0.066	763.1	38693.9	644.3	1.20	664.1	16659	390.68	14.56	7.79%	85.34
RodC4_93.4	235	2.372	0.124	778.6	39317.9	652.4	1.20	673.4	16394	373.83	13.82	7.99%	80.03
RodC4_95.3	236	2.421	0.173	792.4	39833.8	659.1	1.20	681.3	16178	358.55	13.17	8.29%	75.49
RodC4_100.1	237	2.543	0.295	804.2	41132.8	675.6	1.20	697.1	15762	383.88	14.16	9.46%	78.20
RodC4_106.1	238	2.695	0.447	826.3	42761.1	695.6	1.20	717.4	15257	392.58	14.45	9.48%	76.72
RodC4_110	239	2.794	0.546	807.2	41387.4	708.0	1.20	724.6	15086	500.47	19.21	9.01%	96.41
RodC4_142.2	240	3.612	0.221	840.1	15793.3	783.1	1.20	792.6	13651	332.20	14.99	10.77%	56.19
RodD4_88.3	241	2.243	-0.005	725.0	37820.3	634.3	1.20	649.4	17093	500.26	19.55	9.19%	112.83
RodD4_91.3	242	2.319	0.071	762.3	38626.3	645.0	1.20	664.6	16646	395.03	14.75	8.77%	86.21
RodD4_93.2	243	2.367	0.119	779.0	39137.2	651.7	1.20	672.9	16409	368.98	13.63	8.80%	79.08
RodD4_95.2	244	2.418	0.170	789.0	39672.6	658.7	1.20	680.4	16201	365.46	13.46	9.12%	77.09
RodD4_100.1	245	2.543	0.295	806.5	40989.3	675.6	1.20	697.4	15752	375.94	13.84	9.75%	76.52
RodD4_106.1	246	2.695	0.447	822.7	42603.8	695.6	1.20	716.8	15271	402.31	14.86	9.83%	78.72
RodD4_110	247	2.794	0.546	806.7	41148.9	708.0	1.20	724.5	15088	500.32	19.23	9.37%	96.40
RodD4_142.1	248	3.609	0.218	834.7	15261.9	783.0	1.20	791.6	13671	354.29	16.72	12.38%	60.04
RodE4_88.4	201	2.245	-0.003	717.4	37251.2	634.7	1.20	648.5	17123	540.51	21.61	8.97%	122.18
RodE4_91.2	202	2.316	0.069	756.2	37968.4	644.6	1.20	663.2	16684	408.41	15.38	8.38%	89.38
RodE4_95.3	204	2.421	0.173	784.7	39023.6	659.1	1.20	680.0	16213	372.83	13.81	8.84%	78.71
RodE4_100.9	205	2.563	0.315	801.1	40465.4	678.3	1.20	698.8	15717	395.56	14.69	9.59%	80.29
RodE4_142.3	208	3.614	0.224	830.2	15418.5	783.2	1.20	791.1	13681	394.04	19.47	10.58%	66.84
RodE3_63.4	193	1.610	0.417	649.9	30851.4	546.9	1.20	564.1	20159	359.48	13.71	12.92%	98.94
RodE3_113.6	194	2.885	0.022	825.2	38021.4	719.0	1.20	736.7	14807	429.76	16.31	7.66%	80.82
RodE3_115.5	195	2.934	0.070	842.1	36606.9	724.6	1.20	744.2	14640	373.78	13.96	7.59%	69.27
RodE3_118.5	196	3.010	0.146	849.4	34375.2	733.1	1.20	752.5	14459	354.75	13.27	7.98%	64.69
RodE3_122.7	197	3.117	0.253	841.1	31252.8	744.4	1.20	760.5	14290	387.93	14.96	9.49%	69.67
RodE3_126.5	198	3.213	0.349	838.0	28427.6	753.8	1.20	767.8	14139	404.91	16.09	9.77%	71.72
RodE3_131.7	199	3.345	-0.046	812.0	24561.4	765.3	1.20	773.1	14032	630.17	31.15	10.44%	110.52
RodE3_135.6	200	3.444	0.053	826.6	21664.9	772.8	1.20	781.8	13860	482.86	22.31	7.77%	83.32

Table SC-3214-C.1: Summary of Steam Cooling Data (cont.)

H.R.	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h(z) (W/m ² -K)	±σ _{h,c} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	650.4	30253.6	547.9	1.20	565.0	20120	354.11	13.54	13.27%	97.24
RodC5_113.6	226	2.885	0.022	823.7	37083.0	719.0	1.20	736.5	14812	425.14	16.20	6.91%	79.99
RodC5_115.7	227	2.939	0.075	841.7	35598.2	725.2	1.20	744.6	14631	366.56	13.73	7.25%	67.88
RodC5_122.7	229	3.117	0.253	845.2	30656.0	744.4	1.20	761.2	14276	364.76	13.97	9.06%	65.42
RodC5_126.7	230	3.218	0.354	845.5	27831.5	754.2	1.20	769.4	14106	366.12	14.30	9.07%	64.65
RodC5_131.6	231	3.343	-0.048	820.8	24368.5	765.1	1.20	774.4	14007	524.83	23.91	9.83%	91.82
RodC5_135.7	232	3.447	0.056	838.6	21473.0	773.0	1.20	783.9	13818	392.56	16.78	7.90%	67.47
RodE5_63.6	209	1.615	0.422	642.0	31005.5	547.6	1.20	563.3	20191	394.00	15.22	13.77%	108.64
RodE5_113.6	210	2.885	0.022	822.5	38259.9	719.0	1.20	736.3	14817	443.48	16.89	6.01%	83.47
RodE5_115.4	211	2.931	0.067	834.5	36938.9	724.3	1.20	742.7	14673	402.28	15.16	6.30%	74.77
RodE5_118.7	212	3.015	0.151	838.8	34519.6	733.7	1.20	751.2	14487	393.96	14.96	6.78%	72.02
RodE5_122.6	213	3.114	0.250	834.4	31666.6	744.1	1.20	759.2	14318	420.95	16.46	7.66%	75.79
RodE5_126.6	214	3.216	0.352	829.8	28733.0	754.0	1.20	766.6	14163	454.94	18.58	8.43%	80.76
RodE5_131.6	215	3.343	-0.048	806.2	25076.1	765.1	1.20	771.9	14055	730.98	38.71	8.87%	128.47
RodE5_135.6	216	3.444	0.053	825.9	22147.1	772.8	1.20	781.6	13862	500.21	23.23	6.44%	86.34
RodC3_79.8	177	2.027	0.227	692.0	35089.1	603.9	1.20	618.6	18086	477.85	18.81	11.38%	115.54
RodC3_85.6	178	2.174	0.374	704.1	36619.4	624.7	1.20	637.9	17451	553.21	22.34	9.90%	128.02
RodC3_88.5	179	2.248	0.000	715.0	37381.1	635.0	1.20	648.4	17126	560.68	22.60	8.22%	126.76
RodC3_92.4	180	2.347	0.099	756.7	38403.2	648.9	1.20	666.9	16580	427.29	16.17	8.42%	92.78
RodC3_94.4	181	2.398	0.150	761.4	38930.9	655.9	1.20	673.5	16392	443.00	16.83	9.10%	94.83
RodC3_97.2	182	2.469	0.221	783.4	39663.6	665.7	1.20	685.3	16070	404.14	15.09	9.17%	84.37
RodC3_108.8	183	2.764	0.516	824.4	41820.7	704.2	1.20	724.3	15093	417.78	15.56	8.96%	80.52
RodD5_50	217	1.270	0.076	604.6	27392.7	505.3	1.20	521.9	22112	330.92	12.66	12.19%	101.20
RodD5_54.1	218	1.374	0.180	621.9	28467.8	517.3	1.20	534.8	21477	326.68	12.39	13.04%	96.69
RodD5_56.9	219	1.445	0.251	629.3	29207.6	525.9	1.20	543.2	21082	339.13	12.89	13.73%	98.29
RodD5_60	220	1.524	0.330	639.5	30024.4	535.8	1.20	553.1	20634	347.22	13.19	13.77%	98.19
RodD5_66.1	221	1.679	0.485	660.9	31630.2	555.9	1.20	573.4	19769	361.53	13.74	12.23%	97.25
RodD5_69.9	222	1.775	-0.025	636.9	32631.4	569.0	1.20	580.3	19494	576.21	24.24	12.42%	152.46
RodD5_72.9	223	1.852	0.051	678.1	33414.4	579.4	1.20	595.9	18896	406.24	15.61	10.43%	103.56
RodD5_74.9	224	1.902	0.102	692.5	33943.6	586.5	1.20	604.1	18593	384.09	14.57	10.62%	96.03

Table SC-3214-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h(z) (W/m ² -K)	$\pm\sigma_{hic}$ (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	577.5	24901.7	481.9	1.20	497.8	23395	312.43	12.05	3.86%	101.58
RodB5_52.9	154	1.344	0.150	615.2	28067.7	511.0	1.20	528.3	21788	323.04	12.26	3.80%	97.18
RodB5_55	155	1.397	0.203	621.5	28623.9	516.6	1.20	534.1	21510	327.55	12.42	3.79%	97.12
RodB5_57.8	156	1.468	0.274	628.5	29370.9	524.3	1.20	541.7	21152	338.39	12.84	3.80%	98.44
RodB5_64	157	1.626	0.432	649.3	31018.4	542.1	1.20	560.0	20333	347.37	13.16	3.79%	96.57
RodB5_73.9	158	1.877	0.077	683.4	33651.1	572.3	1.20	590.8	19085	363.60	13.69	3.77%	93.81
RodB5_75.9	159	1.928	0.128	693.0	34183.2	578.7	1.20	597.7	18828	358.77	13.45	3.75%	91.07
RodB5_76.9	160	1.953	0.153	697.0	34452.0	581.8	1.20	601.0	18706	359.06	13.45	3.75%	90.43
RodF5_41	105	1.041	0.343	569.5	24748.3	481.9	1.20	496.5	23470	338.87	13.31	3.93%	110.55
RodF5_53.1	106	1.349	0.155	606.7	27965.2	511.5	1.20	527.4	21836	352.38	13.60	3.86%	106.27
RodF5_55	107	1.397	0.203	613.1	28471.2	516.6	1.20	532.7	21577	354.09	13.63	3.85%	105.36
RodF5_57.8	108	1.468	0.274	621.8	29215.7	524.3	1.20	540.5	21204	359.76	13.82	3.84%	104.95
RodF5_64	109	1.626	0.432	641.9	30864.9	542.1	1.20	558.7	20386	371.24	14.20	3.83%	103.52
RodF5_73.8	110	1.875	0.074	668.0	33469.4	572.0	1.20	588.0	19193	418.52	16.18	3.87%	108.70
RodF5_75.8	111	1.925	0.125	676.3	34000.9	578.3	1.20	594.7	18941	416.71	16.05	3.85%	106.54
RodF5_76.8	112	1.951	0.150	678.1	34266.8	581.5	1.20	597.6	18831	425.79	16.44	3.86%	108.10
RodC2_41	57	1.041	0.343	571.7	24862.4	481.9	1.20	496.9	23450	332.26	12.98	3.91%	108.29
RodC2_53.1	58	1.349	0.155	611.0	28079.1	511.5	1.20	528.1	21801	338.77	12.96	3.83%	101.98
RodC2_55	59	1.397	0.203	615.1	28584.7	516.6	1.20	533.0	21561	348.17	13.35	3.83%	103.51
RodC2_57.8	60	1.468	0.274	619.3	29330.5	524.3	1.20	540.1	21223	370.67	14.31	3.86%	108.25
RodC2_63.9	61	1.623	0.429	638.8	30951.8	541.8	1.20	558.0	20419	382.94	14.72	3.84%	106.98
RodC2_73.8	62	1.875	0.074	669.2	33584.7	572.0	1.20	588.2	19185	414.55	15.98	3.86%	107.62
RodC2_75.8	63	1.925	0.125	677.6	34114.7	578.3	1.20	594.9	18933	412.37	15.84	3.84%	105.37
RodC2_76.8	64	1.951	0.150	679.8	34380.8	581.5	1.20	597.9	18821	419.74	16.15	3.85%	106.49
RodC6_40.9	137	1.039	0.340	575.1	24740.4	481.7	1.20	497.3	23428	317.74	12.31	3.87%	103.46
RodC6_52.8	138	1.341	0.147	616.0	28039.5	510.7	1.20	528.3	21793	319.62	12.11	3.79%	96.17
RodC6_54.8	139	1.392	0.198	622.6	28596.3	516.1	1.20	533.8	21523	322.16	12.18	3.78%	95.59
RodC6_57.8	140	1.468	0.274	631.8	29428.6	524.3	1.20	542.2	21126	328.44	12.40	3.78%	95.41
RodC6_63.8	141	1.621	0.427	652.9	31093.0	541.5	1.20	560.1	20328	334.97	12.61	3.76%	93.09
RodC6_73.7	142	1.872	0.072	684.9	33836.1	571.7	1.20	590.6	19095	358.65	13.46	3.75%	92.59
RodC6_75.8	143	1.925	0.125	691.8	34420.2	578.3	1.20	597.3	18844	363.89	13.65	3.75%	92.46
RodC6_76.8	144	1.951	0.150	696.2	34698.4	581.5	1.20	600.6	18720	363.18	13.61	3.75%	91.56

Table SC-3214-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h(z) (W/m ² -K)	$\pm\sigma_{hc}$ (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	712.3	37229.4	619.2	1.20	634.7	17552	480.12	18.68	3.89%	111.90
RodB4_91.3	162	2.319	0.071	754.7	37974.5	628.8	1.20	649.8	17082	362.09	13.41	3.70%	81.61
RodB4_93.3	163	2.370	0.122	765.0	38492.0	635.4	1.20	657.0	16865	356.49	13.15	3.69%	79.08
RodB4_95.1	164	2.416	0.168	778.5	38953.9	641.4	1.20	664.3	16654	340.86	12.49	3.67%	74.43
RodB4_100	165	2.540	0.292	789.1	40212.4	657.7	1.20	679.6	16225	367.13	13.52	3.68%	77.58
RodB4_106	166	2.692	0.445	818.3	41754.8	677.4	1.20	700.9	15663	355.67	13.00	3.66%	71.88
RodB4_109.9	167	2.791	0.544	798.4	40424.6	690.2	1.20	708.2	15481	448.31	16.97	3.79%	89.26
RodB4_142.3	168	3.614	0.224	832.6	15685.0	785.6	1.20	793.4	13636	400.37	19.75	4.93%	67.63
RodF4_85.6	98	2.174	0.374	706.9	36743.1	610.0	1.20	626.2	17832	455.09	17.56	3.86%	108.14
RodF4_88.4	99	2.245	-0.003	713.5	37475.5	619.2	1.20	634.9	17546	476.87	18.50	3.88%	111.09
RodF4_92.4	100	2.347	0.099	756.5	38525.9	632.5	1.20	653.1	16982	372.77	13.82	3.71%	83.40
RodF4_94.3	101	2.395	0.147	767.9	39027.2	638.8	1.20	660.3	16770	362.60	13.38	3.69%	79.86
RodF4_97.2	102	2.469	0.221	780.6	39789.2	648.4	1.20	670.4	16479	361.18	13.29	3.68%	77.83
RodF4_108.8	103	2.764	0.516	819.6	42017.8	686.6	1.20	708.7	15467	379.06	13.93	3.68%	75.39
RodF4_111	104	2.819	-0.044	783.5	40308.7	693.7	1.20	708.7	15468	538.68	21.11	3.92%	107.15
RodD2_103.2	65	2.621	0.373	803.1	41573.0	668.2	1.20	690.7	15927	369.91	13.57	3.67%	76.36
RodD2_106	66	2.692	0.445	813.8	42316.6	677.4	1.20	700.2	15682	372.44	13.65	3.66%	75.39
RodD2_112.6	67	2.860	-0.004	804.2	38823.7	698.9	1.20	716.4	15279	442.22	16.80	3.80%	86.59
RodD2_114.9	68	2.918	0.055	824.8	37017.0	706.2	1.20	726.0	15053	374.52	13.97	3.73%	71.94
RodD2_117.4	69	2.982	0.118	831.6	35056.1	714.1	1.20	733.7	14875	358.14	13.38	3.74%	67.75
RodD2_120.8	70	3.068	0.204	825.6	32390.5	724.7	1.20	741.5	14699	385.16	14.75	3.83%	71.75
RodD2_124.8	71	3.170	0.306	821.4	29258.6	736.9	1.20	751.0	14492	415.45	16.52	3.98%	75.98
RodD2_128.6	72	3.266	0.403	819.8	26281.8	748.2	1.20	760.1	14299	440.30	18.32	4.16%	79.13
RodD6_103.1	129	2.619	0.371	786.0	41642.2	667.9	1.20	687.6	16009	423.10	15.78	3.73%	87.91
RodD6_106	130	2.692	0.445	796.8	42407.0	677.4	1.20	697.3	15755	426.33	15.88	3.72%	86.80
RodD6_112.9	131	2.868	0.004	797.0	38685.0	699.8	1.20	716.0	15289	477.82	18.42	3.86%	93.63
RodD6_114.9	132	2.918	0.055	819.3	37103.8	706.2	1.20	725.1	15074	393.82	14.79	3.76%	75.79
RodD6_116.8	133	2.967	0.103	824.9	35599.3	712.2	1.20	731.0	14936	379.17	14.25	3.76%	72.11
RodD6_120.9	134	3.071	0.207	819.4	32350.1	725.0	1.20	740.7	14716	411.47	15.96	3.88%	76.77
RodD6_124.8	135	3.170	0.306	818.7	29260.5	736.9	1.20	750.5	14502	429.27	17.20	4.01%	78.58
RodD6_128.7	136	3.269	0.405	820.1	26170.1	748.4	1.20	760.4	14292	438.21	18.23	4.16%	78.71

Table SC-3214-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h(z) (W/m ² -K)	±σ _{hlc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	595.7	27481.3	503.7	1.20	519.0	22256	358.27	13.91	3.88%	110.35
RodE2_54	74	1.372	0.178	611.4	28527.8	513.9	1.20	530.1	21700	351.15	13.48	3.84%	105.15
RodE2_56.9	75	1.445	0.251	619.3	29308.1	521.8	1.20	538.0	21321	360.84	13.85	3.84%	105.93
RodE2_59.9	76	1.521	0.328	628.6	30113.6	530.2	1.20	546.6	20924	367.38	14.08	3.83%	105.56
RodE2_66	77	1.676	0.483	647.4	31753.9	548.1	1.20	564.6	20135	383.61	14.68	3.83%	105.43
RodE2_69.8	78	1.773	-0.027	626.2	32777.9	559.6	1.20	570.7	19881	590.24	24.98	4.23%	159.84
RodE2_72.9	79	1.852	0.051	666.3	33604.1	569.2	1.20	585.4	19294	415.24	16.01	3.85%	108.53
RodE2_74.9	80	1.902	0.102	680.1	34146.2	575.5	1.20	592.9	19006	391.73	14.89	3.80%	100.56
RodB3_50.2	169	1.275	0.081	592.5	27321.8	503.9	1.20	518.7	22273	370.36	14.51	3.92%	114.17
RodB3_54.1	170	1.374	0.180	603.2	28357.7	514.2	1.20	529.0	21755	382.02	14.94	3.91%	114.72
RodB3_56.9	171	1.445	0.251	611.5	29103.2	521.8	1.20	536.8	21382	389.24	15.20	3.91%	114.64
RodB3_60.1	172	1.527	0.333	619.8	29954.5	530.8	1.20	545.6	20969	404.07	15.81	3.91%	116.39
RodB3_66.1	173	1.679	0.485	643.5	31551.7	548.4	1.20	564.2	20152	398.16	15.37	3.86%	109.54
RodB3_69.9	174	1.775	-0.025	626.1	32563.3	559.9	1.20	570.9	19872	590.58	25.06	4.24%	159.84
RodB3_73	175	1.854	0.054	663.9	33387.2	569.5	1.20	585.2	19300	424.65	16.47	3.88%	111.03
RodB3_75	176	1.905	0.105	677.5	33918.0	575.8	1.20	592.8	19013	400.30	15.30	3.82%	102.81
RodF3_50.1	89	1.273	0.079	600.0	27325.7	503.7	1.20	519.7	22220	340.39	13.10	3.85%	104.65
RodF3_54	90	1.372	0.178	614.5	28384.7	513.9	1.20	530.7	21675	338.60	12.93	3.82%	101.26
RodF3_57	91	1.448	0.254	621.1	29200.6	522.1	1.20	538.6	21296	353.99	13.56	3.83%	103.78
RodF3_60	92	1.524	0.330	630.0	30018.4	530.5	1.20	547.1	20902	361.95	13.85	3.83%	103.88
RodF3_66.1	93	1.679	0.485	642.8	31672.0	548.4	1.20	564.1	20157	402.30	15.54	3.86%	110.71
RodF3_70	94	1.778	-0.022	630.8	32735.6	560.2	1.20	572.0	19829	556.45	23.12	4.16%	150.22
RodF3_73	95	1.854	0.054	671.4	33549.9	569.5	1.20	586.5	19251	395.13	15.10	3.82%	103.00
RodF3_75	96	1.905	0.105	688.3	34091.4	575.8	1.20	594.6	18945	363.75	13.67	3.76%	93.02
RodE6_50.2	121	1.275	0.081	598.5	27310.5	503.9	1.20	519.7	22222	346.67	13.40	3.86%	106.60
RodE6_54.1	122	1.374	0.180	612.5	28336.5	514.2	1.20	530.6	21680	345.95	13.27	3.84%	103.49
RodE6_57	123	1.448	0.254	617.8	29099.3	522.1	1.20	538.0	21321	364.67	14.06	3.85%	107.06
RodE6_60.2	124	1.529	0.335	627.6	29941.8	531.1	1.20	547.2	20899	372.29	14.33	3.85%	106.83
RodE6_66.1	125	1.679	0.485	650.3	31493.8	548.4	1.20	565.4	20104	370.56	14.16	3.82%	101.66
RodE6_70	126	1.778	-0.022	629.7	32522.5	560.2	1.20	571.8	19836	561.31	23.44	4.18%	151.60
RodE6_73.1	127	1.857	0.056	668.6	33334.9	569.8	1.20	586.3	19259	405.03	15.57	3.84%	105.63
RodE6_75	128	1.905	0.105	680.5	33839.2	575.8	1.20	593.2	18994	388.04	14.76	3.80%	99.54

RBHT Steam Cooling Test SC-3214-D

Matrix test # 12

Test date – 4/26/2005

Steady state time window: 19300 - 19700 sec

Inlet flow: 5.95 m³/min (210.0 ft³/min)

Inlet steam temperature: 415 K (287 °F)

Upper plenum pressure: 133.8 kPa (19.4 psia)

Bundle power: 70.0 kW

Outlet steam temperature: 790 K (963 °F)

Bundle inlet Reynolds number: 11080

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

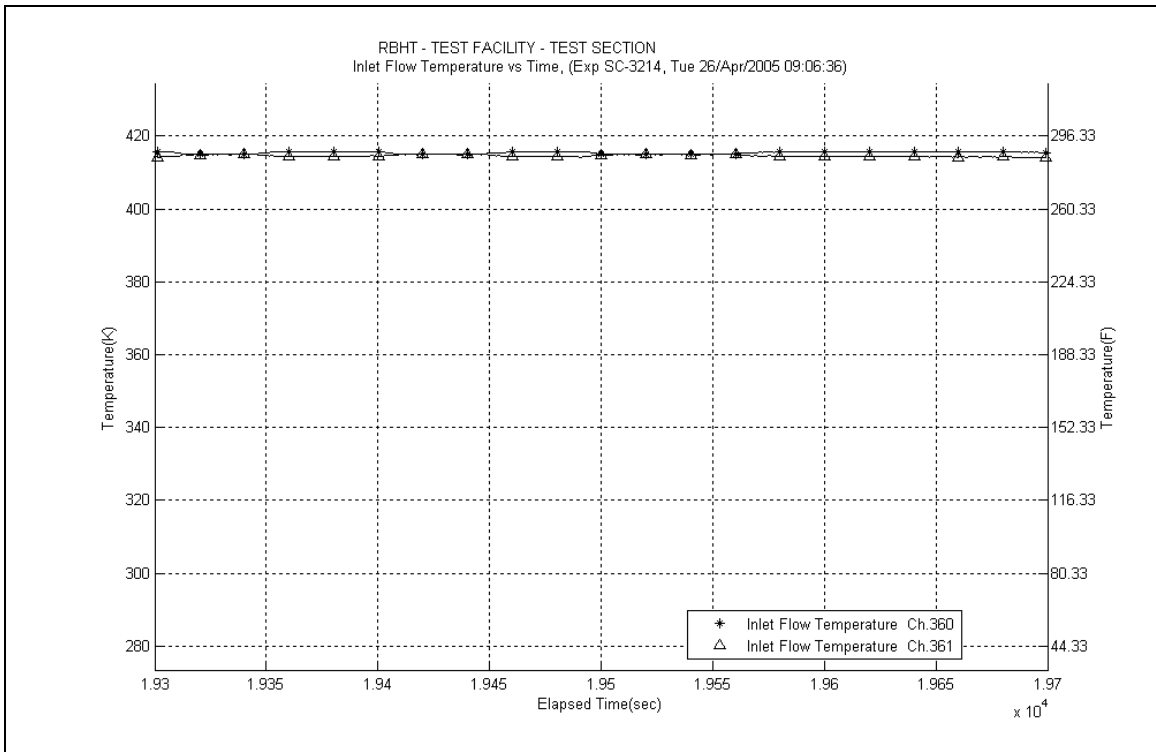
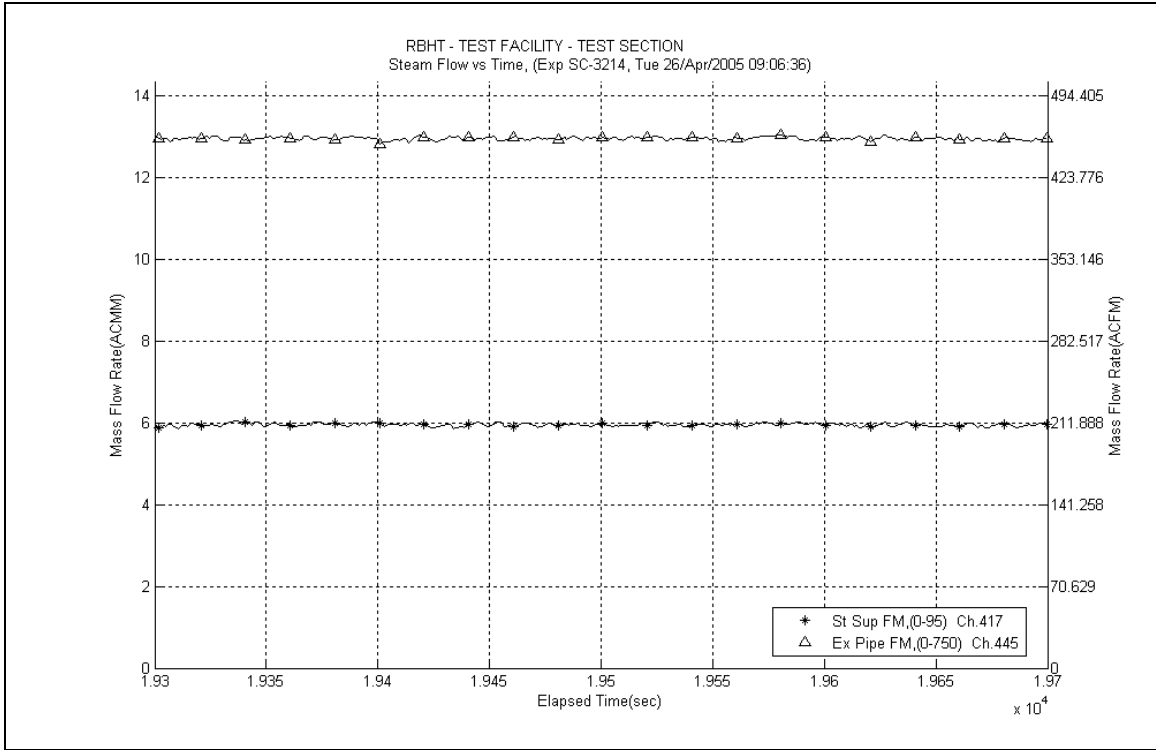
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

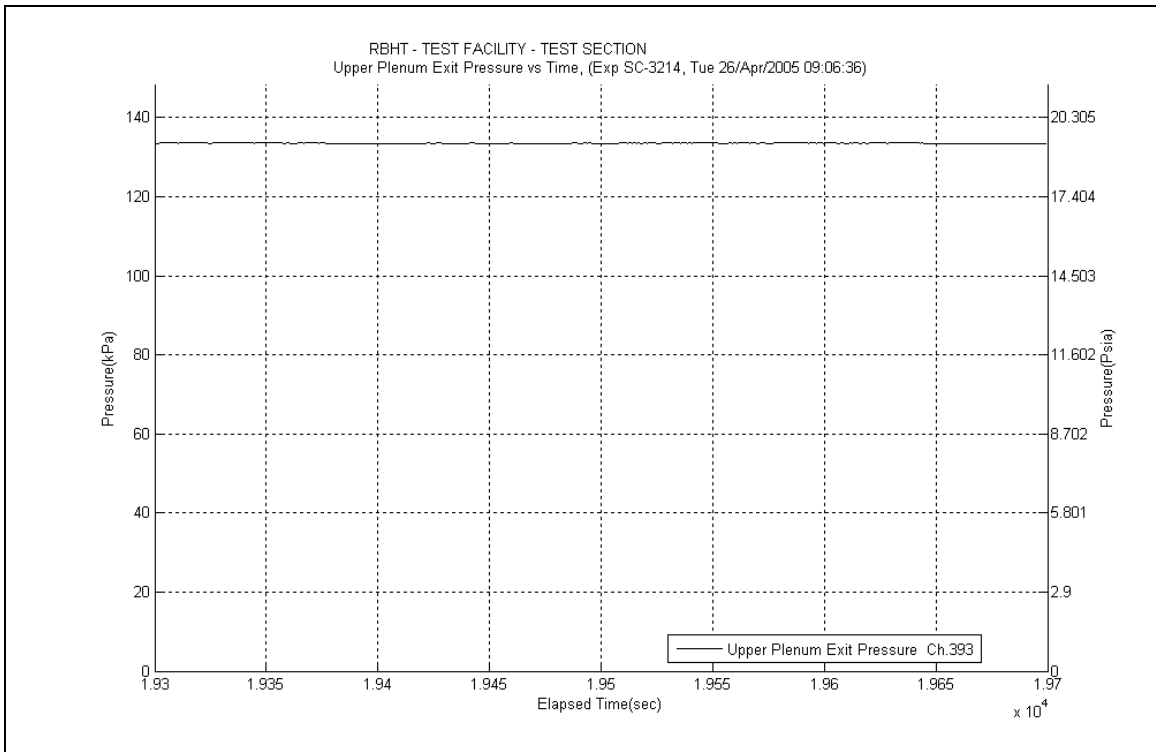
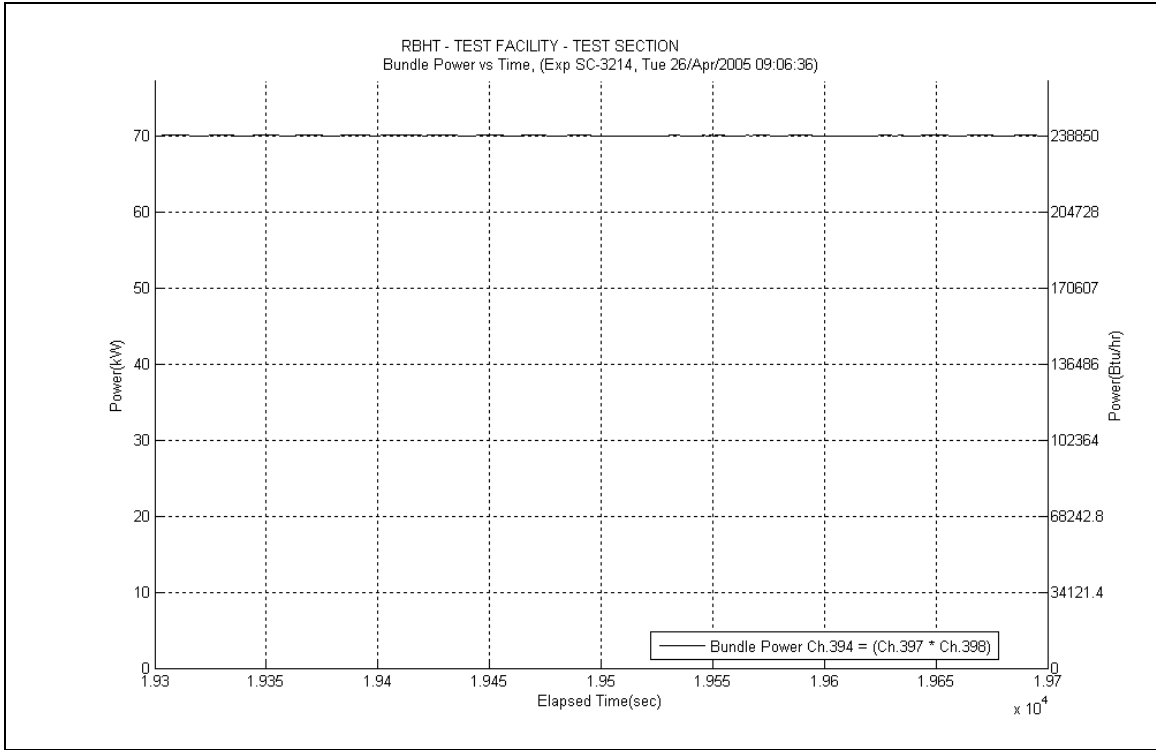
$$T_{cl} = -13.003x^3 + 82.397x^2 - 30.146x + 438.44$$

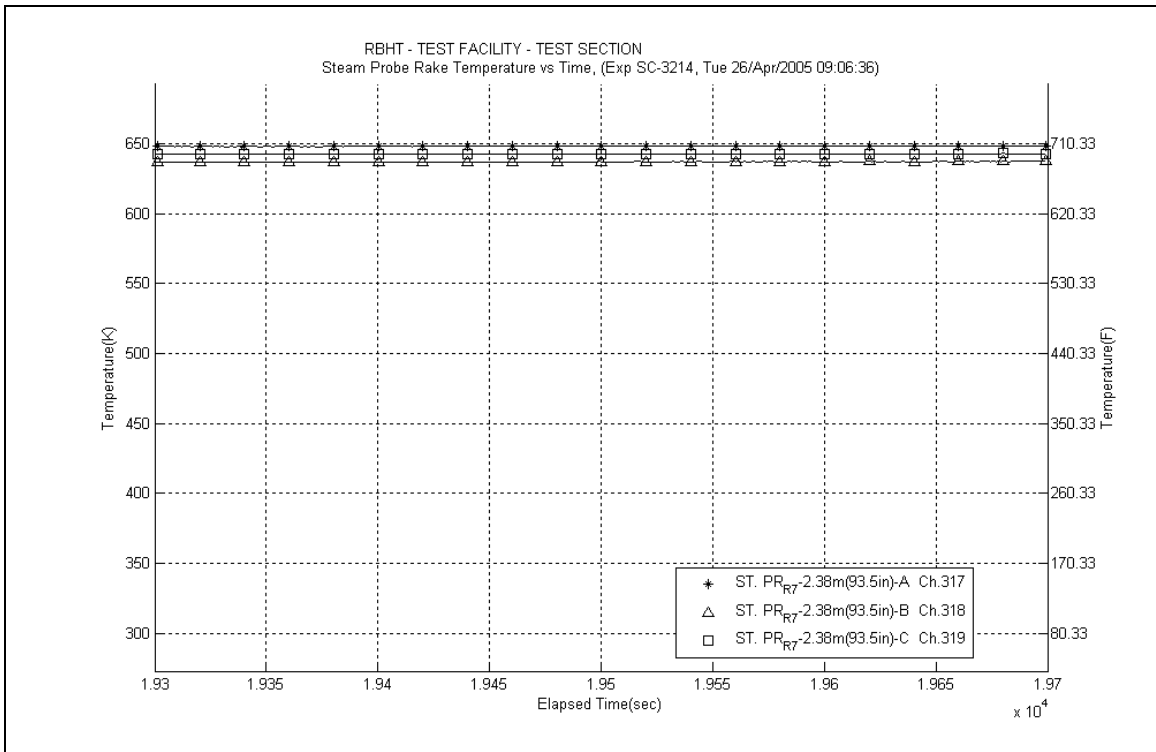
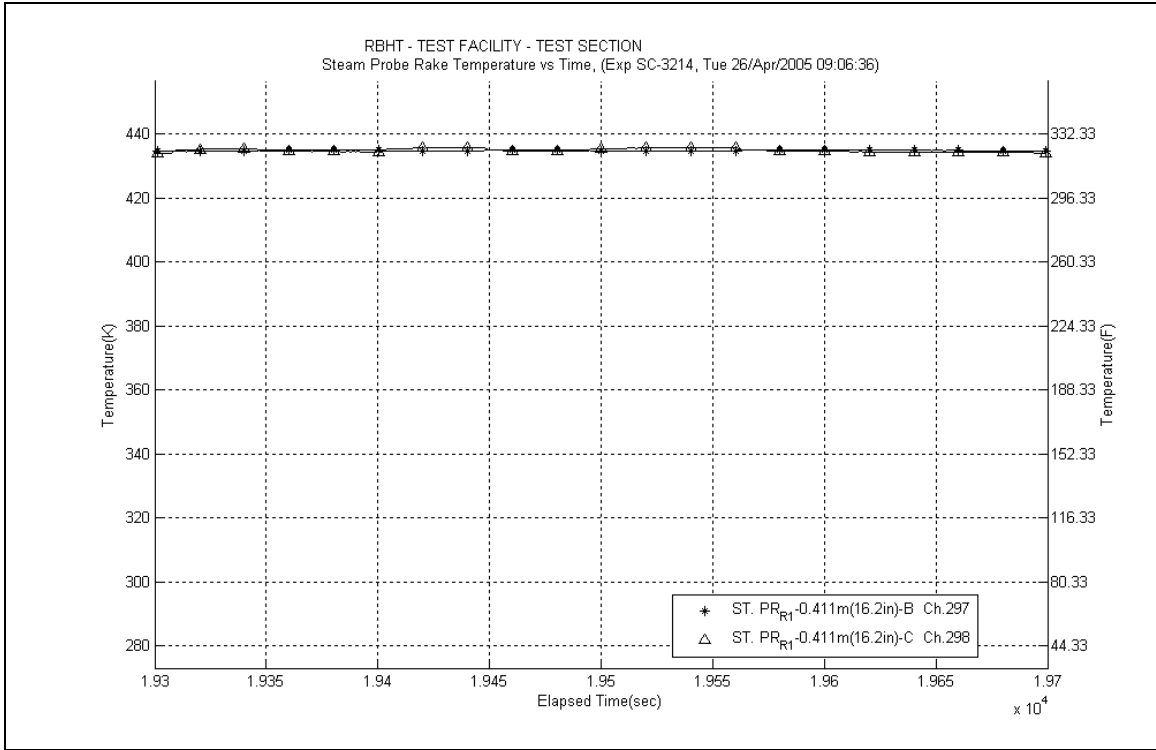
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

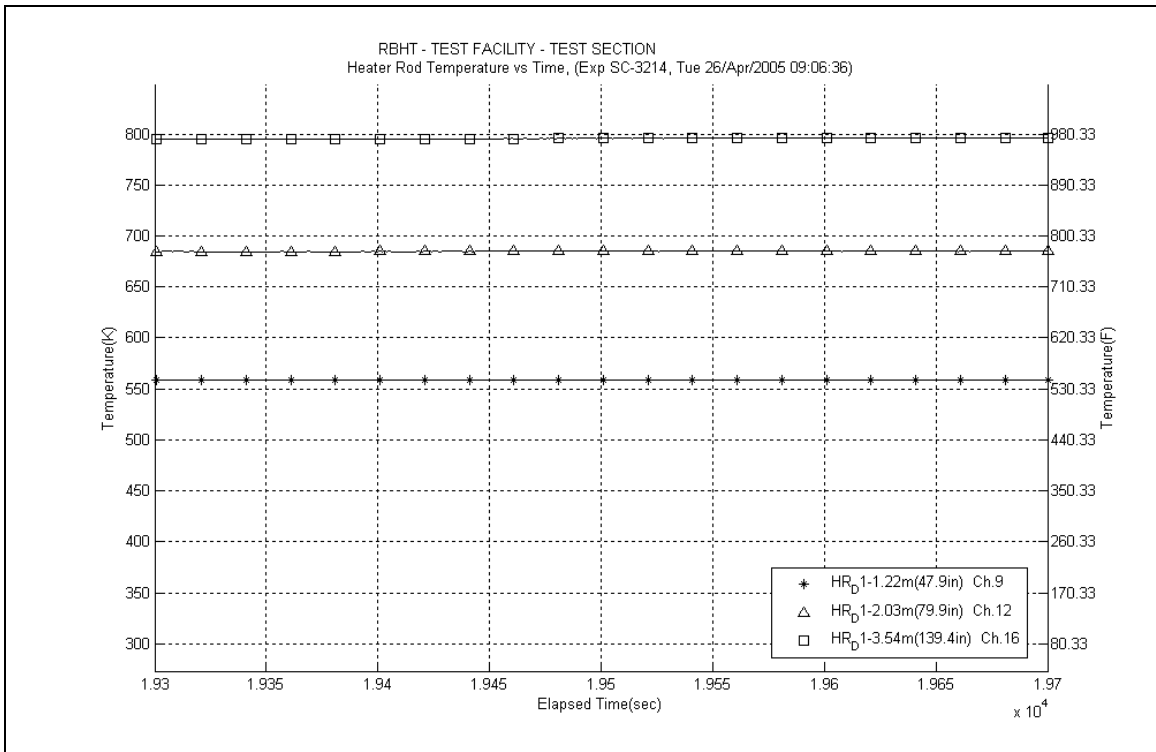
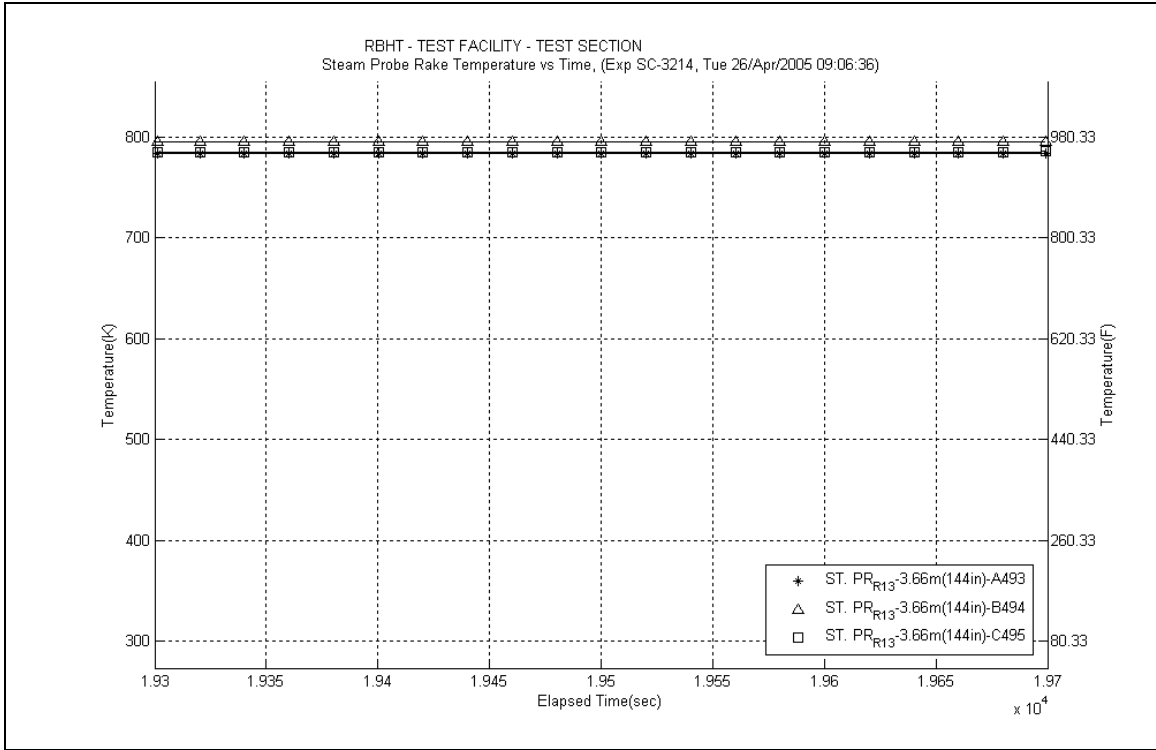
$$T_{cl} = -10.194x^3 + 68.413x^2 - 16.692x + 433.78$$

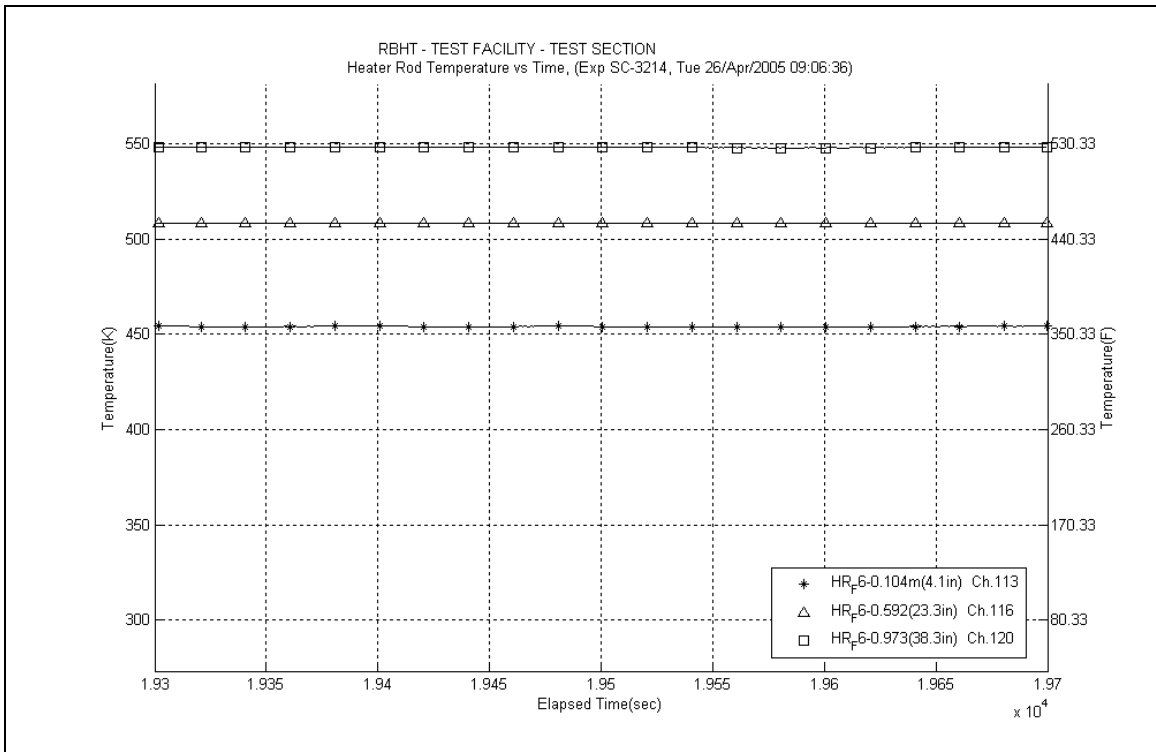
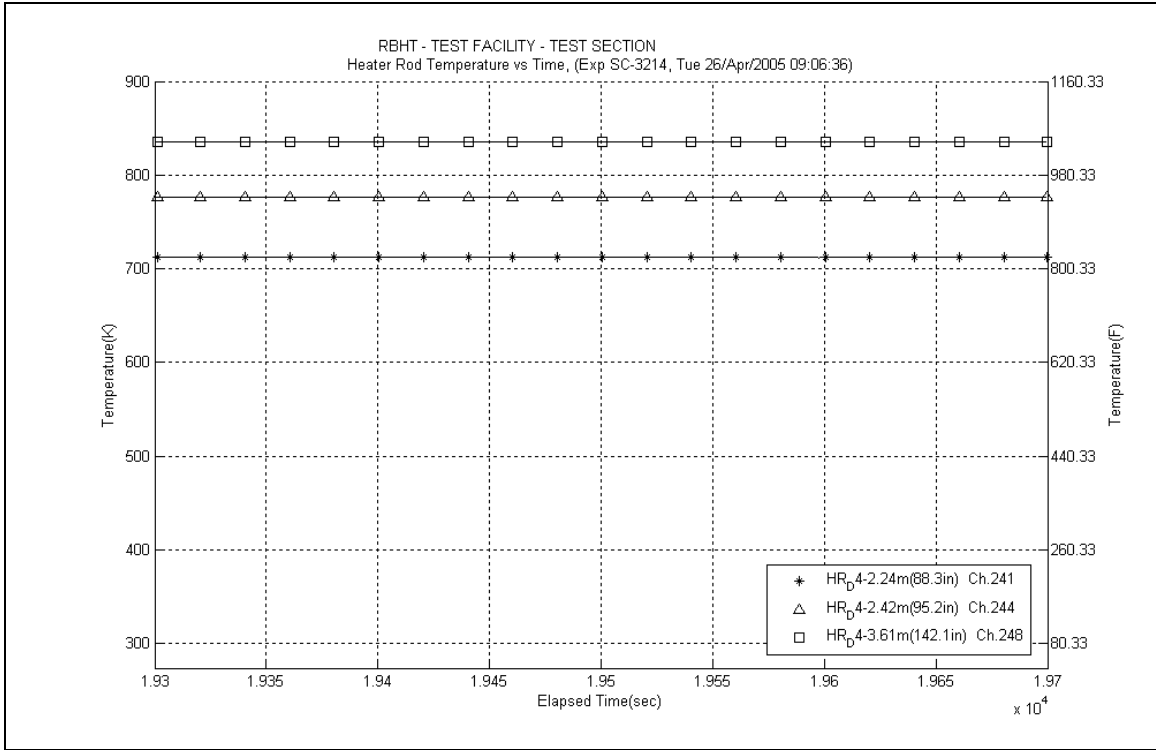
where x is the elevation (m) and T_{cl} is in (K)











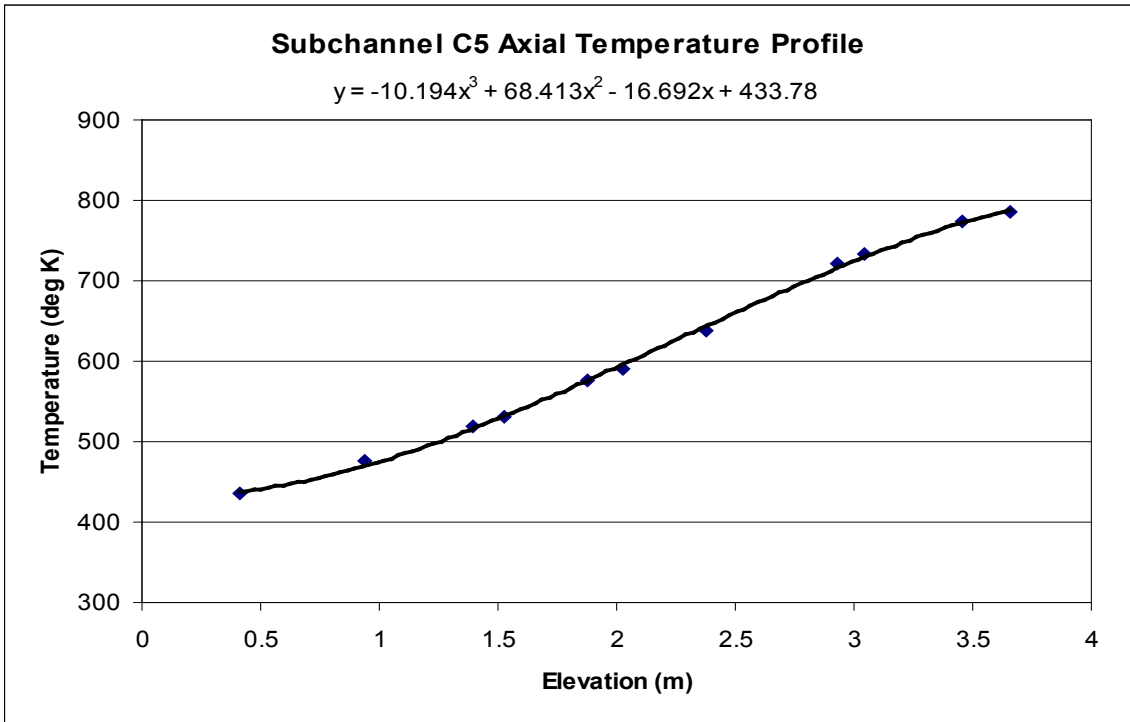
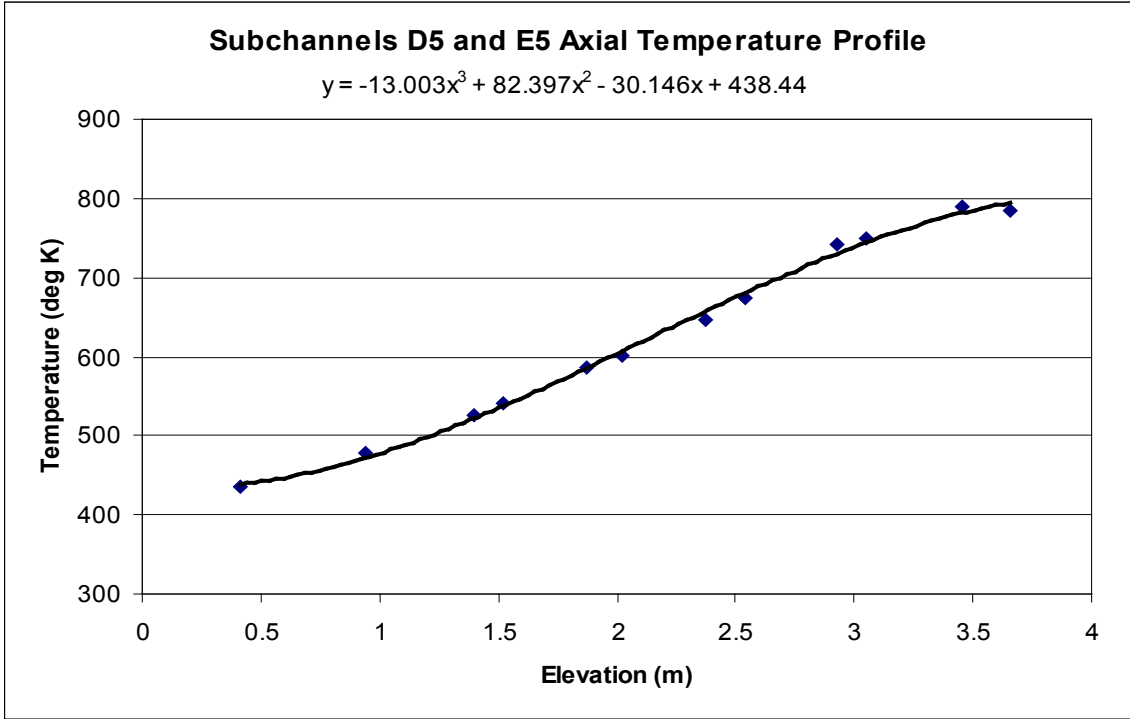


Table SC-3214-D.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	701.3	18744.9	638.6	1.20	649.0	7541	358.84	19.30	7.60%	81.23
RodD3_91.3	186	2.319	0.071	743.8	19140.3	649.5	1.20	665.2	7331	243.61	12.55	7.00%	53.22
RodD3_93.1	187	2.365	0.117	759.9	19380.3	656.0	1.20	673.3	7231	223.71	11.14	6.88%	48.02
RodD3_95.3	188	2.421	0.173	774.2	19671.5	663.8	1.20	682.2	7122	213.89	10.24	6.80%	45.04
RodD3_100.1	189	2.543	0.295	793.5	20307.7	680.7	1.20	699.5	6923	216.14	9.60	6.74%	43.89
RodD3_106.1	190	2.695	0.447	817.6	21102.6	701.1	1.20	720.5	6695	217.45	9.81	6.73%	42.30
RodD3_110	191	2.794	0.546	799.1	20839.2	713.8	1.20	728.0	6617	293.37	13.37	6.94%	56.22
RodD3_142.1	192	3.609	0.218	825.7	7271.9	791.6	1.20	797.3	5982	256.04	22.06	10.92%	43.00
RodC4_88.4	233	2.245	-0.003	708.2	18945.1	639.0	1.20	650.5	7522	328.32	18.60	7.50%	74.08
RodC4_91.1	234	2.314	0.066	745.6	19313.3	648.8	1.20	664.9	7335	239.30	13.10	7.01%	52.31
RodC4_93.4	235	2.372	0.124	760.0	19625.3	657.0	1.20	674.2	7219	228.81	11.94	6.90%	49.02
RodC4_95.3	236	2.421	0.173	774.8	19883.7	663.8	1.20	682.3	7121	214.95	10.80	6.81%	45.26
RodC4_100.1	237	2.543	0.295	790.6	20531.2	680.7	1.20	699.0	6928	224.20	10.08	6.73%	45.58
RodC4_106.1	238	2.695	0.447	812.4	21345.2	701.1	1.20	719.7	6704	230.26	10.24	6.72%	44.87
RodC4_110	239	2.794	0.546	791.9	20654.3	713.8	1.20	726.8	6629	317.29	15.12	7.10%	60.95
RodC4_142.2	240	3.612	0.221	840.8	7881.0	791.8	1.20	799.9	5960	192.96	11.76	8.45%	32.25
RodD4_88.3	241	2.243	-0.005	711.1	18883.4	638.6	1.20	650.7	7520	312.61	15.38	7.23%	70.51
RodD4_91.3	242	2.319	0.071	747.9	19283.0	649.5	1.20	665.9	7323	235.15	11.61	6.90%	51.29
RodD4_93.2	243	2.367	0.119	763.2	19536.4	656.3	1.20	674.1	7220	219.35	10.54	6.81%	47.00
RodD4_95.2	244	2.418	0.170	775.3	19807.3	663.5	1.20	682.1	7124	212.63	9.97	6.76%	44.79
RodD4_100.1	245	2.543	0.295	792.4	20466.0	680.7	1.20	699.3	6925	219.93	9.52	6.71%	44.68
RodD4_106.1	246	2.695	0.447	813.3	21270.0	701.1	1.20	719.8	6702	227.49	10.16	6.72%	44.32
RodD4_110	247	2.794	0.546	792.7	20539.5	713.8	1.20	727.0	6628	312.34	14.50	7.07%	59.98
RodD4_142.1	248	3.609	0.218	835.4	7621.0	791.6	1.20	798.9	5969	209.07	11.54	8.55%	35.01
RodE4_88.4	201	2.245	-0.003	704.6	18602.6	639.0	1.20	649.9	7530	340.28	18.14	7.53%	76.89
RodE4_91.2	202	2.316	0.069	742.1	18959.9	649.1	1.20	664.6	7339	244.64	12.95	7.06%	53.51
RodE4_95.3	204	2.421	0.173	771.9	19484.0	663.8	1.20	681.8	7127	216.33	10.72	6.87%	45.60
RodE4_100.9	205	2.563	0.315	793.1	20204.4	683.5	1.20	701.8	6898	221.29	10.46	6.82%	44.73
RodE4_142.3	208	3.614	0.224	830.1	7701.4	791.9	1.20	798.3	5974	242.02	18.10	9.84%	40.57
RodE3_63.4	193	1.610	0.417	644.1	15407.6	549.3	1.20	565.1	8863	195.00	7.14	6.73%	53.84
RodE3_113.6	194	2.885	0.022	808.9	18983.2	725.1	1.20	739.1	6507	271.83	15.46	7.26%	50.97
RodE3_115.5	195	2.934	0.070	824.9	18280.3	730.8	1.20	746.5	6434	233.29	13.06	7.10%	43.11
RodE3_118.5	196	3.010	0.146	837.3	17162.9	739.6	1.20	755.9	6345	210.89	11.71	7.04%	38.27
RodE3_122.7	197	3.117	0.253	839.7	15605.5	751.2	1.20	765.9	6253	211.46	11.18	7.09%	37.64
RodE3_126.5	198	3.213	0.349	835.6	14194.0	760.9	1.20	773.3	6186	228.16	12.00	7.29%	40.05
RodE3_131.7	199	3.345	-0.046	808.5	12266.2	772.9	1.20	778.8	6138	413.26	29.11	9.76%	71.80
RodE3_135.6	200	3.444	0.053	822.6	10821.4	780.8	1.20	787.7	6062	310.80	29.58	10.30%	53.11

Table SC-3214-D.1: Summary of Steam Cooling Data (cont.)

H.R.	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	642.6	15102.1	550.3	1.20	565.7	8852	196.30	6.91	6.77%	54.12
RodC5_113.6	226	2.885	0.022	806.3	18509.7	725.1	1.20	738.6	6511	273.41	17.65	7.54%	51.31
RodC5_115.7	227	2.939	0.075	826.8	17768.6	731.4	1.20	747.3	6426	223.46	13.71	7.24%	41.22
RodC5_122.7	229	3.117	0.253	840.2	15302.0	751.2	1.20	766.0	6252	206.18	11.00	7.13%	36.70
RodC5_126.7	230	3.218	0.354	838.1	13892.6	761.4	1.20	774.2	6179	217.20	11.49	7.29%	38.07
RodC5_131.6	231	3.343	-0.048	814.9	12167.4	772.7	1.20	779.7	6131	346.08	21.47	8.82%	60.03
RodC5_135.7	232	3.447	0.056	831.4	10717.8	781.0	1.20	789.4	6048	254.84	18.62	8.77%	43.42
RodE5_63.6	209	1.615	0.422	634.6	15483.5	549.9	1.20	564.1	8882	219.43	7.45	6.74%	60.74
RodE5_113.6	210	2.885	0.022	807.0	19096.8	725.1	1.20	738.7	6510	279.93	21.95	7.80%	52.52
RodE5_115.4	211	2.931	0.067	818.8	18442.4	730.5	1.20	745.2	6446	250.78	18.08	7.52%	46.45
RodE5_118.7	212	3.015	0.151	825.9	17234.9	740.2	1.20	754.5	6358	241.22	16.49	7.47%	43.89
RodE5_122.6	213	3.114	0.250	830.0	15807.7	750.9	1.20	764.1	6269	239.86	16.30	7.58%	42.85
RodE5_126.6	214	3.216	0.352	827.3	14348.7	761.1	1.20	772.2	6197	260.27	17.36	7.88%	45.79
RodE5_131.6	215	3.343	-0.048	802.3	12515.1	772.7	1.20	777.6	6149	506.15	53.95	12.36%	88.14
RodE5_135.6	216	3.444	0.053	820.5	11060.9	780.8	1.20	787.4	6065	334.07	42.57	11.80%	57.13
RodC3_79.8	177	2.027	0.227	687.7	17514.7	607.6	1.20	620.9	7938	262.21	11.60	7.02%	63.28
RodC3_85.6	178	2.174	0.374	693.4	18279.4	628.8	1.20	639.5	7671	339.18	16.76	7.42%	78.44
RodC3_88.5	179	2.248	0.000	701.6	18656.7	639.3	1.20	649.7	7533	359.56	21.50	7.82%	81.28
RodC3_92.4	180	2.347	0.099	744.6	19173.1	653.4	1.20	668.6	7288	252.41	13.63	7.10%	54.73
RodC3_94.4	181	2.398	0.150	750.9	19433.1	660.6	1.20	675.7	7201	258.41	13.01	7.03%	55.19
RodC3_97.2	182	2.469	0.221	775.6	19797.6	670.6	1.20	688.1	7053	226.17	11.33	6.89%	47.05
RodC3_108.8	183	2.764	0.516	811.2	20875.3	710.0	1.20	726.8	6630	247.49	11.95	6.88%	47.54
RodD5_50	217	1.270	0.076	593.8	13677.6	506.4	1.20	521.0	9756	187.74	7.05	6.78%	58.07
RodD5_54.1	218	1.374	0.180	616.8	14217.2	518.9	1.20	535.2	9450	174.15	6.36	6.70%	51.90
RodD5_56.9	219	1.445	0.251	625.5	14586.1	527.7	1.20	544.0	9269	178.93	6.27	6.68%	52.11
RodD5_60	220	1.524	0.330	631.9	14992.8	537.8	1.20	553.5	9082	191.30	6.39	6.67%	54.38
RodD5_66.1	221	1.679	0.485	649.0	15791.2	558.5	1.20	573.6	8708	209.40	7.57	6.74%	56.60
RodD5_69.9	222	1.775	-0.025	628.4	16289.5	571.9	1.20	581.3	8573	346.00	14.29	7.32%	91.77
RodD5_72.9	223	1.852	0.051	666.1	16682.8	582.6	1.20	596.5	8318	239.77	10.38	6.93%	61.29
RodD5_74.9	224	1.902	0.102	683.4	16942.5	589.8	1.20	605.4	8176	217.11	9.40	6.85%	54.34

Table SC-3214-D.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hic} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	570.1	12424.9	479.1	1.20	494.2	10386	163.87	4.95	5.87%	54.45
RodB5_52.9	154	1.344	0.150	610.7	14004.9	510.1	1.20	526.9	9626	167.06	6.83	6.75%	50.87
RodB5_55	155	1.397	0.203	618.7	14281.8	516.2	1.20	533.3	9490	167.14	6.76	6.73%	50.06
RodB5_57.8	156	1.468	0.274	626.1	14654.9	524.5	1.20	541.4	9322	172.99	6.57	6.70%	50.73
RodB5_64	157	1.626	0.432	642.2	15477.7	543.6	1.20	560.1	8957	188.42	7.03	6.71%	52.68
RodB5_73.9	158	1.877	0.077	674.3	16794.3	576.1	1.20	592.5	8384	205.10	9.01	6.81%	52.94
RodB5_75.9	159	1.928	0.128	687.4	17059.7	582.8	1.20	600.2	8257	195.86	8.39	6.76%	49.62
RodB5_76.9	160	1.953	0.153	692.4	17188.3	586.2	1.20	603.9	8199	194.21	8.25	6.75%	48.77
RodF5_41	105	1.041	0.343	561.9	12362.0	479.1	1.20	492.9	10420	179.04	5.15	5.93%	59.71
RodF5_53.1	106	1.349	0.155	601.4	13966.8	510.7	1.20	525.8	9650	184.71	7.30	6.82%	56.40
RodF5_55	107	1.397	0.203	608.5	14220.2	516.2	1.20	531.6	9526	184.82	7.03	6.78%	55.59
RodF5_57.8	108	1.468	0.274	616.6	14592.9	524.5	1.20	539.8	9354	190.11	6.90	6.75%	55.97
RodF5_64	109	1.626	0.432	633.5	15415.4	543.6	1.20	558.6	8984	205.79	7.54	6.77%	57.75
RodF5_73.8	110	1.875	0.074	659.4	16712.3	575.7	1.20	589.7	8431	239.77	10.89	6.99%	62.31
RodF5_75.8	111	1.925	0.125	671.7	16972.7	582.5	1.20	597.4	8304	228.34	9.90	6.91%	58.25
RodF5_76.8	112	1.951	0.150	675.7	17109.2	585.9	1.20	600.9	8248	228.56	9.64	6.88%	57.82
RodC2_41	57	1.041	0.343	562.5	12408.5	479.1	1.20	493.0	10417	178.55	5.40	5.94%	59.53
RodC2_53.1	58	1.349	0.155	605.6	14016.5	510.7	1.20	526.5	9635	177.25	6.76	6.75%	54.03
RodC2_55	59	1.397	0.203	611.3	14269.9	516.2	1.20	532.0	9516	179.95	6.64	6.73%	54.06
RodC2_57.8	60	1.468	0.274	618.0	14640.4	524.5	1.20	540.1	9350	187.91	6.52	6.71%	55.29
RodC2_63.9	61	1.623	0.429	633.0	15450.4	543.3	1.20	558.3	8990	206.68	7.20	6.73%	58.05
RodC2_73.8	62	1.875	0.074	660.7	16763.7	575.7	1.20	589.9	8427	236.67	10.75	6.97%	61.47
RodC2_75.8	63	1.925	0.125	671.6	17034.4	582.5	1.20	597.3	8304	229.34	10.08	6.89%	58.51
RodC2_76.8	64	1.951	0.150	675.8	17164.9	585.9	1.20	600.9	8247	229.10	10.00	6.89%	57.96
RodC6_40.9	137	1.039	0.340	564.5	12348.8	478.8	1.20	493.1	10414	173.03	4.79	5.87%	57.67
RodC6_52.8	138	1.341	0.147	607.2	13999.4	509.9	1.20	526.1	9644	172.55	6.54	6.73%	52.66
RodC6_54.8	139	1.392	0.198	615.0	14275.3	515.6	1.20	532.2	9514	172.37	6.34	6.70%	51.77
RodC6_57.8	140	1.468	0.274	624.5	14686.6	524.5	1.20	541.1	9327	176.17	6.20	6.67%	51.69
RodC6_63.8	141	1.621	0.427	642.9	15521.9	543.0	1.20	559.7	8964	186.52	6.59	6.66%	52.20
RodC6_73.7	142	1.872	0.072	674.2	16891.5	575.4	1.20	591.9	8394	205.22	8.50	6.76%	53.05
RodC6_75.8	143	1.925	0.125	684.3	17181.0	582.5	1.20	599.5	8270	202.51	8.18	6.73%	51.40
RodC6_76.8	144	1.951	0.150	690.5	17318.0	585.9	1.20	603.3	8208	198.72	7.94	6.70%	49.98

Table SC-3214-D.1: Summary of Steam Cooling Data (cont.)

H.R.	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hic} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	701.3	18581.1	625.8	1.20	638.4	7687	295.20	12.61	7.05%	68.44
RodB4_91.3	162	2.319	0.071	740.6	18951.5	635.9	1.20	653.3	7485	217.14	9.45	6.80%	48.69
RodB4_93.3	163	2.370	0.122	752.0	19205.8	642.8	1.20	661.0	7385	211.01	8.80	6.74%	46.53
RodB4_95.1	164	2.416	0.168	766.3	19439.9	649.0	1.20	668.5	7289	198.74	8.38	6.71%	43.10
RodB4_100	165	2.540	0.292	783.0	20066.2	665.7	1.20	685.3	7087	205.31	8.39	6.70%	42.96
RodB4_106	166	2.692	0.445	806.2	20835.5	685.8	1.20	705.9	6852	207.71	8.46	6.69%	41.63
RodB4_109.9	167	2.791	0.544	782.0	20165.8	698.5	1.20	712.4	6781	290.00	11.09	6.88%	57.35
RodB4_142.3	168	3.614	0.224	834.9	7824.0	785.8	1.20	794.0	6009	191.49	11.79	8.47%	32.35
RodF4_85.6	98	2.174	0.374	694.6	18343.1	616.1	1.20	629.2	7817	280.54	12.05	7.00%	66.42
RodF4_88.4	99	2.245	-0.003	699.7	18713.6	625.8	1.20	638.1	7690	303.87	14.38	7.18%	70.49
RodF4_92.4	100	2.347	0.099	744.0	19236.9	639.7	1.20	657.1	7436	221.17	10.03	6.81%	49.19
RodF4_94.3	101	2.395	0.147	757.9	19481.6	646.2	1.20	664.8	7336	209.35	9.21	6.75%	45.77
RodF4_97.2	102	2.469	0.221	774.0	19864.4	656.2	1.20	675.8	7200	202.38	8.59	6.70%	43.21
RodF4_108.8	103	2.764	0.516	803.1	20982.3	695.0	1.20	713.0	6775	232.90	9.79	6.73%	46.00
RodF4_111	104	2.819	-0.044	774.1	20124.3	702.1	1.20	714.1	6763	335.10	12.61	6.95%	66.05
RodD2_103.2	65	2.621	0.373	786.8	20756.9	676.5	1.20	694.9	6975	225.78	9.24	6.70%	46.30
RodD2_106	66	2.692	0.445	796.4	21121.2	685.8	1.20	704.2	6870	229.13	9.30	6.69%	46.08
RodD2_112.6	67	2.860	-0.004	785.2	19379.5	707.2	1.20	720.2	6698	297.83	14.01	7.11%	57.98
RodD2_114.9	68	2.918	0.055	806.7	18477.1	714.4	1.20	729.8	6600	240.21	10.94	6.92%	45.87
RodD2_117.4	69	2.982	0.118	816.0	17499.6	722.0	1.20	737.7	6520	223.41	10.37	6.92%	42.00
RodD2_120.8	70	3.068	0.204	822.7	16169.6	732.2	1.20	747.3	6427	214.25	9.70	6.94%	39.53
RodD2_124.8	71	3.170	0.306	819.6	14606.9	743.6	1.20	756.3	6341	230.52	9.81	7.05%	41.80
RodD2_128.6	72	3.266	0.403	816.7	13111.0	753.9	1.20	764.4	6267	250.76	10.98	7.31%	44.77
RodD6_103.1	129	2.619	0.371	783.3	20781.6	676.2	1.20	694.0	6985	232.83	8.90	6.67%	47.83
RodD6_106	130	2.692	0.445	791.2	21165.8	685.8	1.20	703.4	6879	240.95	9.33	6.69%	48.54
RodD6_112.9	131	2.868	0.004	784.4	19315.2	708.1	1.20	720.8	6692	303.75	15.01	7.19%	59.06
RodD6_114.9	132	2.918	0.055	806.3	18518.2	714.4	1.20	729.7	6600	241.62	12.12	7.00%	46.15
RodD6_116.8	133	2.967	0.103	817.1	17767.9	720.2	1.20	736.4	6533	220.00	10.59	6.92%	41.47
RodD6_120.9	134	3.071	0.207	821.2	16152.9	732.5	1.20	747.3	6427	218.41	9.99	6.96%	40.30
RodD6_124.8	135	3.170	0.306	819.2	14604.7	743.6	1.20	756.2	6342	231.82	9.75	7.04%	42.04
RodD6_128.7	136	3.269	0.405	819.4	13063.0	754.2	1.20	765.0	6261	240.38	10.34	7.24%	42.86

Table SC-3214-D.1: Summary of Steam Cooling Data (cont.)

H.R.	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hfc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	587.7	13725.3	502.3	1.20	516.5	9856	192.96	8.07	6.88%	60.39
RodE2_54	74	1.372	0.178	606.9	14248.1	513.3	1.20	528.9	9584	182.64	7.04	6.75%	55.33
RodE2_56.9	75	1.445	0.251	618.0	14636.8	521.8	1.20	537.8	9396	182.52	6.84	6.72%	54.02
RodE2_59.9	76	1.521	0.328	624.8	15041.1	530.8	1.20	546.5	9220	192.20	6.70	6.69%	55.62
RodE2_66	77	1.676	0.483	639.4	15856.7	550.0	1.20	564.9	8866	212.95	7.84	6.75%	58.82
RodE2_69.8	78	1.773	-0.027	618.3	16365.7	562.4	1.20	571.7	8742	351.68	15.21	7.40%	95.50
RodE2_72.9	79	1.852	0.051	654.4	16783.6	572.7	1.20	586.3	8487	246.54	11.27	6.99%	64.59
RodE2_74.9	80	1.902	0.102	669.6	17048.0	579.4	1.20	594.5	8351	226.89	10.44	6.91%	58.28
RodB3_50.2	169	1.275	0.081	585.2	13633.1	502.6	1.20	516.4	9860	197.97	8.66	6.96%	61.99
RodB3_54.1	170	1.374	0.180	597.3	14150.6	513.6	1.20	527.5	9613	202.80	8.29	6.89%	61.65
RodB3_56.9	171	1.445	0.251	606.6	14523.4	521.8	1.20	535.9	9435	205.36	8.33	6.87%	61.08
RodB3_60.1	172	1.527	0.333	612.5	14945.7	531.5	1.20	545.0	9250	221.31	8.67	6.88%	64.30
RodB3_66.1	173	1.679	0.485	636.7	15742.8	550.4	1.20	564.7	8869	218.82	8.84	6.85%	60.47
RodB3_69.9	174	1.775	-0.025	618.6	16247.4	562.7	1.20	572.1	8736	349.34	15.77	7.48%	94.79
RodB3_73	175	1.854	0.054	654.2	16660.7	573.1	1.20	586.6	8483	246.44	11.03	6.99%	64.53
RodB3_75	176	1.905	0.105	669.8	16924.8	579.8	1.20	594.8	8346	225.58	9.99	6.89%	57.90
RodF3_50.1	89	1.273	0.079	591.4	13647.8	502.3	1.20	517.2	9842	183.91	7.65	6.86%	57.46
RodF3_54	90	1.372	0.178	608.5	14177.4	513.3	1.20	529.2	9578	178.68	6.77	6.75%	54.09
RodF3_57	91	1.448	0.254	617.2	14583.8	522.1	1.20	537.9	9393	184.05	6.61	6.71%	54.46
RodF3_60	92	1.524	0.330	624.6	14988.0	531.2	1.20	546.7	9215	192.44	6.57	6.69%	55.66
RodF3_66.1	93	1.679	0.485	634.2	15821.5	550.4	1.20	564.3	8877	226.44	8.28	6.80%	62.64
RodF3_70	94	1.778	-0.022	622.4	16347.6	563.1	1.20	573.0	8720	330.49	14.88	7.38%	89.47
RodF3_73	95	1.854	0.054	659.9	16751.5	573.1	1.20	587.5	8467	231.43	10.90	6.97%	60.46
RodF3_75	96	1.905	0.105	678.4	17024.6	579.8	1.20	596.2	8323	207.23	9.66	6.85%	53.01
RodE6_50.2	121	1.275	0.081	589.1	13633.7	502.6	1.20	517.0	9845	189.15	7.88	6.88%	59.12
RodE6_54.1	122	1.374	0.180	607.5	14146.4	513.6	1.20	529.2	9576	180.78	7.13	6.78%	54.71
RodE6_57	123	1.448	0.254	616.0	14528.7	522.1	1.20	537.7	9397	185.62	7.07	6.76%	54.95
RodE6_60.2	124	1.529	0.335	623.2	14948.3	531.8	1.20	547.0	9209	196.22	7.06	6.74%	56.72
RodE6_66.1	125	1.679	0.485	641.0	15724.9	550.4	1.20	565.5	8856	208.20	8.12	6.80%	57.43
RodE6_70	126	1.778	-0.022	621.5	16236.9	563.1	1.20	572.8	8722	333.40	14.78	7.39%	90.29
RodE6_73.1	127	1.857	0.056	658.8	16643.7	573.4	1.20	587.6	8465	233.90	11.02	7.00%	61.09
RodE6_75	128	1.905	0.105	673.5	16891.0	579.8	1.20	595.4	8336	216.30	9.97	6.90%	55.44

RBHT Steam Cooling Test SC-3214-E

Matrix test # 20

Test date – 4/26/2005

Steady state time window: 27300 - 27600 sec

Inlet flow: 4.81 m³/min (169.9 ft³/min)

Inlet steam temperature: 426 K (307 °F)

Upper plenum pressure: 409.5 kPa (59.4 psia)

Bundle power: 139.8 kW

Outlet steam temperature: 780 K (945 °F)

Bundle inlet Reynolds number: 26858

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

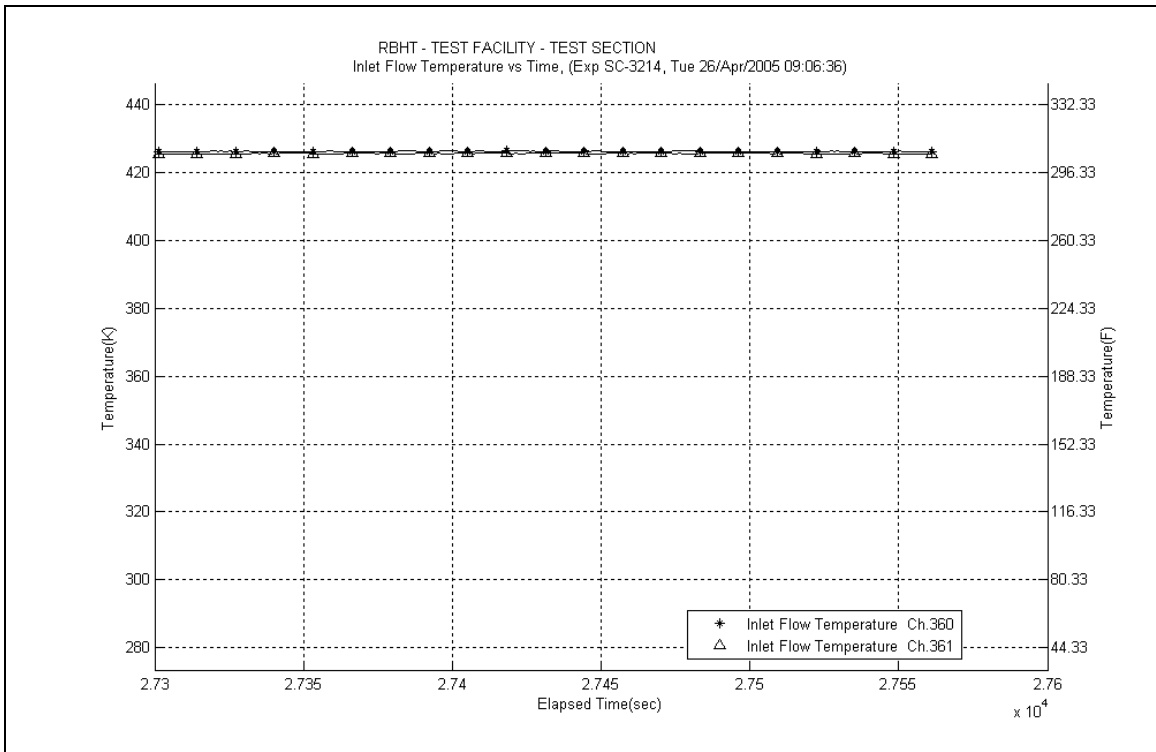
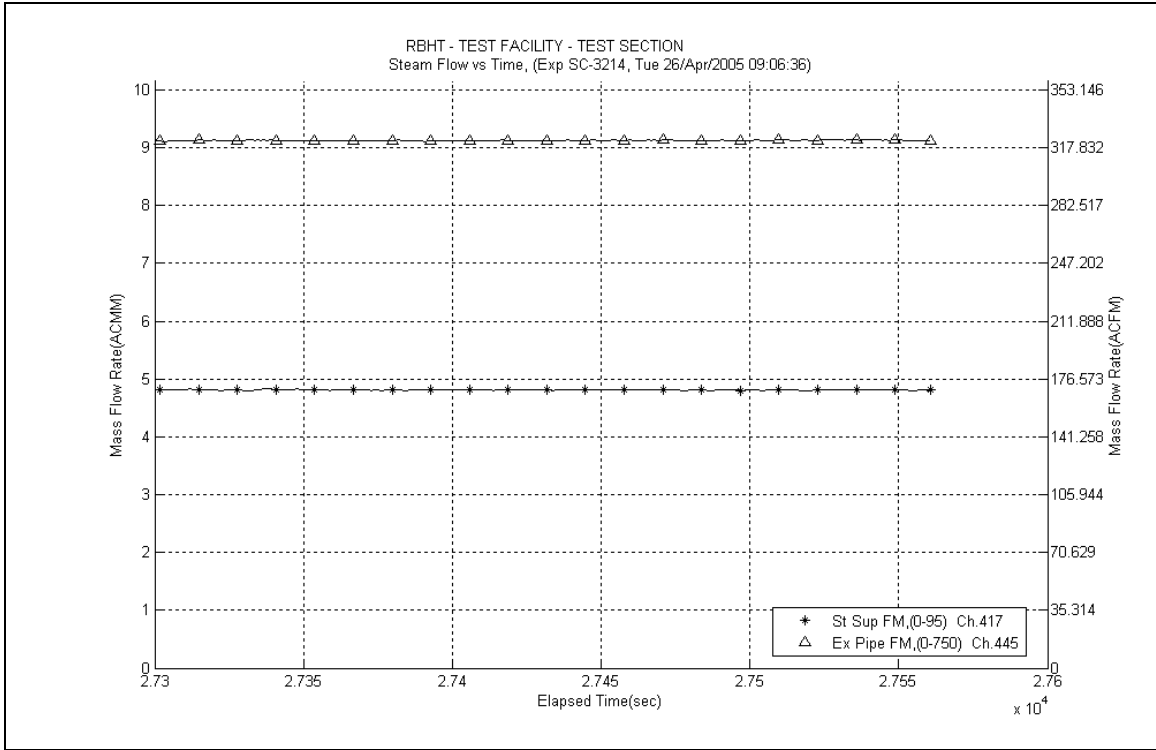
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

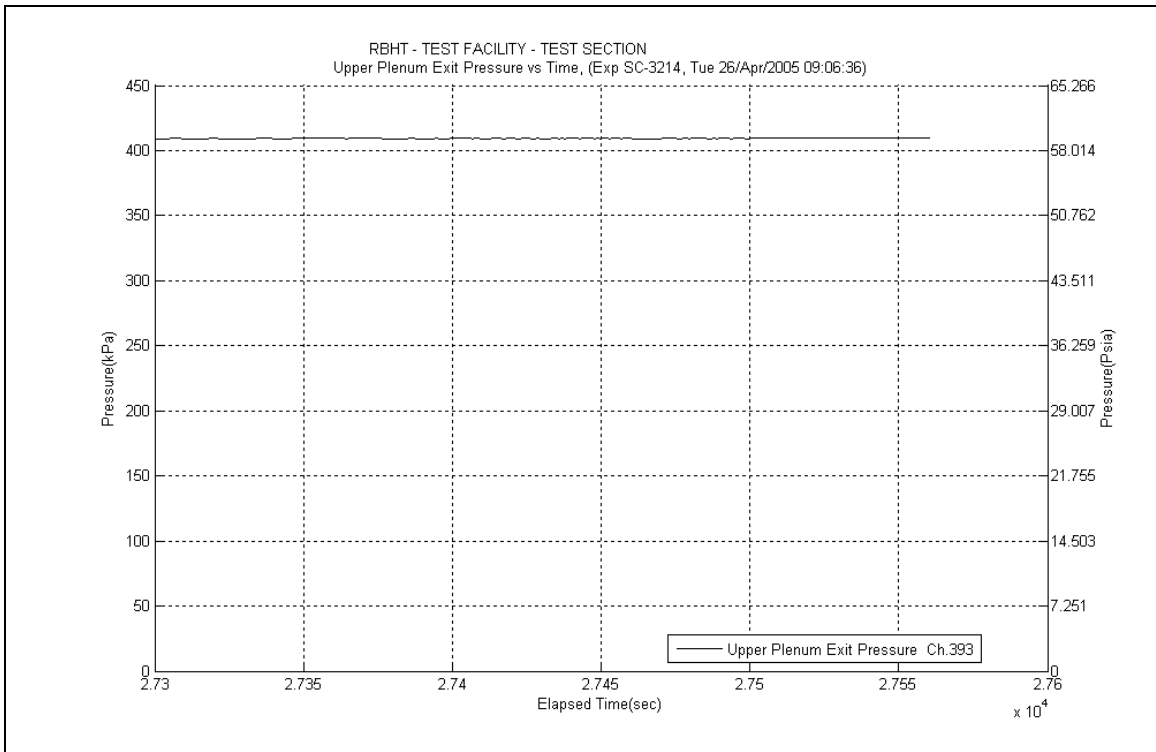
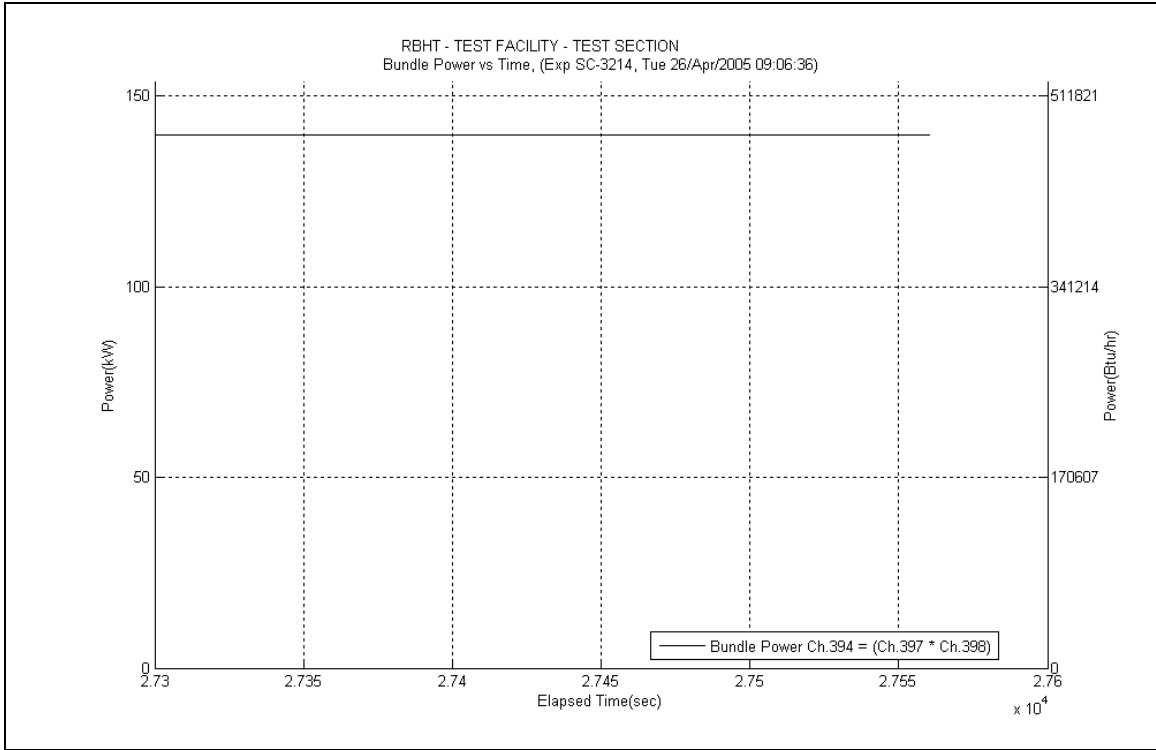
$$T_{cl} = -13.241x^3 + 84.47x^2 - 39.173x + 448.99$$

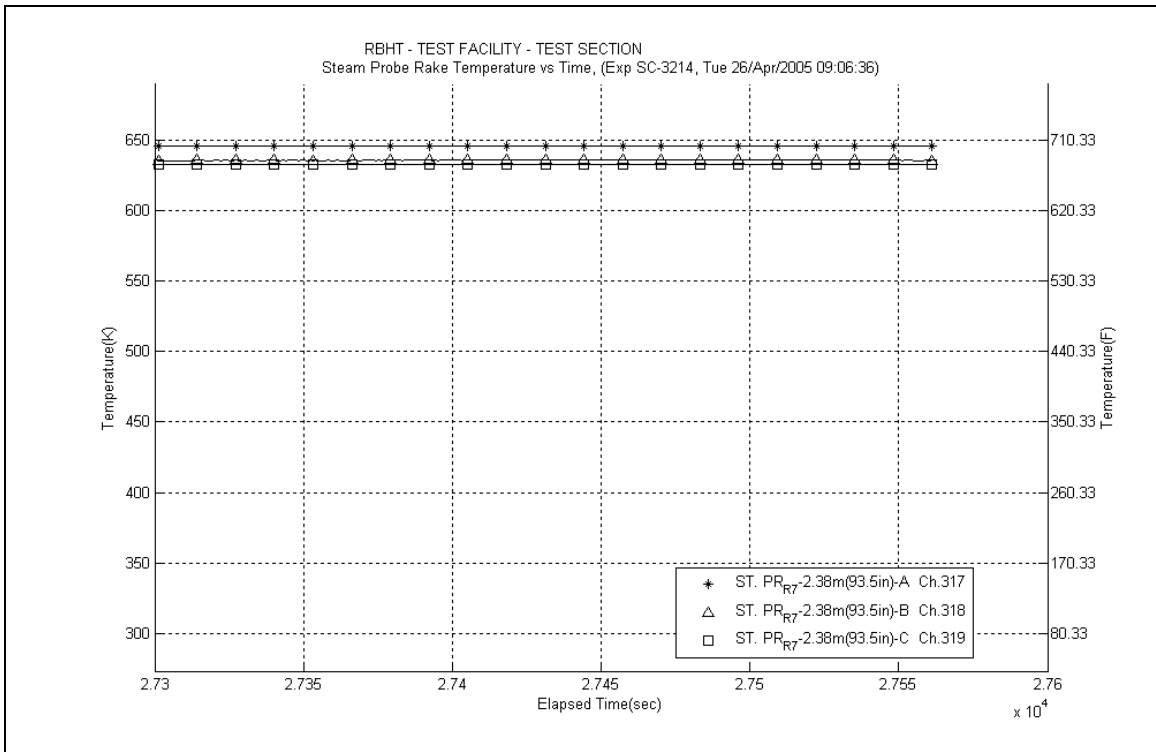
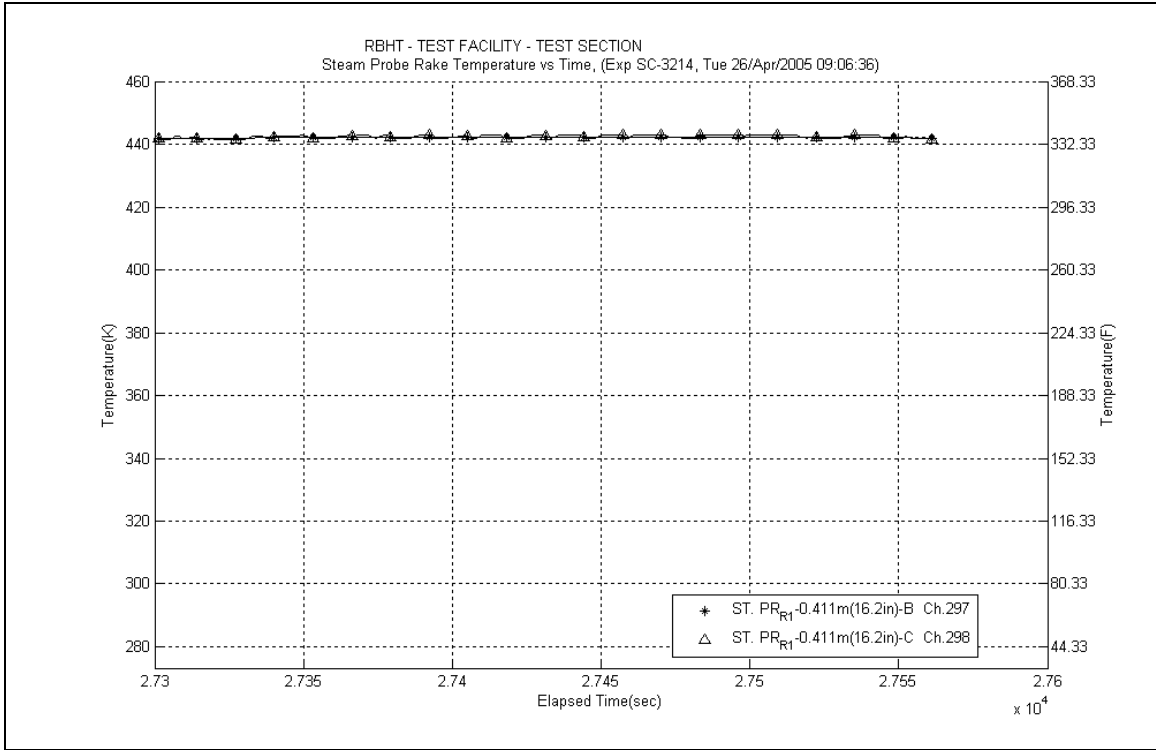
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

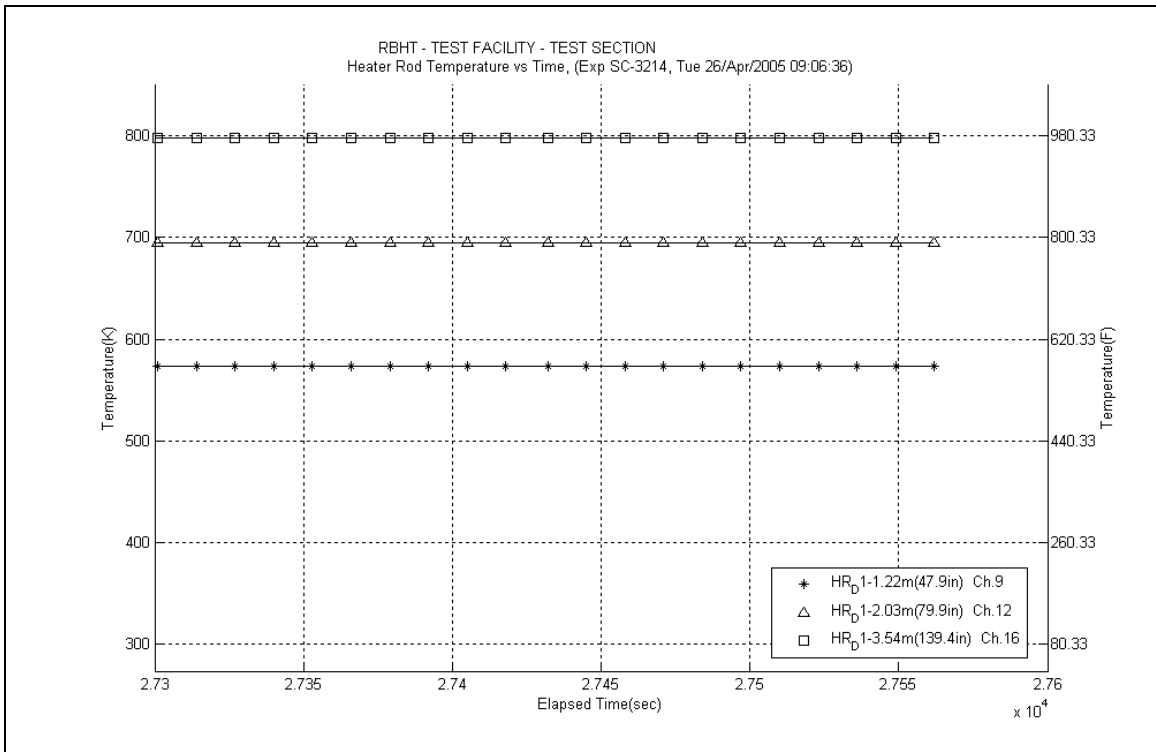
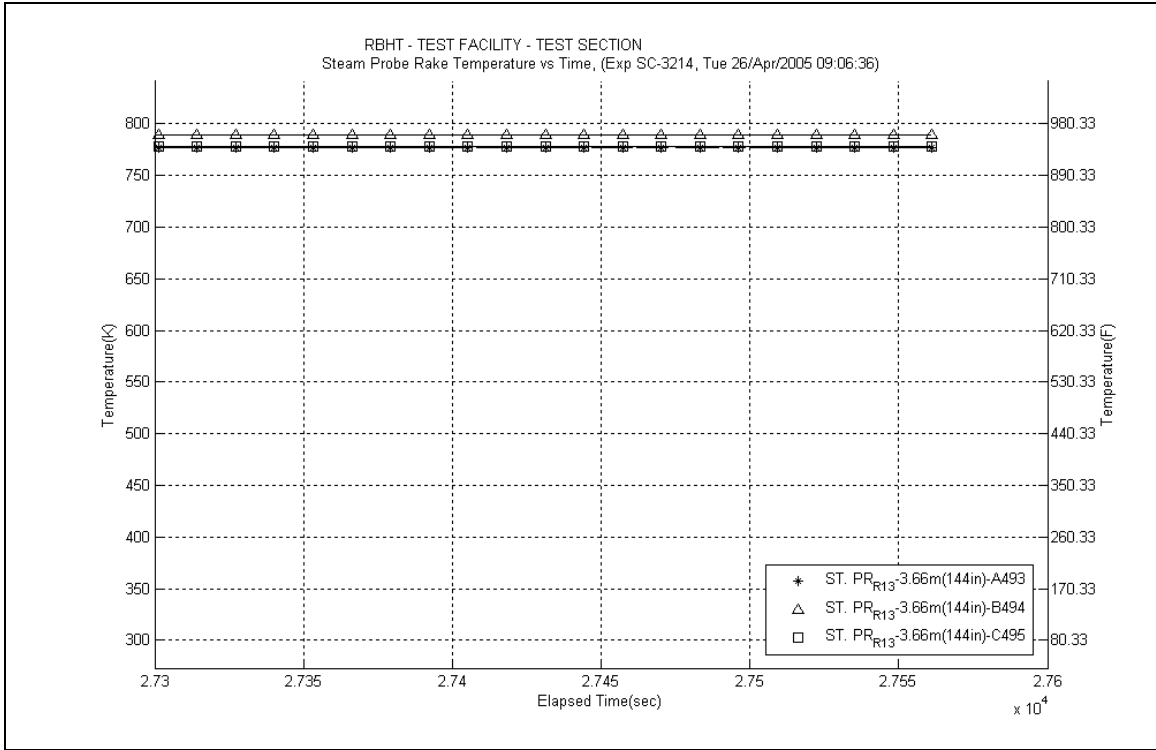
$$T_{cl} = -10.095x^3 + 68.576x^2 - 23.746x + 444.23$$

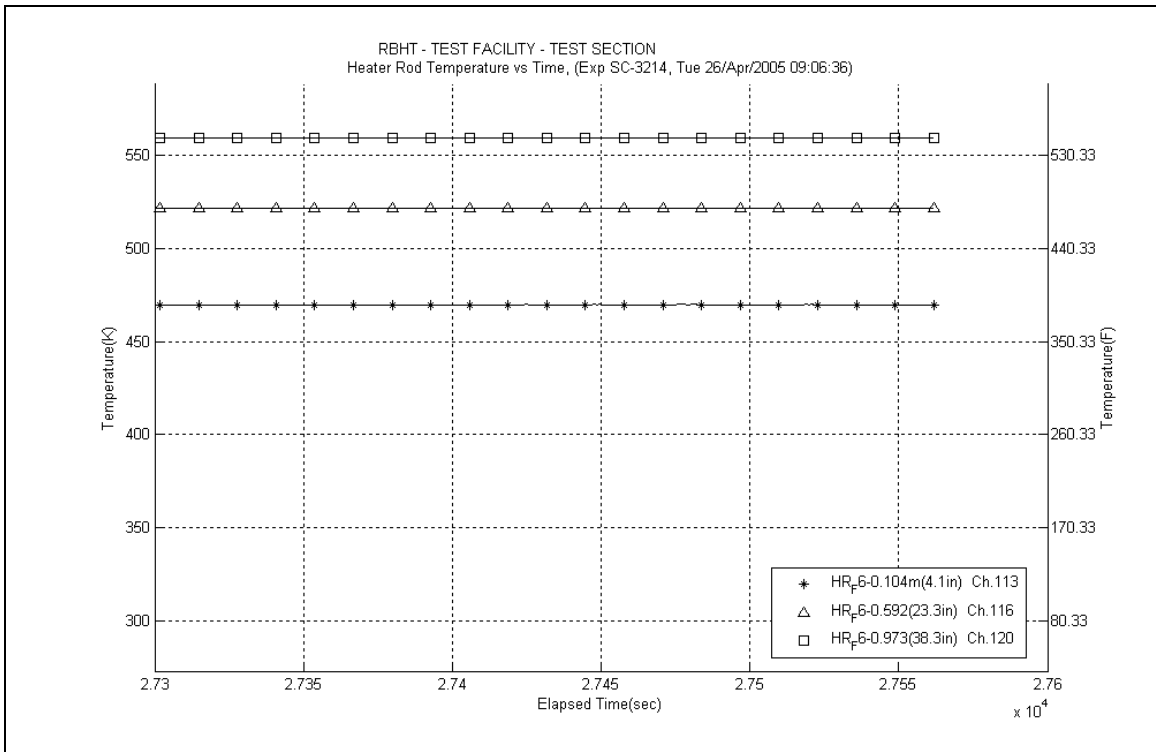
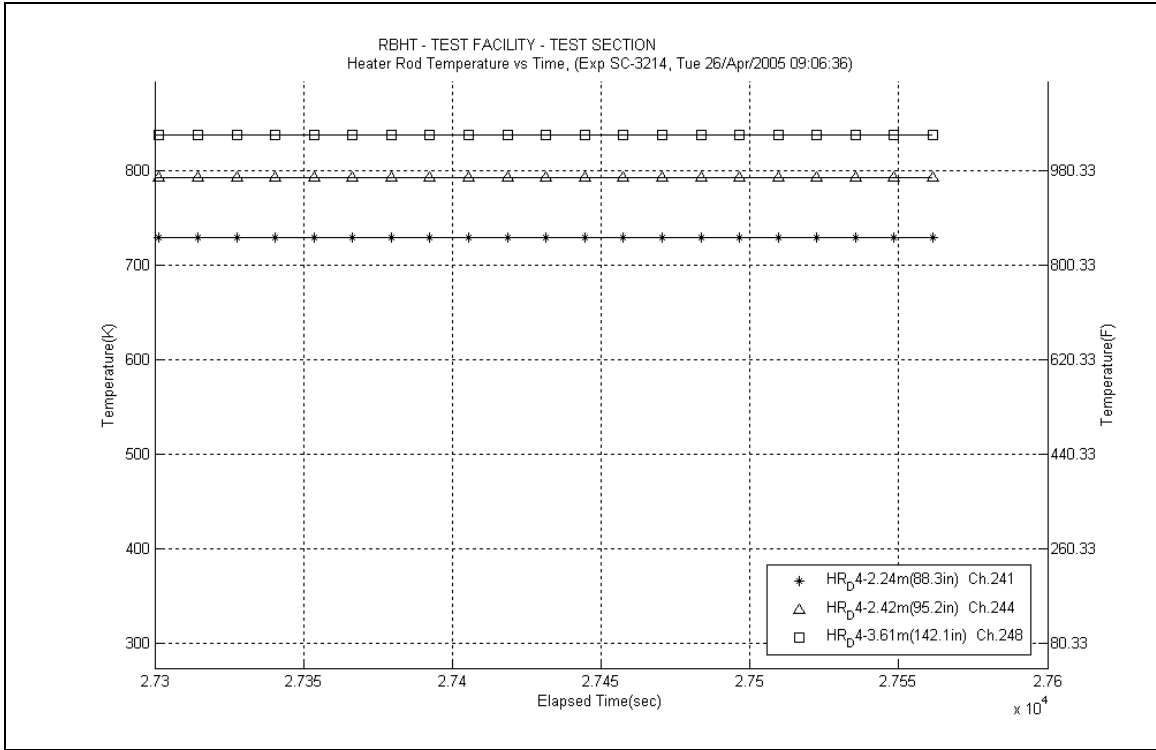
where x is the elevation (m) and T_{cl} is in (K)











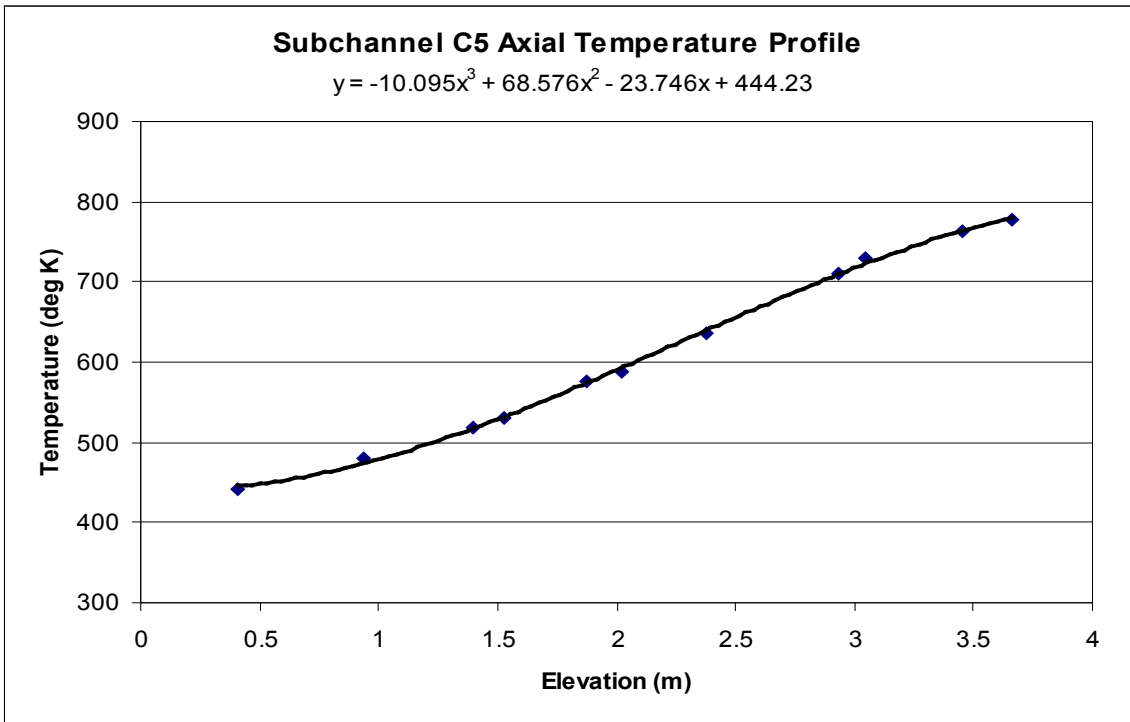
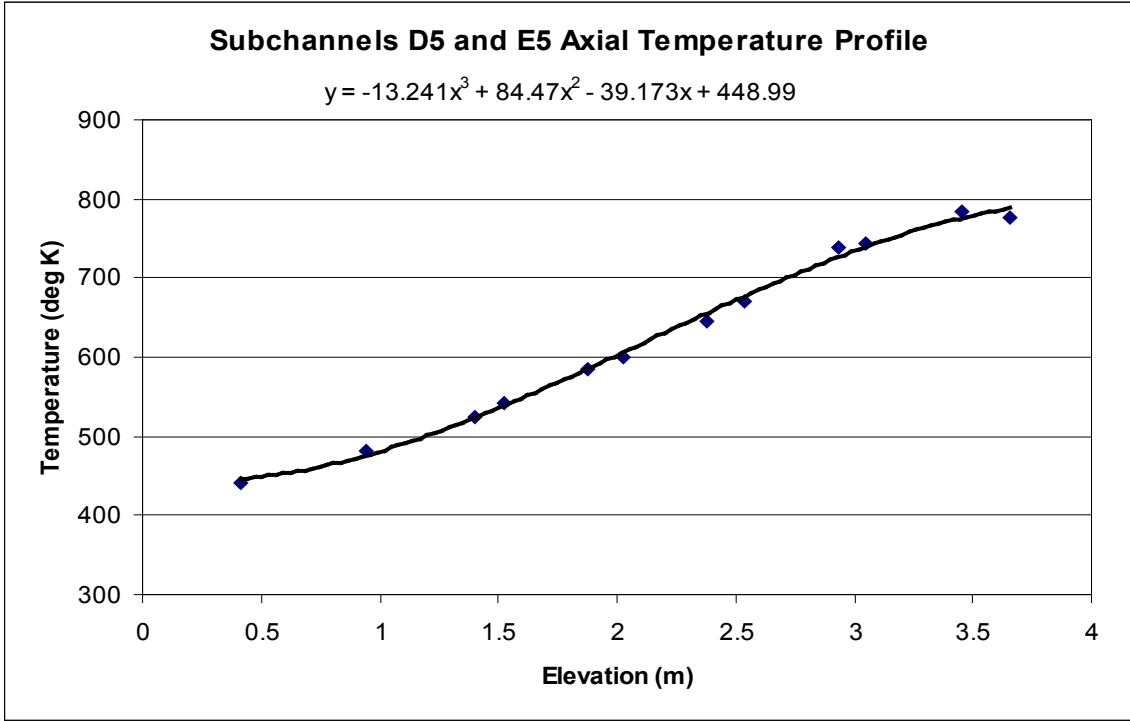


Table SC-3214-E.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	± _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	716.5	37447.2	636.7	1.20	650.0	18652	562.77	22.69	4.03%	126.44
RodD3_91.3	186	2.319	0.071	764.0	38244.3	647.3	1.20	666.7	18111	393.08	14.69	3.74%	85.17
RodD3_93.1	187	2.365	0.117	780.2	38715.0	653.6	1.20	674.7	17865	367.11	13.58	3.70%	78.20
RodD3_95.3	188	2.421	0.173	791.5	39302.9	661.3	1.20	683.0	17617	362.29	13.35	3.69%	75.83
RodD3_100.1	189	2.543	0.295	808.9	40580.3	677.8	1.20	699.7	17139	371.47	13.68	3.68%	75.11
RodD3_106.1	190	2.695	0.447	831.3	42173.3	697.7	1.20	720.0	16591	378.98	13.92	3.67%	73.54
RodD3_110	191	2.794	0.546	817.7	41647.3	710.1	1.20	728.1	16384	464.85	17.58	3.78%	88.77
RodD3_142.1	192	3.609	0.218	827.3	14540.8	785.4	1.20	792.4	14909	416.63	21.94	5.27%	70.41
RodC4_88.4	233	2.245	-0.003	722.0	37880.4	637.0	1.20	651.2	18612	534.65	21.21	3.97%	119.80
RodC4_91.1	234	2.314	0.066	764.3	38614.1	646.6	1.20	666.2	18128	393.61	14.69	3.73%	85.38
RodC4_93.4	235	2.372	0.124	779.7	39241.1	654.7	1.20	675.5	17841	376.65	13.94	3.70%	80.10
RodC4_95.3	236	2.421	0.173	792.8	39750.4	661.3	1.20	683.2	17610	362.69	13.34	3.68%	75.88
RodC4_100.1	237	2.543	0.295	804.2	41049.5	677.8	1.20	698.9	17161	389.83	14.41	3.70%	78.96
RodC4_106.1	238	2.695	0.447	825.7	42677.0	697.7	1.20	719.1	16615	400.10	14.76	3.69%	77.78
RodC4_110	239	2.794	0.546	807.9	41305.7	710.1	1.20	726.4	16425	506.85	19.51	3.85%	97.10
RodC4_142.2	240	3.612	0.221	841.8	15770.3	785.5	1.20	794.9	14857	336.46	15.27	4.54%	56.60
RodD4_88.3	241	2.243	-0.005	726.9	37740.7	636.7	1.20	651.7	18595	501.65	19.63	3.91%	112.28
RodD4_91.3	242	2.319	0.071	764.2	38546.0	647.3	1.20	666.8	18110	395.45	14.77	3.74%	85.67
RodD4_93.2	243	2.367	0.119	780.5	39055.9	654.0	1.20	675.1	17855	370.45	13.69	3.70%	78.85
RodD4_95.2	244	2.418	0.170	790.3	39592.4	661.0	1.20	682.5	17631	367.39	13.54	3.69%	76.98
RodD4_100.1	245	2.543	0.295	807.5	40901.8	677.8	1.20	699.4	17145	378.33	13.94	3.68%	76.54
RodD4_106.1	246	2.695	0.447	824.0	42512.5	697.7	1.20	718.8	16623	403.93	14.93	3.70%	78.57
RodD4_110	247	2.794	0.546	808.3	41055.4	710.1	1.20	726.5	16424	502.04	19.32	3.85%	96.17
RodD4_142.1	248	3.609	0.218	836.7	15237.6	785.4	1.20	794.0	14877	356.47	16.88	4.74%	60.07
RodE4_88.4	201	2.245	-0.003	719.7	37174.5	637.0	1.20	650.8	18625	539.76	21.58	4.00%	121.05
RodE4_91.2	202	2.316	0.069	758.1	37885.7	646.9	1.20	665.5	18152	409.07	15.41	3.77%	88.88
RodE4_95.3	204	2.421	0.173	786.6	38942.4	661.3	1.20	682.2	17641	372.88	13.81	3.70%	78.19
RodE4_100.9	205	2.563	0.315	803.3	40383.3	680.5	1.20	701.0	17102	394.79	14.67	3.71%	79.61
RodE4_142.3	208	3.614	0.224	832.3	15396.4	785.7	1.20	793.4	14888	396.70	19.68	4.96%	66.91
RodE3_63.4	193	1.610	0.417	651.7	30782.1	549.7	1.20	566.7	21910	361.94	13.83	3.82%	98.42
RodE3_113.6	194	2.885	0.022	825.9	37947.6	721.1	1.20	738.6	16121	434.49	16.52	3.80%	81.27
RodE3_115.5	195	2.934	0.070	843.0	36537.5	726.7	1.20	746.1	15939	377.18	14.11	3.74%	69.53
RodE3_118.5	196	3.010	0.146	850.2	34305.1	735.3	1.20	754.4	15743	358.16	13.42	3.75%	64.97
RodE3_122.7	197	3.117	0.253	842.5	31197.5	746.5	1.20	762.5	15557	390.22	15.08	3.86%	69.71
RodE3_126.5	198	3.213	0.349	839.8	28374.2	756.0	1.20	769.9	15391	405.99	16.16	3.98%	71.52
RodE3_131.7	199	3.345	-0.046	814.5	24520.3	767.5	1.20	775.4	15272	626.49	30.91	4.93%	109.25
RodE3_135.6	200	3.444	0.053	828.4	21630.8	775.1	1.20	784.0	15086	487.36	22.63	4.64%	83.64

Table SC-3214-E.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	651.4	30188.7	550.7	1.20	567.5	21875	359.57	13.79	3.84%	97.60
RodC5_113.6	226	2.885	0.022	824.0	37008.5	721.1	1.20	738.3	16129	431.75	16.50	3.82%	80.81
RodC5_115.7	227	2.939	0.075	842.1	35536.6	727.3	1.20	746.4	15932	371.63	13.95	3.75%	68.46
RodC5_122.7	229	3.117	0.253	846.2	30598.2	746.5	1.20	763.1	15543	368.60	14.15	3.84%	65.77
RodC5_126.7	230	3.218	0.354	846.6	27778.0	756.4	1.20	771.5	15357	369.47	14.47	3.92%	64.90
RodC5_131.6	231	3.343	-0.048	822.2	24325.4	767.3	1.20	776.5	15247	531.54	24.37	4.58%	92.50
RodC5_135.7	232	3.447	0.056	840.4	21441.1	775.3	1.20	786.1	15040	395.42	16.95	4.29%	67.59
RodE5_63.6	209	1.615	0.422	643.3	30937.3	550.3	1.20	565.8	21950	399.27	15.48	3.88%	108.80
RodE5_113.6	210	2.885	0.022	824.7	38179.2	721.1	1.20	738.4	16126	442.35	16.85	3.81%	82.77
RodE5_115.4	211	2.931	0.067	836.6	36865.5	726.4	1.20	744.8	15971	401.66	15.14	3.77%	74.23
RodE5_118.7	212	3.015	0.151	840.0	34458.2	735.8	1.20	753.2	15772	397.08	15.11	3.80%	72.20
RodE5_122.6	213	3.114	0.250	835.8	31605.4	746.3	1.20	761.2	15587	423.50	16.59	3.92%	75.84
RodE5_126.6	214	3.216	0.352	830.5	28683.9	756.2	1.20	768.6	15421	462.92	19.01	4.11%	81.75
RodE5_131.6	215	3.343	-0.048	807.6	25033.3	767.3	1.20	774.0	15300	745.77	40.00	5.36%	130.37
RodE5_135.6	216	3.444	0.053	827.4	22112.2	775.1	1.20	783.8	15089	507.50	23.74	4.68%	87.12
RodC3_79.8	177	2.027	0.227	693.0	35012.4	606.4	1.20	620.8	19675	484.74	19.16	3.95%	116.21
RodC3_85.6	178	2.174	0.374	705.8	36537.9	627.0	1.20	640.2	18984	556.79	22.54	4.05%	127.82
RodC3_88.5	179	2.248	0.000	716.5	37299.5	637.4	1.20	650.6	18633	565.67	22.87	4.04%	126.93
RodC3_92.4	180	2.347	0.099	758.5	38319.4	651.2	1.20	669.0	18039	428.46	16.23	3.79%	92.37
RodC3_94.4	181	2.398	0.150	763.5	38845.8	658.2	1.20	675.7	17835	442.65	16.82	3.80%	94.09
RodC3_97.2	182	2.469	0.221	785.8	39579.7	667.9	1.20	687.5	17484	402.88	15.04	3.73%	83.54
RodC3_108.8	183	2.764	0.516	826.7	41737.6	706.4	1.20	726.4	16425	416.26	15.50	3.72%	79.75
RodD5_50	217	1.270	0.076	606.1	27333.6	508.4	1.20	524.6	24026	335.72	12.89	3.84%	101.04
RodD5_54.1	218	1.374	0.180	624.5	28407.7	520.3	1.20	537.7	23329	327.31	12.42	3.80%	95.45
RodD5_56.9	219	1.445	0.251	631.4	29143.7	528.8	1.20	545.9	22906	340.85	12.97	3.81%	97.42
RodD5_60	220	1.524	0.330	641.3	29961.5	538.6	1.20	555.7	22426	350.24	13.33	3.80%	97.78
RodD5_66.1	221	1.679	0.485	662.3	31562.6	558.7	1.20	575.9	21493	365.38	13.92	3.81%	97.19
RodD5_69.9	222	1.775	-0.025	638.0	32564.3	571.6	1.20	582.7	21199	588.32	24.93	4.24%	154.03
RodD5_72.9	223	1.852	0.051	679.3	33346.5	582.0	1.20	598.2	20550	411.36	15.86	3.86%	103.86
RodD5_74.9	224	1.902	0.102	693.6	33871.9	589.0	1.20	606.5	20222	388.51	14.78	3.80%	96.24

Table SC-3214-E.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	578.4	24844.0	482.5	1.20	498.5	25558	310.81	11.98	3.85%	99.68
RodB5_52.9	154	1.344	0.150	615.7	28002.4	511.6	1.20	529.0	23789	322.76	12.25	3.80%	96.12
RodB5_55	155	1.397	0.203	621.7	28559.8	517.4	1.20	534.8	23482	328.33	12.46	3.79%	96.42
RodB5_57.8	156	1.468	0.274	628.3	29303.8	525.2	1.20	542.4	23085	340.99	12.97	3.80%	98.30
RodB5_64	157	1.626	0.432	649.0	30949.4	543.5	1.20	561.1	22172	351.98	13.37	3.80%	97.01
RodB5_73.9	158	1.877	0.077	683.7	33580.9	574.5	1.20	592.7	20776	369.06	13.94	3.78%	94.38
RodB5_75.9	159	1.928	0.128	693.2	34111.0	581.0	1.20	599.7	20491	364.90	13.72	3.76%	91.82
RodB5_76.9	160	1.953	0.153	697.1	34376.2	584.2	1.20	603.1	20356	365.37	13.73	3.76%	91.22
RodF5_41	105	1.041	0.343	571.6	24690.7	482.5	1.20	497.3	25628	332.34	13.01	3.91%	106.87
RodF5_53.1	106	1.349	0.155	608.2	27901.5	512.2	1.20	528.2	23833	348.68	13.44	3.85%	104.05
RodF5_55	107	1.397	0.203	614.5	28407.1	517.4	1.20	533.6	23545	350.80	13.49	3.84%	103.32
RodF5_57.8	108	1.468	0.274	623.2	29151.1	525.2	1.20	541.6	23129	356.98	13.70	3.84%	103.12
RodF5_64	109	1.626	0.432	643.3	30795.1	543.5	1.20	560.1	22216	370.11	14.16	3.83%	102.24
RodF5_73.8	110	1.875	0.074	669.6	33398.8	574.2	1.20	590.1	20884	419.83	16.25	3.87%	108.02
RodF5_75.8	111	1.925	0.125	678.3	33927.1	580.7	1.20	596.9	20602	417.08	16.07	3.85%	105.62
RodF5_76.8	112	1.951	0.150	680.2	34194.1	583.9	1.20	600.0	20480	426.12	16.46	3.86%	107.15
RodC2_41	57	1.041	0.343	573.2	24803.5	482.5	1.20	497.6	25612	328.10	12.79	3.90%	105.44
RodC2_53.1	58	1.349	0.155	612.8	28013.2	512.2	1.20	529.0	23791	333.97	12.75	3.82%	99.47
RodC2_55	59	1.397	0.203	616.5	28517.4	517.4	1.20	533.9	23527	345.05	13.21	3.83%	101.55
RodC2_57.8	60	1.468	0.274	620.6	29262.1	525.2	1.20	541.1	23151	368.09	14.20	3.86%	106.44
RodC2_63.9	61	1.623	0.429	640.0	30880.3	543.2	1.20	559.3	22254	382.62	14.72	3.85%	105.90
RodC2_73.8	62	1.875	0.074	671.2	33511.3	574.2	1.20	590.3	20874	414.66	16.00	3.86%	106.63
RodC2_75.8	63	1.925	0.125	679.7	34041.7	580.7	1.20	597.2	20593	412.42	15.85	3.84%	104.38
RodC2_76.8	64	1.951	0.150	681.9	34302.3	583.9	1.20	600.2	20468	420.07	16.17	3.85%	105.56
RodC6_40.9	137	1.039	0.340	576.6	24681.7	482.2	1.20	498.0	25589	314.07	12.15	3.87%	100.84
RodC6_52.8	138	1.341	0.147	617.0	27975.4	511.4	1.20	529.0	23790	317.88	12.04	3.79%	94.67
RodC6_54.8	139	1.392	0.198	623.6	28532.3	516.8	1.20	534.6	23490	320.75	12.13	3.78%	94.23
RodC6_57.8	140	1.468	0.274	632.7	29361.6	525.2	1.20	543.1	23048	327.75	12.38	3.78%	94.32
RodC6_63.8	141	1.621	0.427	653.7	31019.8	542.9	1.20	561.3	22158	335.72	12.65	3.77%	92.46
RodC6_73.7	142	1.872	0.072	686.1	33760.1	573.9	1.20	592.6	20782	361.07	13.57	3.76%	92.37
RodC6_75.8	143	1.925	0.125	693.0	34342.0	580.7	1.20	599.4	20503	366.92	13.79	3.76%	92.39
RodC6_76.8	144	1.951	0.150	697.3	34618.5	583.9	1.20	602.8	20366	366.47	13.75	3.75%	91.54

Table SC-3214-E.1: Summary of Steam Cooling Data (cont.)

H.R.	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	713.7	37145.9	622.4	1.20	637.6	19073	487.90	19.06	3.91%	112.65
RodB4_91.3	162	2.319	0.071	756.4	37887.7	632.0	1.20	652.8	18559	365.54	13.56	3.71%	81.62
RodB4_93.3	163	2.370	0.122	766.7	38402.4	638.7	1.20	660.0	18323	360.11	13.31	3.70%	79.16
RodB4_95.1	164	2.416	0.168	780.0	38863.2	644.7	1.20	667.3	18095	344.67	12.65	3.67%	74.59
RodB4_100	165	2.540	0.292	790.1	40124.9	660.9	1.20	682.4	17634	372.80	13.76	3.69%	78.13
RodB4_106	166	2.692	0.445	818.9	41665.0	680.4	1.20	703.5	17034	360.87	13.21	3.66%	72.41
RodB4_109.9	167	2.791	0.544	799.3	40334.8	692.7	1.20	710.5	16843	454.09	17.23	3.80%	89.82
RodB4_142.3	168	3.614	0.224	834.0	15659.5	777.6	1.20	787.0	15022	332.90	15.09	4.53%	56.82
RodF4_85.6	98	2.174	0.374	708.4	36660.1	613.0	1.20	628.9	19380	461.27	17.85	3.87%	108.58
RodF4_88.4	99	2.245	-0.003	714.6	37398.7	622.4	1.20	637.7	19068	486.65	18.97	3.90%	112.33
RodF4_92.4	100	2.347	0.099	756.8	38442.6	635.7	1.20	655.9	18457	381.06	14.18	3.72%	84.52
RodF4_94.3	101	2.395	0.147	768.0	38942.1	642.0	1.20	663.0	18228	371.15	13.74	3.70%	81.06
RodF4_97.2	102	2.469	0.221	780.3	39704.3	651.7	1.20	673.1	17915	370.49	13.68	3.69%	79.19
RodF4_108.8	103	2.764	0.516	819.9	41935.6	689.3	1.20	711.0	16828	385.30	14.19	3.68%	76.13
RodF4_111	104	2.819	-0.044	784.2	40222.0	696.1	1.20	710.8	16834	547.81	21.56	3.94%	108.28
RodD2_103.2	65	2.621	0.373	803.5	41488.6	671.3	1.20	693.4	17316	376.69	13.85	3.68%	77.16
RodD2_106	66	2.692	0.445	814.1	42231.9	680.4	1.20	702.6	17056	379.05	13.92	3.67%	76.18
RodD2_112.6	67	2.860	-0.004	804.9	38741.1	701.1	1.20	718.4	16634	447.91	17.06	3.81%	87.20
RodD2_114.9	68	2.918	0.055	825.1	36939.8	708.1	1.20	727.6	16396	378.71	14.15	3.74%	72.39
RodD2_117.4	69	2.982	0.118	832.1	34990.5	715.5	1.20	734.9	16212	360.17	13.47	3.74%	67.85
RodD2_120.8	70	3.068	0.204	826.4	32328.7	725.3	1.20	742.2	16034	383.79	14.69	3.83%	71.28
RodD2_124.8	71	3.170	0.306	822.4	29210.2	736.5	1.20	750.8	15829	408.02	16.16	3.96%	74.54
RodD2_128.6	72	3.266	0.403	820.8	26231.9	746.5	1.20	758.9	15640	423.64	17.43	4.11%	76.20
RodD6_103.1	129	2.619	0.371	788.5	41554.9	671.0	1.20	690.6	17396	424.52	15.85	3.73%	87.47
RodD6_106	130	2.692	0.445	799.4	42318.2	680.4	1.20	700.2	17124	426.66	15.90	3.73%	86.18
RodD6_112.9	131	2.868	0.004	798.5	38619.3	702.0	1.20	718.1	16641	480.18	18.54	3.86%	93.54
RodD6_114.9	132	2.918	0.055	821.6	37029.3	708.1	1.20	727.0	16411	391.20	14.68	3.75%	74.86
RodD6_116.8	133	2.967	0.103	827.3	35529.3	713.7	1.20	732.7	16268	375.41	14.09	3.75%	71.04
RodD6_120.9	134	3.071	0.207	821.5	32287.1	725.6	1.20	741.6	16048	404.33	15.63	3.87%	75.19
RodD6_124.8	135	3.170	0.306	820.7	29203.8	736.5	1.20	750.5	15835	416.17	16.56	3.98%	76.07
RodD6_128.7	136	3.269	0.405	822.1	26121.0	746.7	1.20	759.3	15630	415.73	17.04	4.10%	74.72

Table SC-3214-E.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	597.3	27418.8	504.3	1.20	519.8	24298	353.50	13.70	3.88%	107.66
RodE2_54	74	1.372	0.178	613.3	28464.8	514.6	1.20	531.1	23678	346.29	13.27	3.83%	102.61
RodE2_56.9	75	1.445	0.251	621.5	29245.2	522.7	1.20	539.1	23253	355.12	13.60	3.83%	103.19
RodE2_59.9	76	1.521	0.328	630.8	30046.7	531.3	1.20	547.9	22810	362.38	13.86	3.83%	103.10
RodE2_66	77	1.676	0.483	649.2	31683.4	549.6	1.20	566.2	21933	381.52	14.64	3.84%	103.87
RodE2_69.8	78	1.773	-0.027	628.2	32704.8	561.4	1.20	572.5	21644	587.78	24.86	4.23%	157.62
RodE2_72.9	79	1.852	0.051	667.4	33533.9	571.3	1.20	587.3	21001	418.50	16.17	3.86%	108.38
RodE2_74.9	80	1.902	0.102	681.3	34072.8	577.7	1.20	595.0	20681	394.63	15.03	3.81%	100.38
RodB3_50.2	169	1.275	0.081	593.6	27256.6	504.5	1.20	519.4	24321	366.94	14.35	3.91%	111.86
RodB3_54.1	170	1.374	0.180	604.9	28292.0	514.9	1.20	529.9	23741	377.29	14.73	3.90%	112.12
RodB3_56.9	171	1.445	0.251	612.8	29033.2	522.7	1.20	537.7	23328	386.49	15.08	3.90%	112.70
RodB3_60.1	172	1.527	0.333	620.9	29883.6	531.9	1.20	546.7	22868	402.87	15.76	3.91%	114.94
RodB3_66.1	173	1.679	0.485	644.5	31475.6	549.9	1.20	565.7	21957	399.03	15.42	3.86%	108.77
RodB3_69.9	174	1.775	-0.025	627.5	32486.2	561.7	1.20	572.7	21637	592.99	25.22	4.25%	158.96
RodB3_73	175	1.854	0.054	665.8	33308.5	571.6	1.20	587.3	21001	424.17	16.46	3.88%	109.85
RodB3_75	176	1.905	0.105	679.1	33838.5	578.1	1.20	594.9	20685	401.78	15.38	3.83%	102.22
RodF3_50.1	89	1.273	0.079	600.4	27263.9	504.3	1.20	520.3	24270	340.41	13.11	3.85%	103.55
RodF3_54	90	1.372	0.178	614.8	28323.4	514.6	1.20	531.3	23665	339.32	12.97	3.82%	100.49
RodF3_57	91	1.448	0.254	621.2	29137.4	523.0	1.20	539.3	23243	355.72	13.64	3.83%	103.31
RodF3_60	92	1.524	0.330	630.3	29951.7	531.6	1.20	548.0	22802	364.14	13.95	3.83%	103.56
RodF3_66.1	93	1.679	0.485	643.5	31606.7	549.9	1.20	565.5	21966	405.35	15.69	3.87%	110.54
RodF3_70	94	1.778	-0.022	631.0	32662.5	562.0	1.20	573.5	21599	568.43	23.80	4.19%	152.07
RodF3_73	95	1.854	0.054	672.6	33471.0	571.6	1.20	588.4	20953	397.58	15.22	3.83%	102.69
RodF3_75	96	1.905	0.105	689.7	34015.5	578.1	1.20	596.7	20613	365.48	13.75	3.76%	92.60
RodE6_50.2	121	1.275	0.081	600.0	27247.3	504.5	1.20	520.4	24261	342.36	13.20	3.86%	104.10
RodE6_54.1	122	1.374	0.180	613.9	28273.0	514.9	1.20	531.4	23661	342.81	13.13	3.83%	101.50
RodE6_57	123	1.448	0.254	619.2	29033.6	523.0	1.20	539.0	23260	361.80	13.93	3.85%	105.16
RodE6_60.2	124	1.529	0.335	628.8	29874.7	532.2	1.20	548.3	22790	370.86	14.27	3.85%	105.41
RodE6_66.1	125	1.679	0.485	651.7	31424.1	549.9	1.20	566.9	21902	370.19	14.15	3.82%	100.62
RodE6_70	126	1.778	-0.022	630.8	32451.8	562.0	1.20	573.5	21601	566.33	23.74	4.19%	151.52
RodE6_73.1	127	1.857	0.056	669.5	33262.2	571.9	1.20	588.2	20964	408.95	15.76	3.85%	105.69
RodE6_75	128	1.905	0.105	681.6	33771.3	578.1	1.20	595.3	20668	391.49	14.92	3.81%	99.51

RBHT Steam Cooling Test SC-3216-A

Matrix test # 19

Test date -5/5/2005

Steady state time window: 14000 - 15300 sec

Inlet flow: 7.93 m³/min (280.0 ft³/min)

Inlet steam temperature: 414 K (286 °F)

Upper plenum pressure: 133.8 kPa (19.4 psia)

Bundle power: 95.1 kW

Outlet steam temperature: 755 K (900 °F)

Bundle inlet Reynolds number: 14832

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

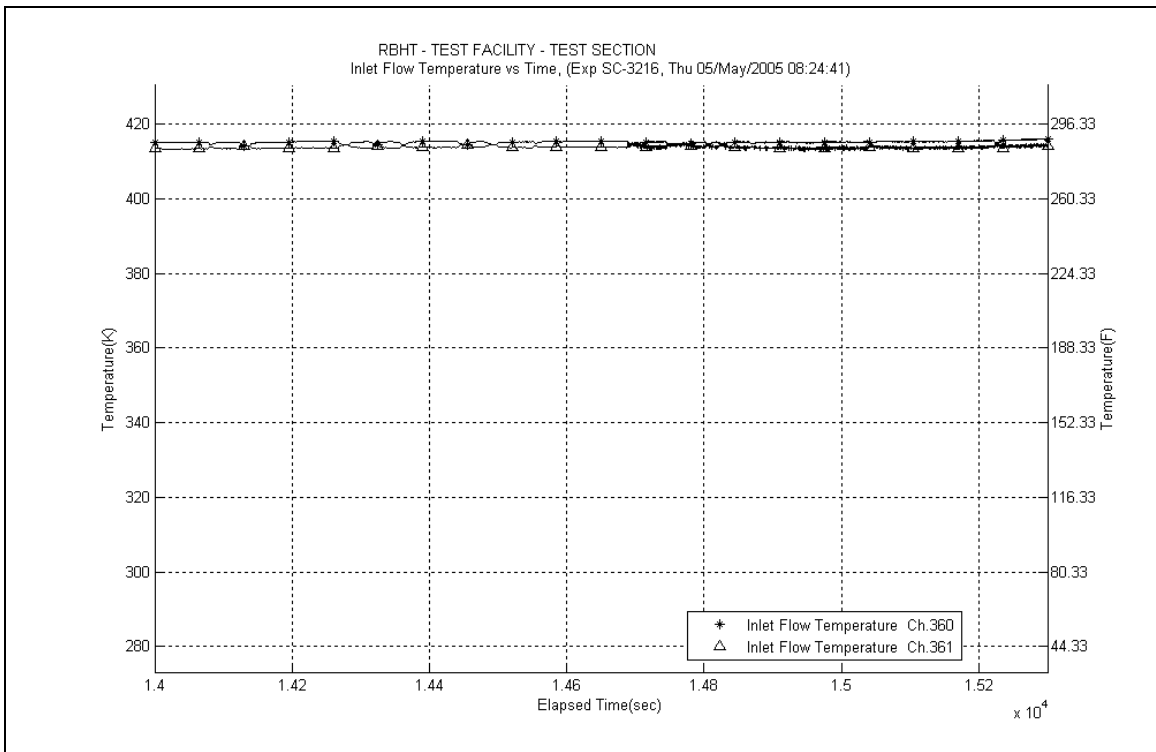
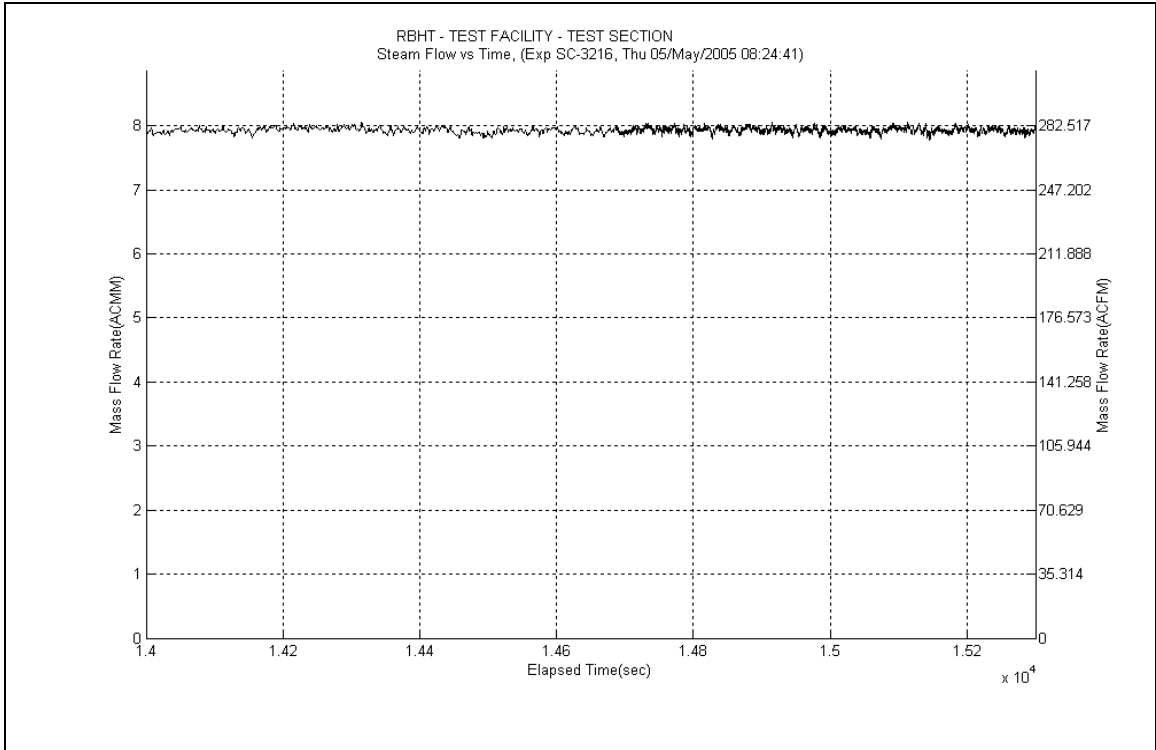
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

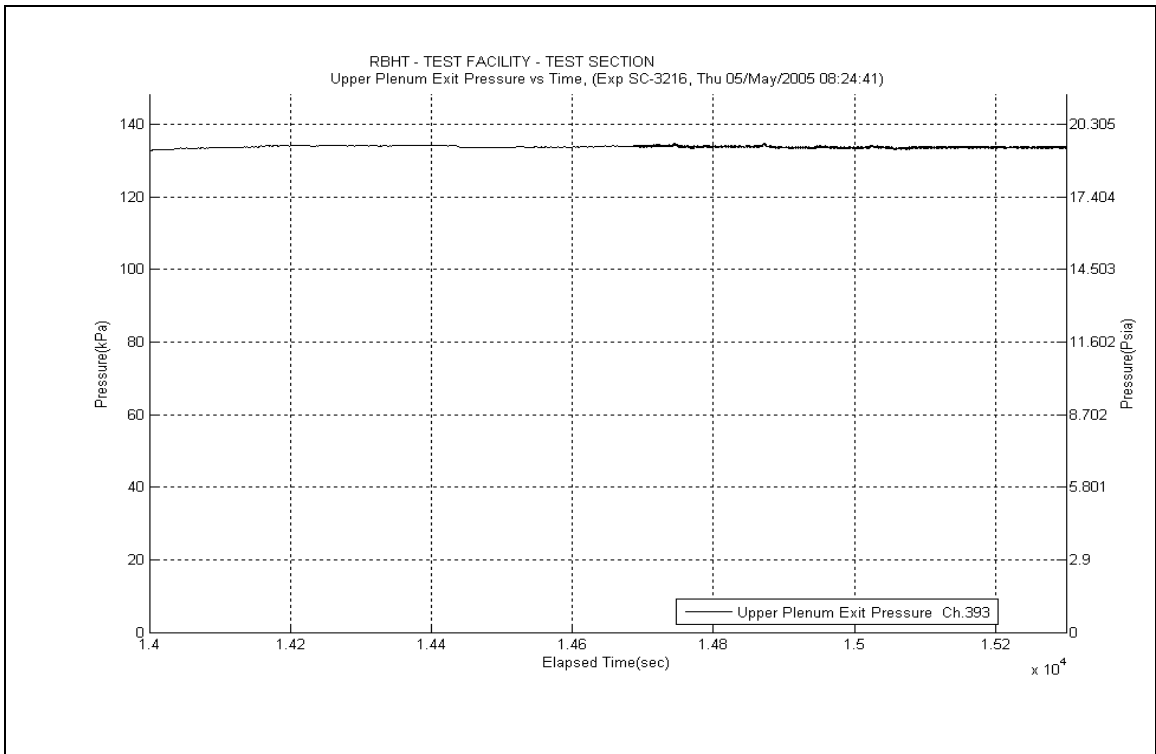
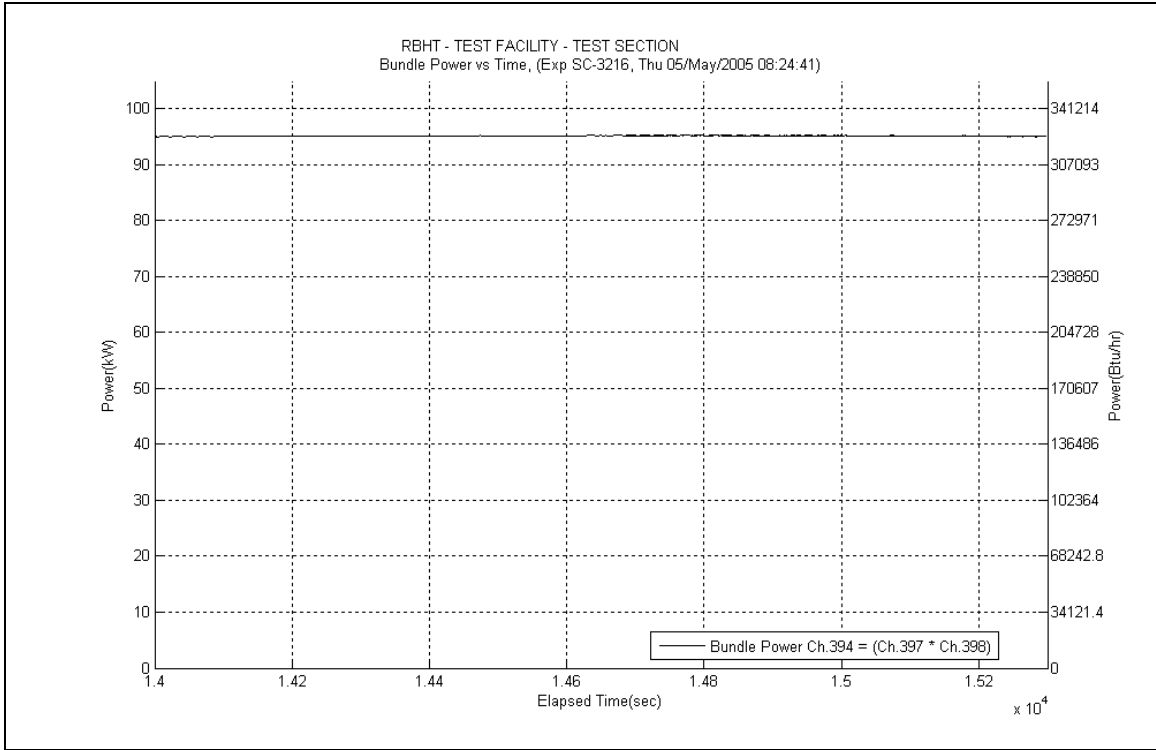
$$T_{cl} = -14.368x^3 + 88.495x^2 - 44.856x + 440.3$$

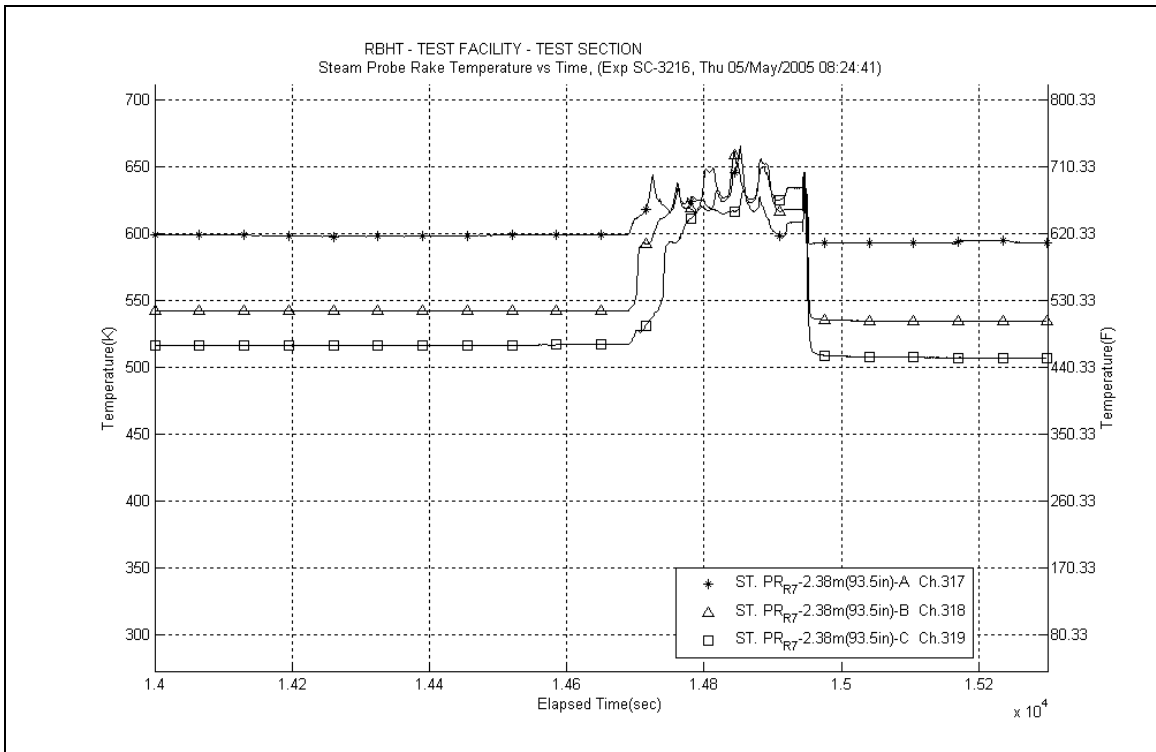
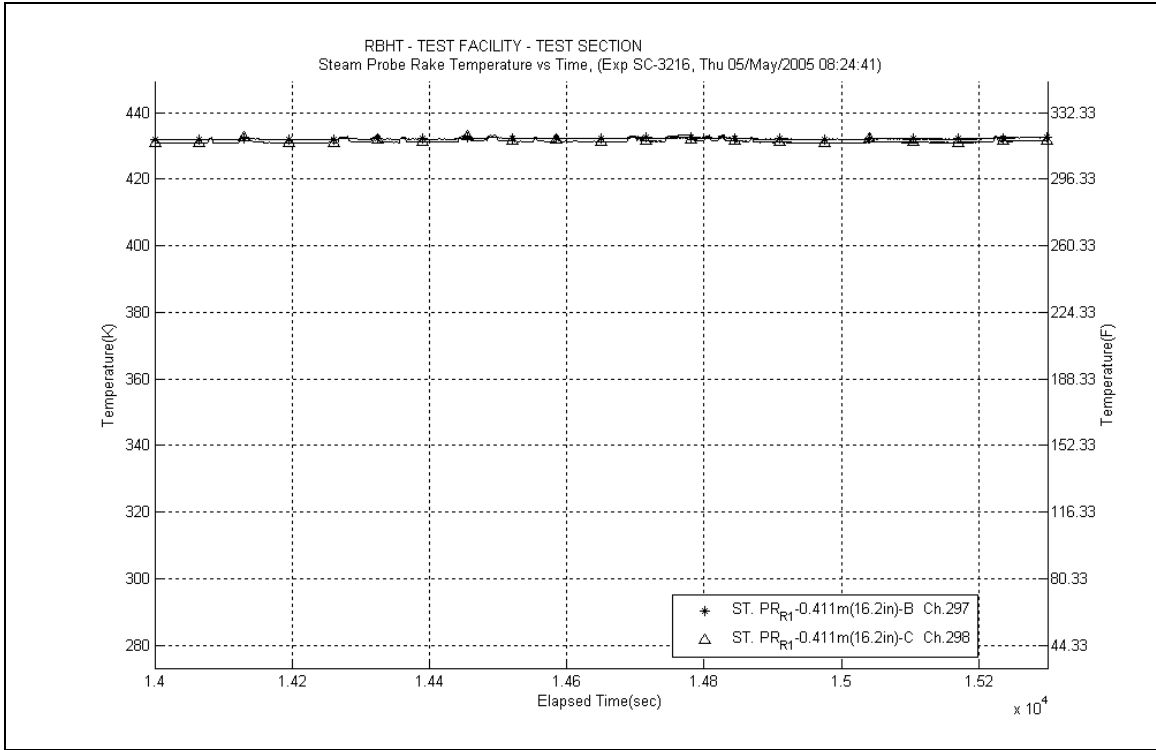
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

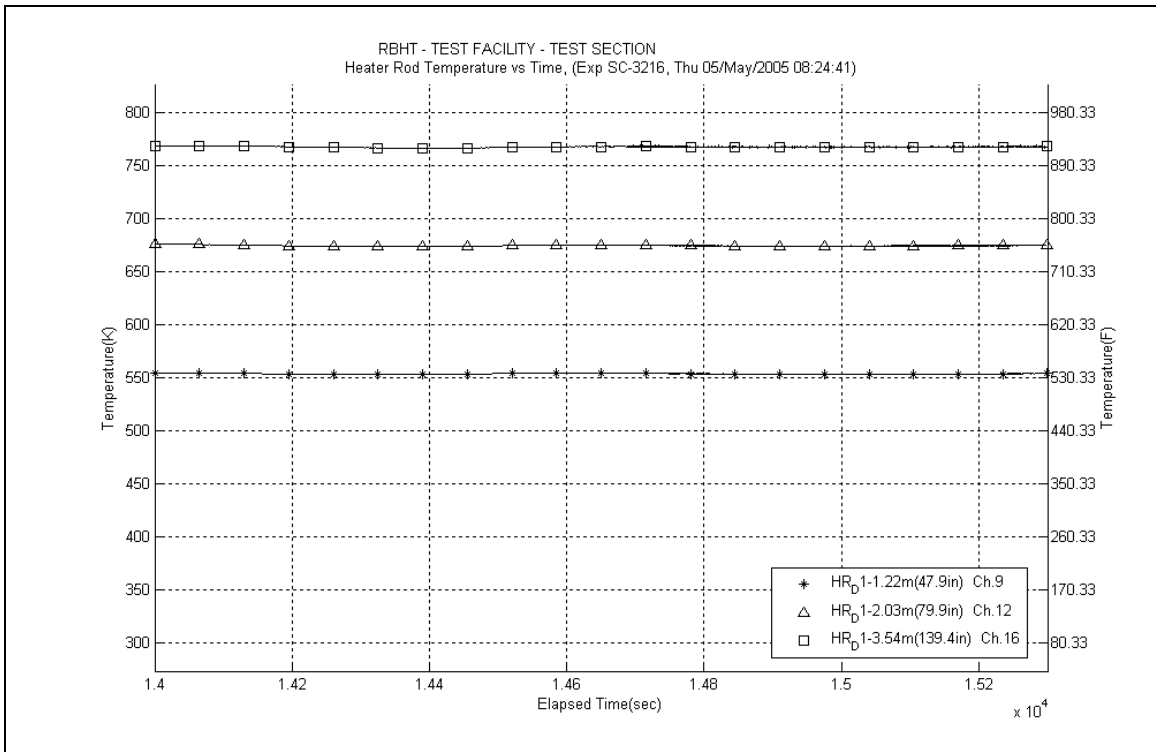
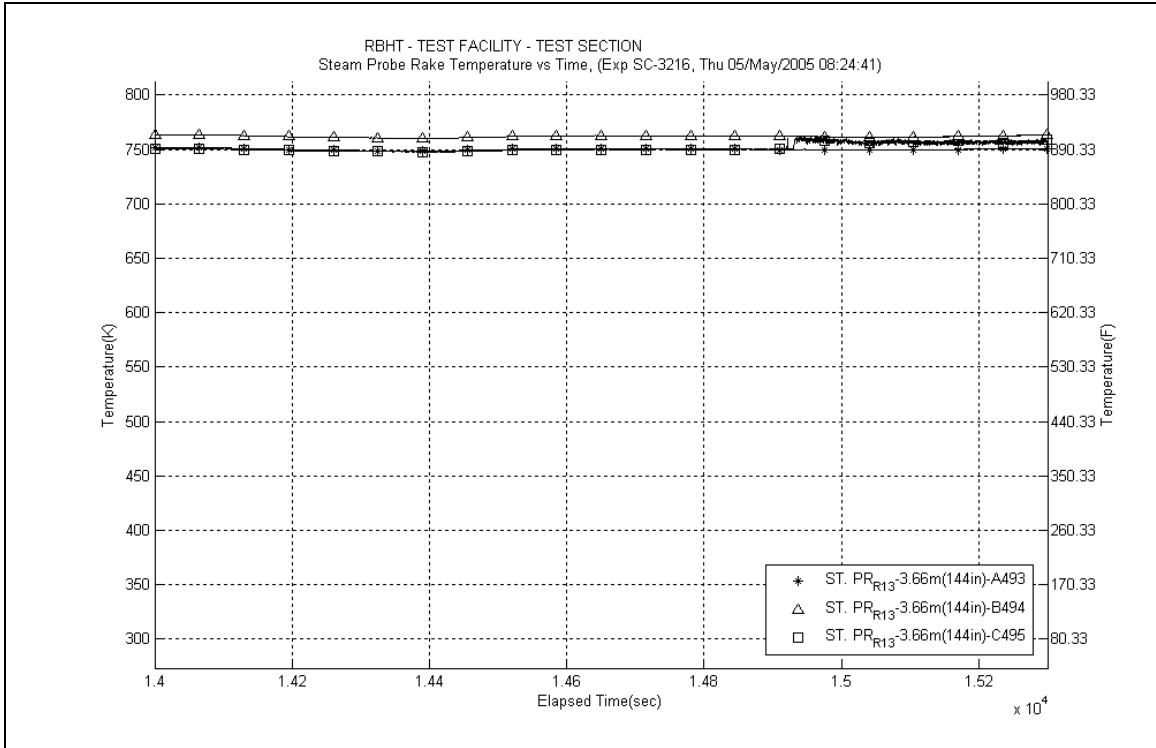
$$T_{cl} = -9.7242x^3 + 63.535x^2 - 14.296x + 429.05$$

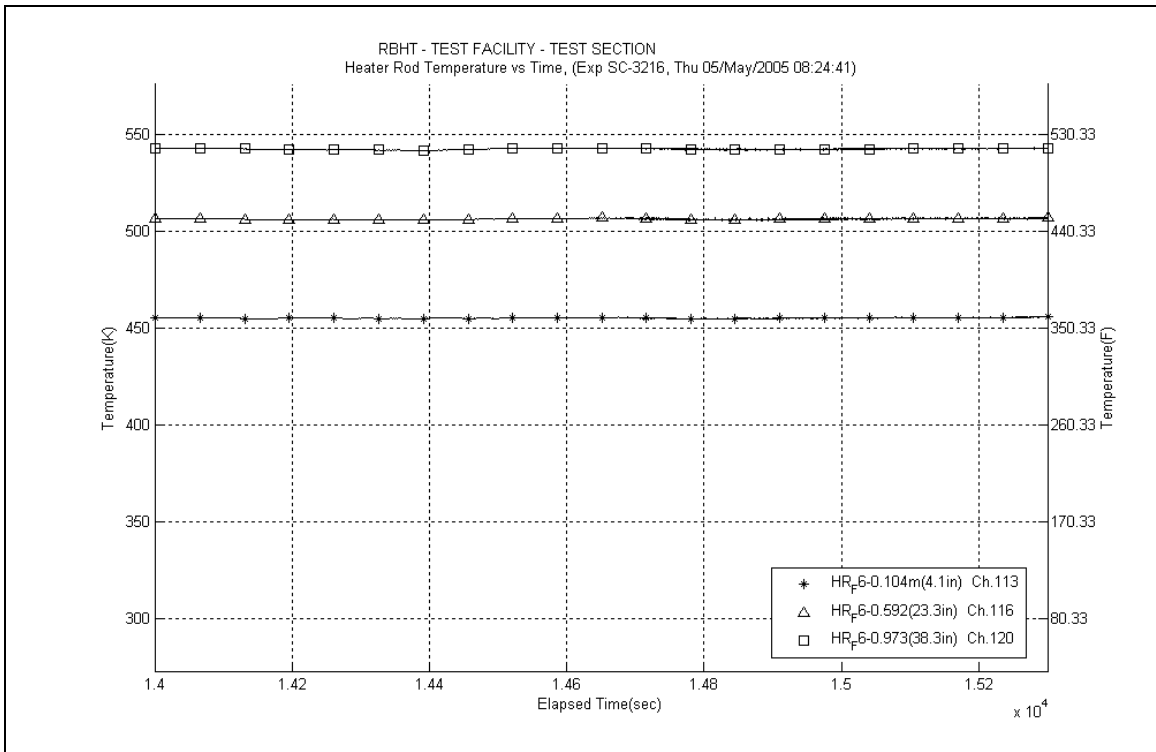
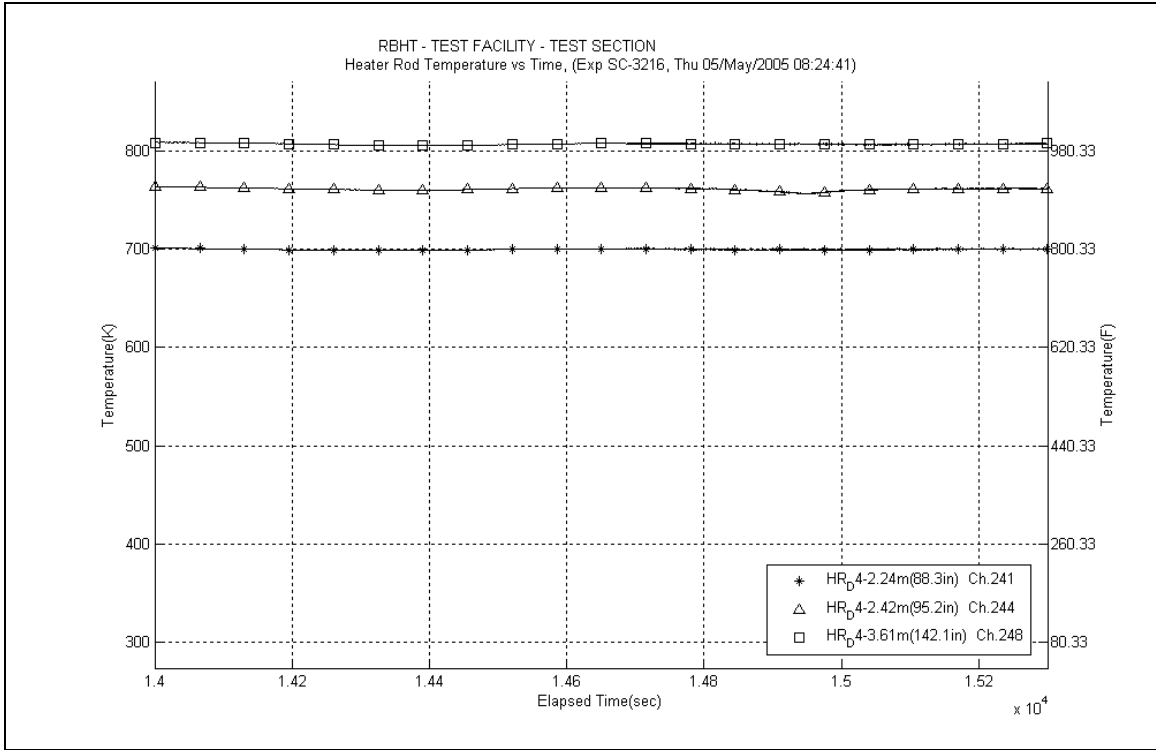
where x is the elevation (m) and T_{cl} is in (K)











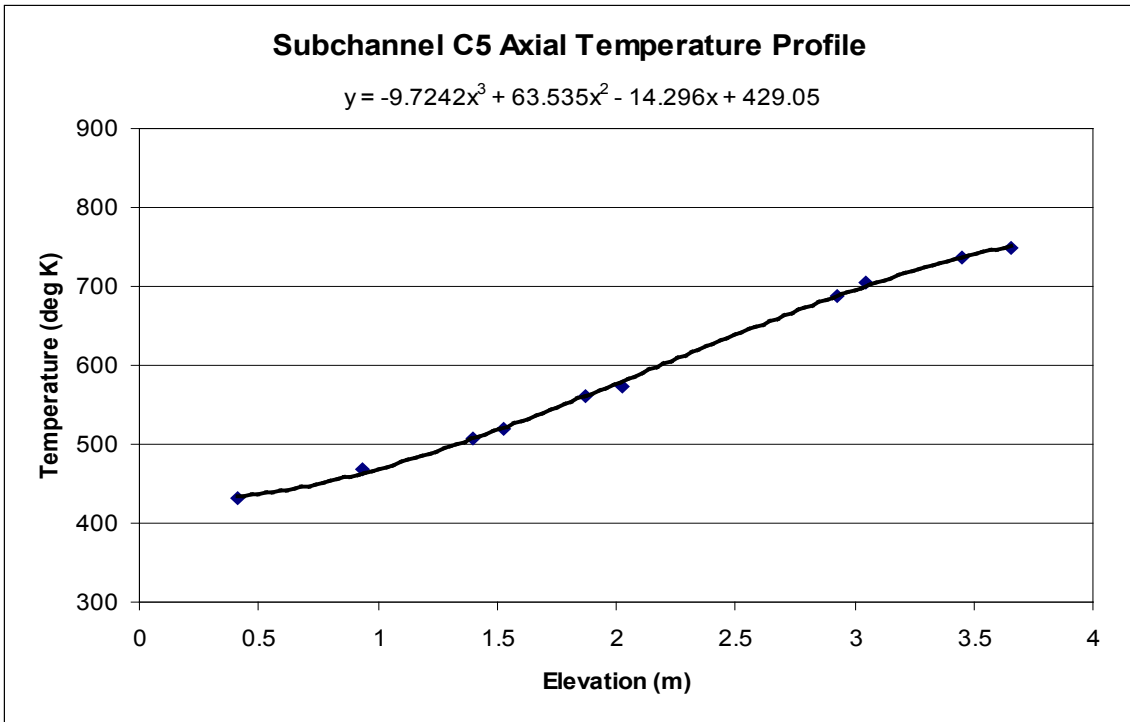
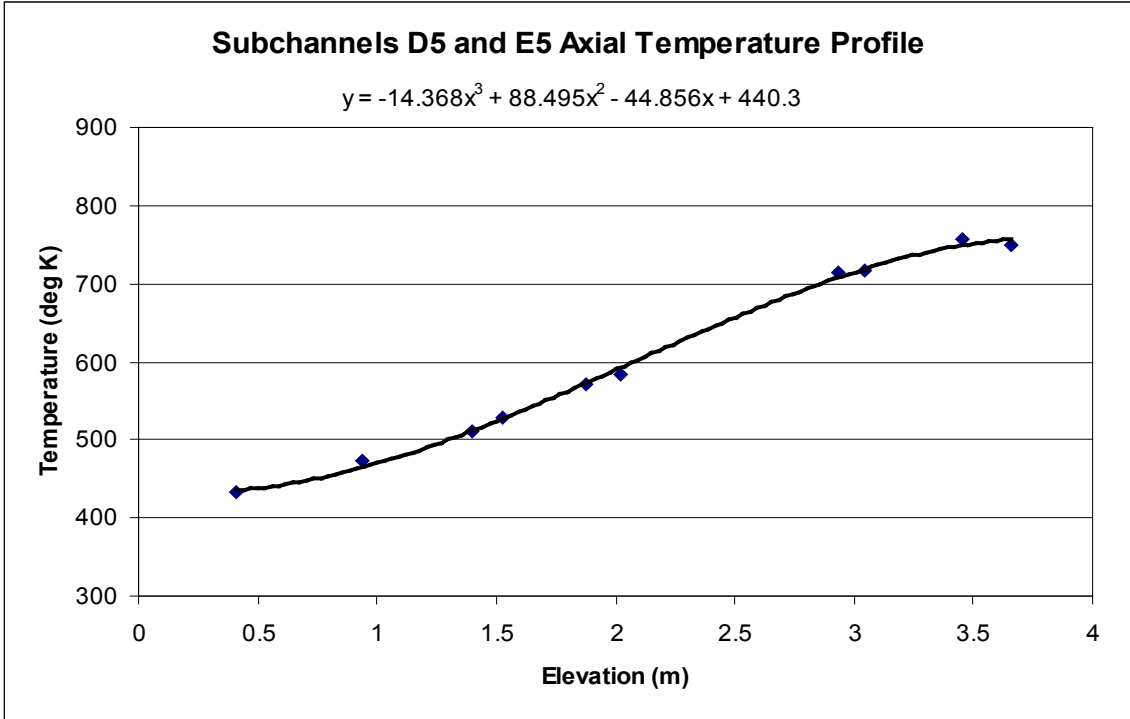


Table SC-3216-A.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	688.5	25454.5	622.8	1.20	633.7	10367	464.38	20.39	4.39%	108.82
RodD3_91.3	186	2.319	0.071	732.1	25995.5	633.0	1.20	649.5	10076	314.87	12.50	3.97%	71.20
RodD3_93.1	187	2.365	0.117	748.8	26319.1	639.1	1.20	657.4	9938	287.85	11.23	3.90%	63.97
RodD3_95.3	188	2.421	0.173	762.7	26715.6	646.5	1.20	665.8	9793	275.80	10.68	3.87%	60.17
RodD3_100.1	189	2.543	0.295	772.2	27584.4	662.2	1.20	680.5	9552	300.84	11.74	3.90%	63.59
RodD3_106.1	190	2.695	0.447	797.0	28666.9	680.9	1.20	700.3	9246	296.34	11.47	3.87%	60.09
RodD3_110	191	2.794	0.546	780.1	28312.3	692.4	1.20	707.0	9146	387.64	15.73	4.06%	77.51
RodD3_142.1	192	3.609	0.218	795.7	9899.5	755.7	1.20	762.4	8405	296.80	16.36	5.51%	53.19
RodC4_88.4	233	2.245	-0.003	691.5	25752.4	623.1	1.20	634.5	10352	451.70	19.57	4.33%	105.66
RodC4_91.1	234	2.314	0.066	730.4	26251.8	632.3	1.20	648.7	10091	321.18	12.75	3.97%	72.77
RodC4_93.4	235	2.372	0.124	748.8	26675.4	640.1	1.20	658.2	9923	294.64	11.50	3.90%	65.36
RodC4_95.3	236	2.421	0.173	760.7	27025.1	646.5	1.20	665.5	9799	283.89	11.00	3.87%	61.98
RodC4_100.1	237	2.543	0.295	768.1	27909.0	662.2	1.20	679.8	9563	316.16	12.39	3.92%	66.92
RodC4_106.1	238	2.695	0.447	789.4	29018.5	680.9	1.20	699.0	9265	320.95	12.53	3.90%	65.25
RodC4_110	239	2.794	0.546	771.1	28082.7	692.4	1.20	705.5	9168	428.47	17.85	4.17%	85.94
RodC4_142.2	240	3.612	0.221	809.7	10733.8	755.8	1.20	764.8	8376	239.05	11.30	4.73%	42.65
RodD4_88.3	241	2.243	-0.005	698.1	25657.6	622.8	1.20	635.3	10337	408.49	17.21	4.21%	95.37
RodD4_91.3	242	2.319	0.071	734.5	26206.3	633.0	1.20	649.9	10069	309.83	12.23	3.95%	70.00
RodD4_93.2	243	2.367	0.119	749.5	26554.0	639.4	1.20	657.8	9931	289.44	11.28	3.90%	64.27
RodD4_95.2	244	2.418	0.170	760.2	26917.8	646.1	1.20	665.1	9805	283.27	10.98	3.88%	61.89
RodD4_100.1	245	2.543	0.295	774.7	27813.7	662.2	1.20	680.9	9545	296.59	11.52	3.88%	62.63
RodD4_106.1	246	2.695	0.447	793.2	28908.3	680.9	1.20	699.6	9255	308.85	12.00	3.89%	62.71
RodD4_110	247	2.794	0.546	774.5	27916.4	692.4	1.20	706.1	9159	408.20	16.84	4.12%	81.78
RodD4_142.1	248	3.609	0.218	806.7	10375.0	755.7	1.20	764.2	8383	243.99	11.85	4.86%	43.58
RodE4_88.4	201	2.245	-0.003	692.0	25272.0	623.1	1.20	634.6	10351	440.32	19.07	4.33%	102.98
RodE4_91.2	202	2.316	0.069	729.8	25758.5	632.7	1.20	648.9	10088	318.11	12.68	3.99%	72.04
RodE4_95.3	204	2.421	0.173	756.4	26480.0	646.5	1.20	664.8	9811	288.96	11.29	3.91%	63.18
RodE4_100.9	205	2.563	0.315	771.8	27459.6	664.7	1.20	682.6	9519	307.82	12.07	3.92%	64.78
RodE4_142.3	208	3.614	0.224	803.5	10480.5	755.9	1.20	763.8	8387	263.89	13.21	5.01%	47.17
RodE3_63.4	193	1.610	0.417	631.0	20927.0	537.6	1.20	553.1	12154	268.64	10.75	4.00%	76.44
RodE3_113.6	194	2.885	0.022	717.3	25803.3	702.5	1.20	717.3	8998	348.83	14.15	4.06%	68.31
RodE3_115.5	195	2.934	0.070	807.5	24846.2	707.6	1.20	724.2	8901	298.49	11.83	3.96%	57.64
RodE3_118.5	196	3.010	0.146	817.8	23333.6	715.2	1.20	732.3	8791	272.95	10.77	3.94%	51.86
RodE3_122.7	197	3.117	0.253	813.4	21219.8	725.1	1.20	739.8	8691	288.48	11.70	4.06%	54.00
RodE3_126.5	198	3.213	0.349	808.8	19303.4	733.2	1.20	745.8	8613	306.35	12.89	4.21%	56.69
RodE3_131.7	199	3.345	-0.046	781.5	16680.8	742.7	1.20	749.2	8570	516.09	28.77	5.57%	94.87
RodE3_135.6	200	3.444	0.053	795.5	14719.4	748.6	1.20	756.4	8479	376.02	18.89	5.02%	68.16

Table SC-3216-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	627.9	20526.3	538.5	1.20	553.4	12147	275.77	11.16	4.05%	78.41
RodC5_113.6	226	2.885	0.022	787.4	25167.9	702.5	1.20	716.7	9007	355.62	14.60	4.11%	69.72
RodC5_115.7	227	2.939	0.075	806.8	24164.9	708.1	1.20	724.5	8897	293.94	11.71	3.98%	56.72
RodC5_122.7	229	3.117	0.253	813.3	20813.0	725.1	1.20	739.8	8691	283.30	11.52	4.07%	53.04
RodC5_126.7	230	3.218	0.354	812.8	18897.4	733.6	1.20	746.8	8600	286.36	11.92	4.16%	52.88
RodC5_131.6	231	3.343	-0.048	789.1	16548.9	742.5	1.20	750.3	8555	426.46	21.55	5.05%	78.22
RodC5_135.7	232	3.447	0.056	806.5	14588.5	748.7	1.20	758.3	8455	302.81	13.89	4.59%	54.69
RodE5_63.6	209	1.615	0.422	622.6	21019.4	538.2	1.20	552.3	12177	298.98	12.21	4.08%	85.26
RodE5_113.6	210	2.885	0.022	788.8	25950.8	702.5	1.20	716.9	9004	361.07	14.73	4.08%	70.76
RodE5_115.4	211	2.931	0.067	802.2	25058.1	707.3	1.20	723.1	8916	316.88	12.67	4.00%	61.32
RodE5_118.7	212	3.015	0.151	811.2	23419.6	715.7	1.20	731.6	8800	294.49	11.75	3.99%	56.03
RodE5_122.6	213	3.114	0.250	808.9	21486.5	724.9	1.20	738.9	8703	307.08	12.58	4.10%	57.59
RodE5_126.6	214	3.216	0.352	804.3	19502.2	733.4	1.20	745.2	8621	330.23	14.13	4.28%	61.17
RodE5_131.6	215	3.343	-0.048	780.8	17020.0	742.5	1.20	748.9	8573	533.53	29.94	5.61%	98.12
RodE5_135.6	216	3.444	0.053	799.5	15036.5	748.6	1.20	757.1	8471	354.63	17.13	4.83%	64.21
RodC3_79.8	177	2.027	0.227	666.9	23806.6	593.3	1.20	605.6	10929	388.39	16.50	4.25%	97.16
RodC3_85.6	178	2.174	0.374	676.6	24839.2	613.4	1.20	624.0	10555	472.13	21.03	4.46%	113.13
RodC3_88.5	179	2.248	0.000	686.5	25359.2	623.4	1.20	634.0	10362	482.27	21.49	4.46%	112.95
RodC3_92.4	180	2.347	0.099	730.8	26058.8	636.7	1.20	652.4	10025	332.61	13.34	4.01%	74.73
RodC3_94.4	181	2.398	0.150	742.3	26416.1	643.5	1.20	659.9	9893	320.62	12.74	3.97%	70.85
RodC3_97.2	182	2.469	0.221	756.0	26915.5	652.8	1.20	670.0	9724	312.71	12.33	3.94%	67.61
RodC3_108.8	183	2.764	0.516	790.3	28378.8	689.0	1.20	705.8	9163	336.01	13.29	3.95%	67.35
RodD5_50	217	1.270	0.076	586.7	18579.6	496.6	1.20	511.7	13329	247.53	9.97	4.03%	78.48
RodD5_54.1	218	1.374	0.180	605.2	19310.5	508.5	1.20	524.6	12940	239.73	9.53	3.97%	73.44
RodD5_56.9	219	1.445	0.251	611.5	19811.0	516.9	1.20	532.7	12707	251.35	10.03	3.99%	75.38
RodD5_60	220	1.524	0.330	619.5	20365.7	526.6	1.20	542.1	12447	263.07	10.53	4.00%	77.00
RodD5_66.1	221	1.679	0.485	637.8	21453.2	546.5	1.20	561.7	11937	281.97	11.33	4.02%	78.52
RodD5_69.9	222	1.775	-0.025	614.7	22131.1	559.2	1.20	568.5	11769	478.39	22.21	4.64%	130.97
RodD5_72.9	223	1.852	0.051	652.7	22667.6	569.4	1.20	583.3	11418	326.61	13.43	4.11%	86.20
RodD5_74.9	224	1.902	0.102	666.7	23025.9	576.3	1.20	591.4	11236	305.64	12.35	4.04%	79.09

Table SC-3216-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	561.2	16894.7	472.1	1.20	486.9	14136	227.40	9.18	4.04%	77.08
RodB5_52.9	154	1.344	0.150	596.6	19041.3	501.0	1.20	516.9	13169	238.93	9.52	3.98%	74.71
RodB5_55	155	1.397	0.203	602.8	19421.4	506.6	1.20	522.6	12999	242.22	9.64	3.98%	74.60
RodB5_57.8	156	1.468	0.274	608.5	19925.9	514.2	1.20	529.9	12786	253.66	10.13	3.99%	76.63
RodB5_64	157	1.626	0.432	626.9	21044.9	531.9	1.20	547.8	12296	265.97	10.61	3.99%	76.73
RodB5_73.9	158	1.877	0.077	657.6	22829.6	561.8	1.20	577.7	11548	285.77	11.41	3.99%	76.46
RodB5_75.9	159	1.928	0.128	667.3	23191.0	567.9	1.20	584.5	11391	280.10	11.11	3.97%	73.71
RodB5_76.9	160	1.953	0.153	671.2	23370.6	571.1	1.20	587.8	11317	279.96	11.09	3.96%	73.09
RodF5_41	105	1.041	0.343	555.9	15529.3	472.1	1.20	486.1	14167	222.28	9.19	4.13%	75.53
RodF5_53.1	106	1.349	0.155	591.9	18185.0	501.5	1.20	516.6	13179	241.31	9.77	4.05%	75.52
RodF5_55	107	1.397	0.203	598.0	18611.4	506.6	1.20	521.8	13023	244.17	9.86	4.04%	75.36
RodF5_57.8	108	1.468	0.274	605.6	19221.5	514.2	1.20	529.5	12800	252.53	10.19	4.04%	76.39
RodF5_64	109	1.626	0.432	622.4	20576.2	531.9	1.20	547.0	12315	272.81	11.01	4.04%	78.85
RodF5_73.8	110	1.875	0.074	645.6	22676.6	561.4	1.20	575.5	11601	323.33	13.22	4.09%	86.99
RodF5_75.8	111	1.925	0.125	654.5	23170.5	567.6	1.20	582.1	11446	319.99	13.03	4.07%	84.70
RodF5_76.8	112	1.951	0.150	657.2	23389.8	570.7	1.20	585.2	11376	324.70	13.24	4.08%	85.31
RodC2_41	57	1.041	0.343	554.3	16862.1	472.1	1.20	485.8	14176	245.97	10.11	4.11%	83.64
RodC2_53.1	58	1.349	0.155	595.4	19045.7	501.5	1.20	517.1	13162	243.26	9.72	4.00%	76.01
RodC2_55	59	1.397	0.203	600.1	19387.7	506.6	1.20	522.1	13012	248.80	9.95	4.00%	76.72
RodC2_57.8	60	1.468	0.274	604.4	19892.6	514.2	1.20	529.3	12805	264.74	10.67	4.03%	80.12
RodC2_63.9	61	1.623	0.429	621.6	20992.4	531.6	1.20	546.6	12326	280.11	11.29	4.03%	81.04
RodC2_73.8	62	1.875	0.074	647.2	22782.4	561.4	1.20	575.7	11595	318.97	12.99	4.07%	85.76
RodC2_75.8	63	1.925	0.125	657.2	23290.3	567.6	1.20	582.6	11436	312.06	12.62	4.05%	82.51
RodC2_76.8	64	1.951	0.150	660.1	23513.9	570.7	1.20	585.6	11365	315.71	12.77	4.05%	82.85
RodC6_40.9	137	1.039	0.340	557.6	16781.6	471.9	1.20	486.2	14163	234.88	9.57	4.07%	79.79
RodC6_52.8	138	1.341	0.147	596.4	19021.6	500.7	1.20	516.6	13177	238.54	9.50	3.98%	74.63
RodC6_54.8	139	1.392	0.198	603.0	19397.7	506.0	1.20	522.2	13011	240.07	9.54	3.97%	74.02
RodC6_57.8	140	1.468	0.274	611.0	19963.4	514.2	1.20	530.4	12774	247.60	9.84	3.97%	74.72
RodC6_63.8	141	1.621	0.427	630.2	21093.5	531.3	1.20	547.8	12294	256.09	10.14	3.96%	73.86
RodC6_73.7	142	1.872	0.072	662.0	22956.6	561.1	1.20	577.9	11543	273.13	10.80	3.95%	73.04
RodC6_75.8	143	1.925	0.125	670.5	23352.4	567.6	1.20	584.8	11385	272.45	10.74	3.94%	71.65
RodC6_76.8	144	1.951	0.150	675.0	23541.1	570.7	1.20	588.1	11309	270.85	10.65	3.93%	70.65

Table SC-3216-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	684.9	25254.2	607.2	1.20	620.1	10631	389.91	16.32	4.19%	94.26
RodB4_91.3	162	2.319	0.071	725.1	25763.0	616.3	1.20	634.4	10353	284.06	11.11	3.91%	66.45
RodB4_93.3	163	2.370	0.122	739.3	26113.3	622.6	1.20	642.0	10212	268.41	10.40	3.87%	61.72
RodB4_95.1	164	2.416	0.168	748.9	26426.8	628.2	1.20	648.3	10098	262.77	10.13	3.86%	59.59
RodB4_100	165	2.540	0.292	757.2	27280.8	643.3	1.20	662.3	9854	287.48	11.17	3.89%	63.21
RodB4_106	166	2.692	0.445	784.8	28328.3	661.3	1.20	681.9	9530	275.42	10.59	3.85%	58.04
RodB4_109.9	167	2.791	0.544	762.6	27424.2	672.7	1.20	687.7	9439	366.13	14.83	4.05%	76.22
RodB4_142.3	168	3.614	0.224	803.6	10659.1	748.2	1.20	757.5	8466	231.15	10.81	4.68%	41.82
RodF4_85.6	98	2.174	0.374	679.4	25402.8	598.4	1.20	611.9	10798	376.06	15.53	4.13%	92.69
RodF4_88.4	99	2.245	-0.003	686.1	26003.9	607.2	1.20	620.3	10627	395.28	16.43	4.16%	95.52
RodF4_92.4	100	2.347	0.099	727.2	27365.2	619.7	1.20	637.7	10293	305.47	11.90	3.90%	70.94
RodF4_94.3	101	2.395	0.147	739.6	27902.0	625.7	1.20	644.7	10164	294.04	11.35	3.86%	67.22
RodF4_97.2	102	2.469	0.221	753.8	26994.9	634.7	1.20	654.5	9988	272.01	10.50	3.86%	60.83
RodF4_108.8	103	2.764	0.516	783.2	28509.6	669.5	1.20	688.5	9426	301.05	11.69	3.88%	62.57
RodF4_111	104	2.819	-0.044	752.3	27349.2	675.8	1.20	688.6	9424	429.50	18.04	4.20%	89.24
RodD2_103.2	65	2.621	0.373	769.0	28213.0	653.0	1.20	672.3	9685	291.70	11.29	3.87%	62.75
RodD2_106	66	2.692	0.445	777.3	28718.5	661.3	1.20	680.7	9550	297.22	11.51	3.87%	62.80
RodD2_112.6	67	2.860	-0.004	768.0	26347.1	680.4	1.20	695.0	9326	360.60	14.66	4.07%	73.93
RodD2_114.9	68	2.918	0.055	786.9	27337.1	686.8	1.20	703.4	9199	327.69	12.87	3.93%	66.01
RodD2_117.4	69	2.982	0.118	795.2	26150.2	693.5	1.20	710.5	9096	308.64	12.07	3.91%	61.28
RodD2_120.8	70	3.068	0.204	794.5	24329.5	702.4	1.20	717.8	8991	316.98	12.62	3.98%	62.01
RodD2_124.8	71	3.170	0.306	790.6	22131.5	712.4	1.20	725.4	8884	339.48	14.03	4.13%	65.39
RodD2_128.6	72	3.266	0.403	787.1	20049.0	721.3	1.20	732.3	8791	366.08	15.93	4.35%	69.56
RodD6_103.1	129	2.619	0.371	764.5	28248.3	652.7	1.20	671.3	9702	303.17	11.79	3.89%	65.36
RodD6_106	130	2.692	0.445	773.9	28765.8	661.3	1.20	680.1	9559	306.76	11.92	3.89%	64.90
RodD6_112.9	131	2.868	0.004	769.5	26249.5	681.2	1.20	695.9	9312	356.80	14.48	4.06%	73.01
RodD6_114.9	132	2.918	0.055	790.3	27448.0	686.8	1.20	704.0	9190	318.19	12.42	3.90%	64.02
RodD6_116.8	133	2.967	0.103	798.3	26563.4	691.9	1.20	709.6	9108	299.74	11.63	3.88%	59.61
RodD6_120.9	134	3.071	0.207	796.4	21956.5	702.7	1.20	718.3	8984	281.30	11.28	4.01%	54.97
RodD6_124.8	135	3.170	0.306	794.9	19862.6	712.4	1.20	726.2	8875	288.86	11.91	4.12%	55.56
RodD6_128.7	136	3.269	0.405	796.0	17765.5	721.6	1.20	734.0	8769	286.49	12.13	4.23%	54.26

Table SC-3216-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	581.6	17717.9	493.7	1.20	508.3	13432	241.97	9.85	4.07%	77.40
RodE2_54	74	1.372	0.178	597.7	18646.4	503.9	1.20	519.5	13090	238.36	9.56	4.01%	74.01
RodE2_56.9	75	1.445	0.251	606.1	19291.8	511.7	1.20	527.5	12857	245.46	9.83	4.00%	74.64
RodE2_59.9	76	1.521	0.328	613.9	19949.2	520.1	1.20	535.8	12622	255.26	10.23	4.01%	75.95
RodE2_66	77	1.676	0.483	629.0	21275.5	537.8	1.20	553.0	12158	280.16	11.27	4.02%	79.74
RodE2_69.8	78	1.773	-0.027	607.5	21667.0	549.2	1.20	558.9	12006	446.16	20.36	4.56%	125.10
RodE2_72.9	79	1.852	0.051	645.9	22774.3	558.7	1.20	573.2	11655	313.35	12.70	4.05%	84.78
RodE2_74.9	80	1.902	0.102	660.1	23349.2	564.8	1.20	580.7	11478	294.30	11.75	3.99%	78.17
RodB3_50.2	169	1.275	0.081	574.8	18531.6	494.0	1.20	507.4	13461	274.91	11.34	4.13%	88.15
RodB3_54.1	170	1.374	0.180	586.1	19233.9	504.1	1.20	517.8	13142	281.64	11.58	4.11%	87.85
RodB3_56.9	171	1.445	0.251	594.6	19740.0	511.7	1.20	525.6	12913	285.85	11.73	4.10%	87.35
RodB3_60.1	172	1.527	0.333	601.4	20315.6	520.7	1.20	534.1	12667	302.22	12.48	4.13%	90.31
RodB3_66.1	173	1.679	0.485	622.0	21398.2	538.1	1.20	552.1	12182	306.12	12.52	4.09%	87.33
RodB3_69.9	174	1.775	-0.025	606.0	22083.3	549.5	1.20	558.9	12006	469.08	21.63	4.61%	131.53
RodB3_73	175	1.854	0.054	639.8	22642.2	559.0	1.20	572.5	11673	336.00	13.86	4.13%	91.08
RodB3_75	176	1.905	0.105	653.3	23005.0	565.2	1.20	579.8	11499	313.29	12.72	4.06%	83.39
RodF3_50.1	89	1.273	0.079	584.1	17650.5	493.7	1.20	508.8	13419	234.31	9.49	4.05%	74.87
RodF3_54	90	1.372	0.178	598.8	18568.6	503.9	1.20	519.7	13085	234.75	9.40	4.01%	72.86
RodF3_57	91	1.448	0.254	605.4	19210.6	512.0	1.20	527.6	12854	246.96	9.92	4.02%	75.07
RodF3_60	92	1.524	0.330	613.7	19876.8	520.4	1.20	535.9	12617	255.78	10.26	4.01%	76.07
RodF3_66.1	93	1.679	0.485	624.6	21157.3	538.1	1.20	552.5	12170	293.57	11.94	4.07%	83.66
RodF3_70	94	1.778	-0.022	611.5	21690.2	549.8	1.20	560.1	11977	422.09	18.88	4.47%	118.00
RodF3_73	95	1.854	0.054	646.8	22748.0	559.0	1.20	573.6	11645	311.01	12.59	4.05%	84.06
RodF3_75	96	1.905	0.105	660.3	23319.0	565.2	1.20	581.0	11471	294.02	11.74	3.99%	78.04
RodE6_50.2	121	1.275	0.081	582.0	17607.4	494.0	1.20	508.6	13423	239.95	9.77	4.07%	76.70
RodE6_54.1	122	1.374	0.180	595.8	18490.9	504.1	1.20	519.4	13094	242.14	9.77	4.04%	75.20
RodE6_57	123	1.448	0.254	602.3	19100.5	512.0	1.20	527.1	12868	253.74	10.26	4.04%	77.23
RodE6_60.2	124	1.529	0.335	610.9	19790.3	521.0	1.20	536.0	12616	264.11	10.68	4.04%	78.54
RodE6_66.1	125	1.679	0.485	629.7	21108.5	538.1	1.20	553.4	12148	276.44	11.12	4.02%	78.61
RodE6_70	126	1.778	-0.022	608.7	21507.5	549.8	1.20	559.6	11988	438.35	19.95	4.55%	122.69
RodE6_73.1	127	1.857	0.056	643.8	22558.5	559.3	1.20	573.4	11651	320.47	13.09	4.09%	86.67
RodE6_75	128	1.905	0.105	656.0	23076.8	565.2	1.20	580.3	11488	304.92	12.30	4.03%	81.07

RBHT Steam Cooling Test SC-3216-B

Matrix test # 8

Test date – 5/5/2005

Steady state time window: 21300 - 22740 sec

Inlet flow: 4.81 m³/min (169.7 ft³/min)

Inlet steam temperature: 419 K (295 °F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 95.2 kW

Outlet steam temperature: 770 K (927 °F)

Bundle inlet Reynolds number: 18147

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

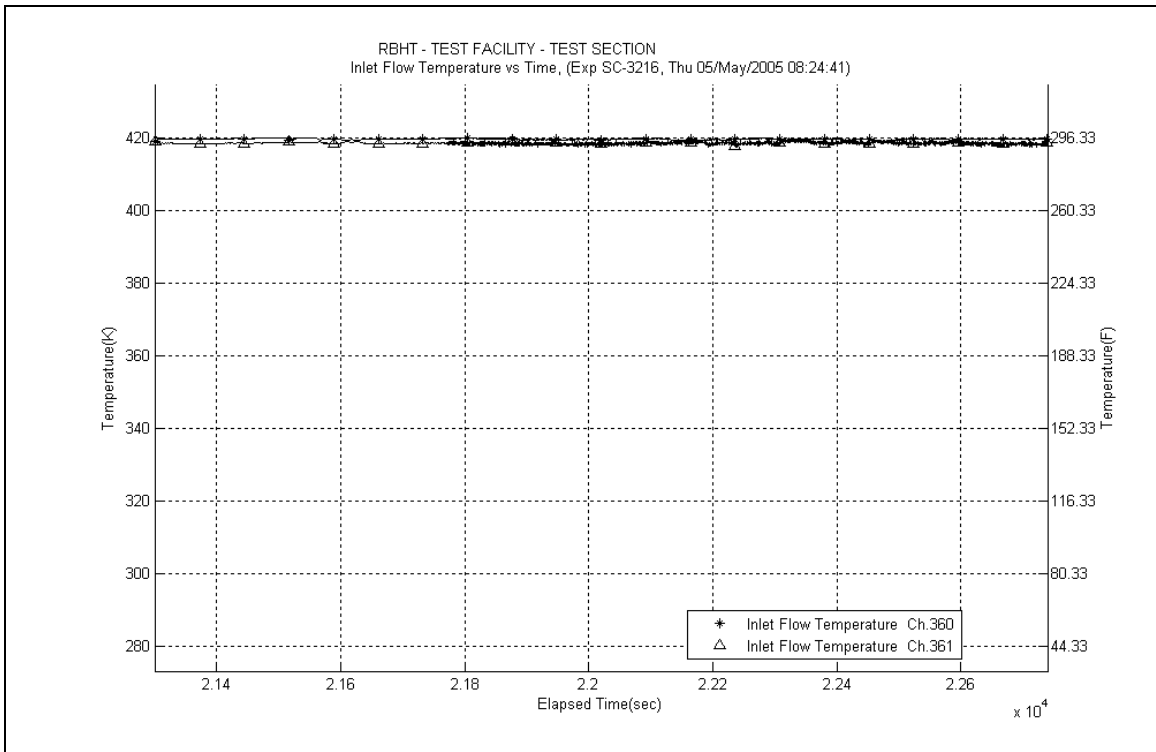
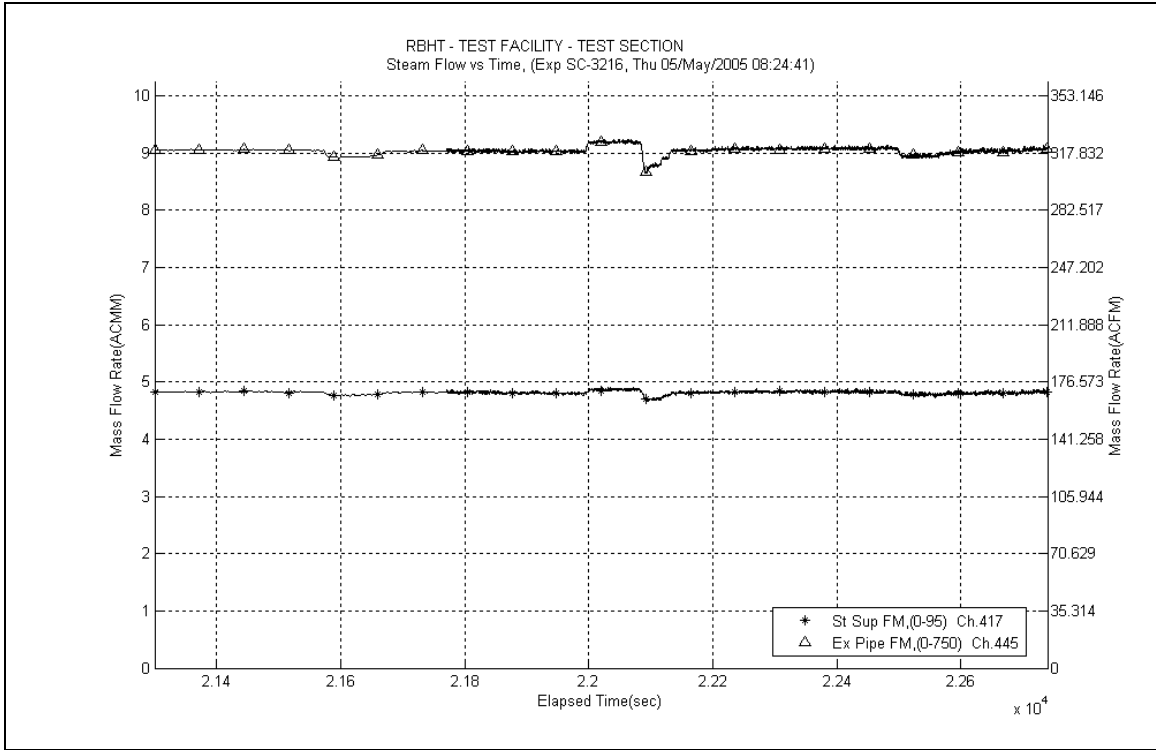
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

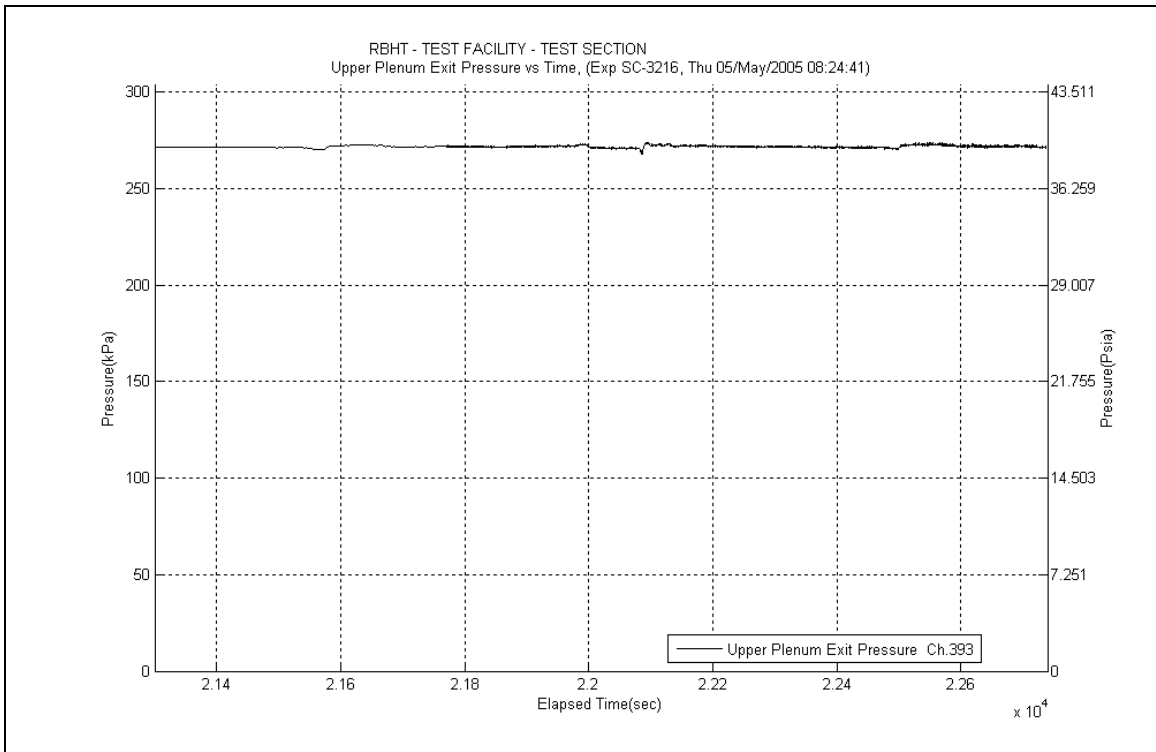
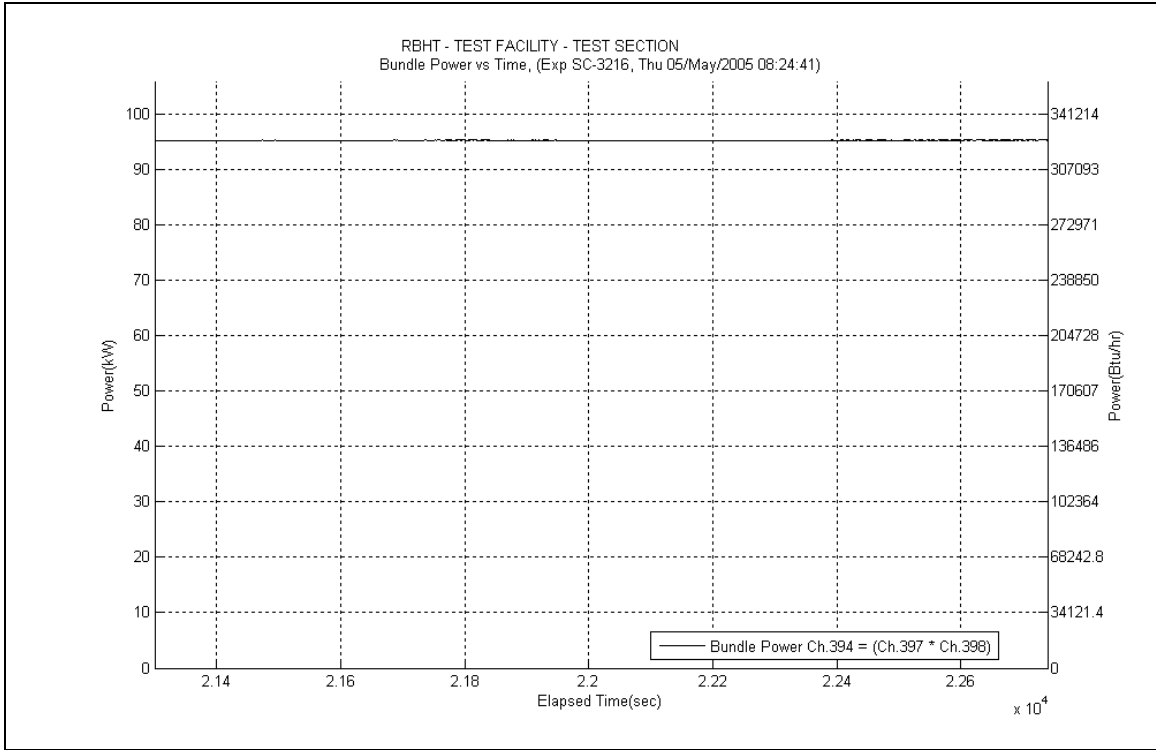
$$T_{cl} = -14.189x^3 + 88.469x^2 - 43.509x + 444.57$$

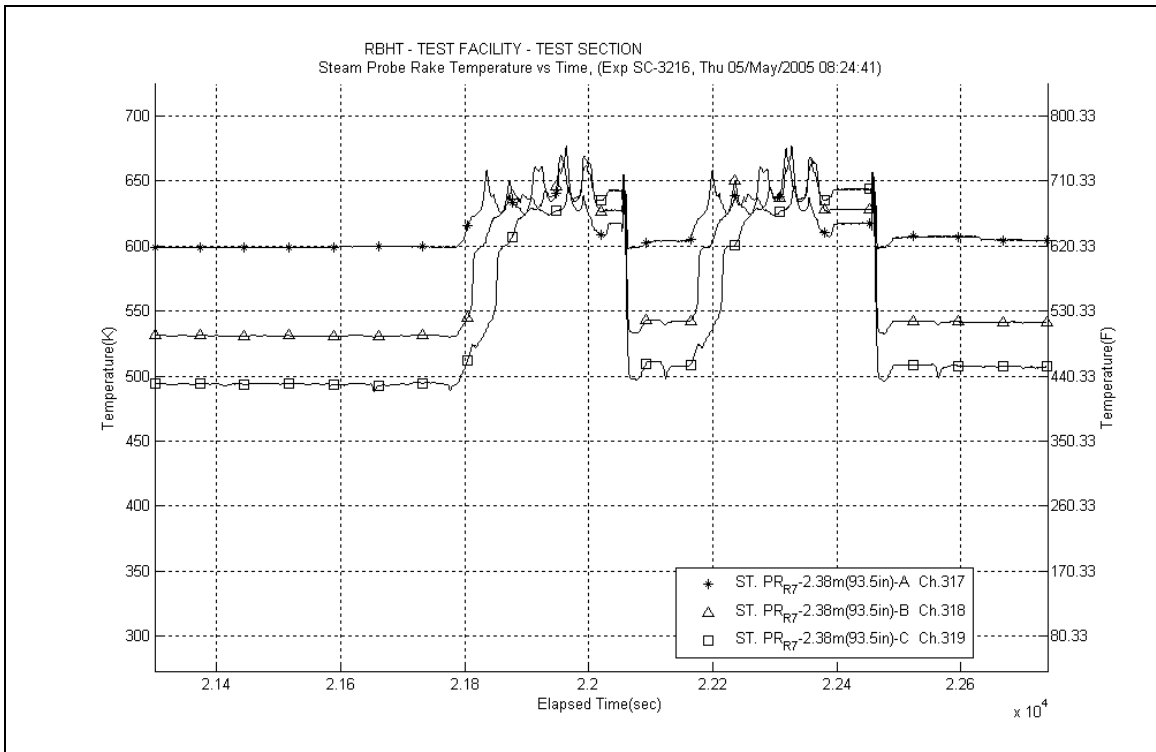
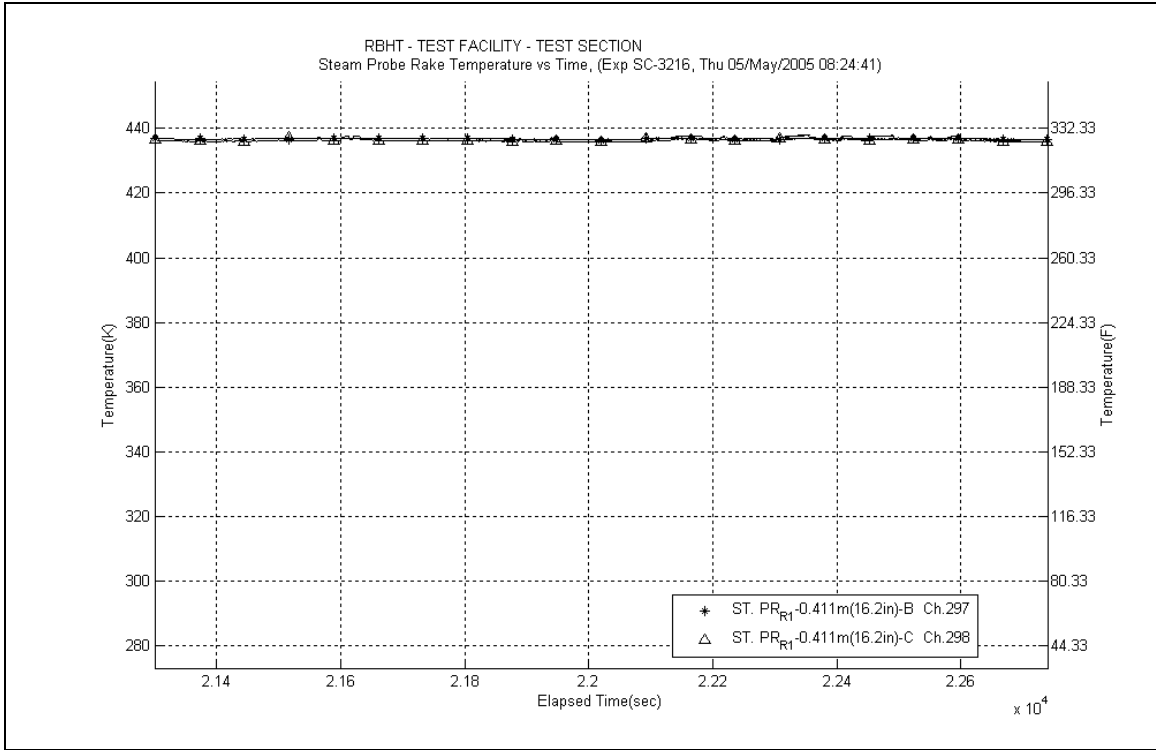
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

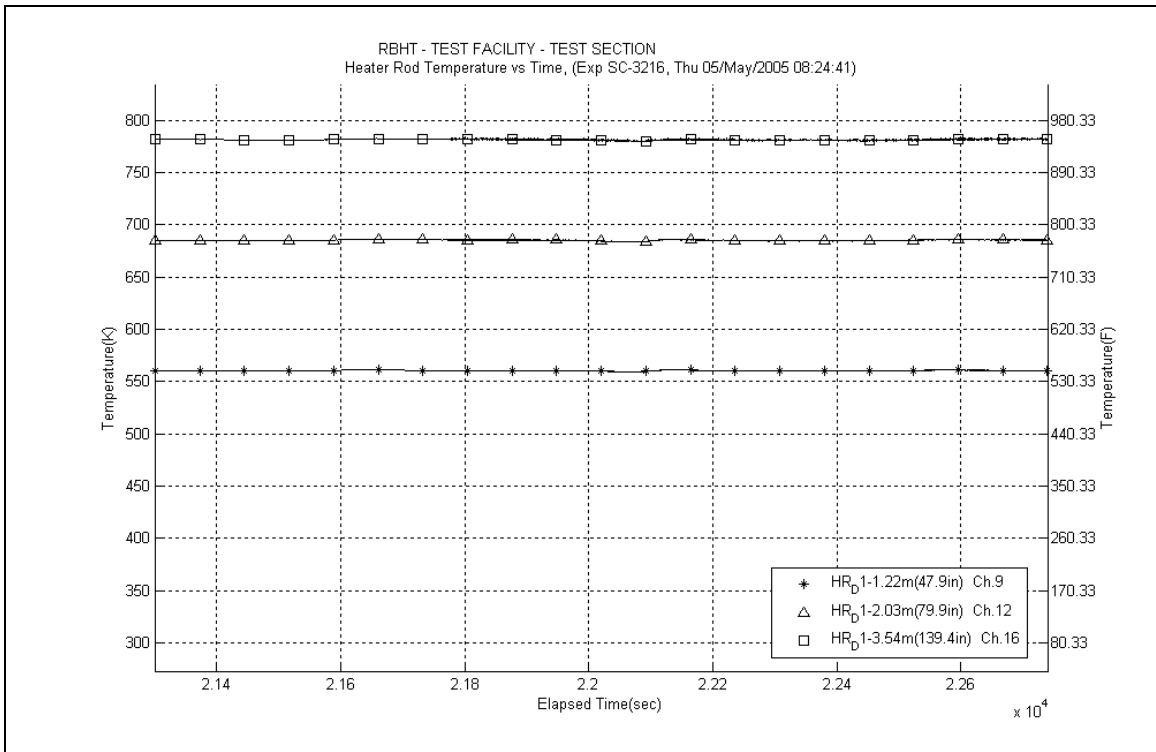
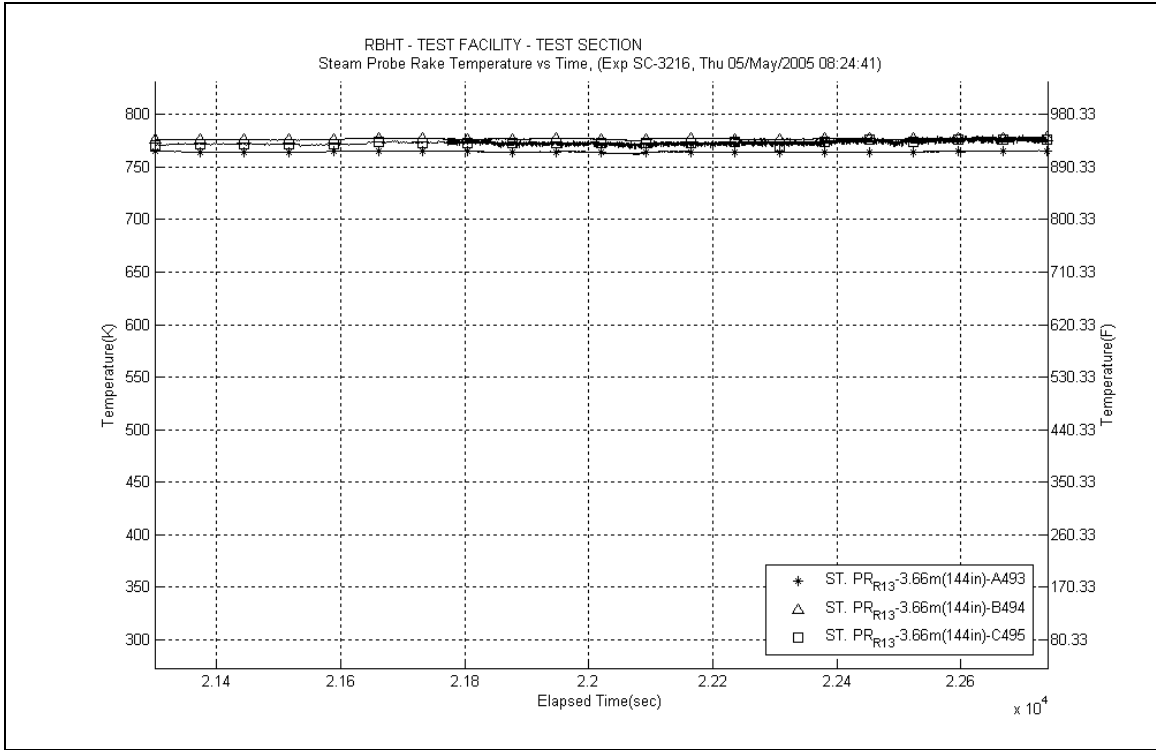
$$T_{cl} = -7.7021x^3 + 53.724x^2 + 0.2758x + 429.27$$

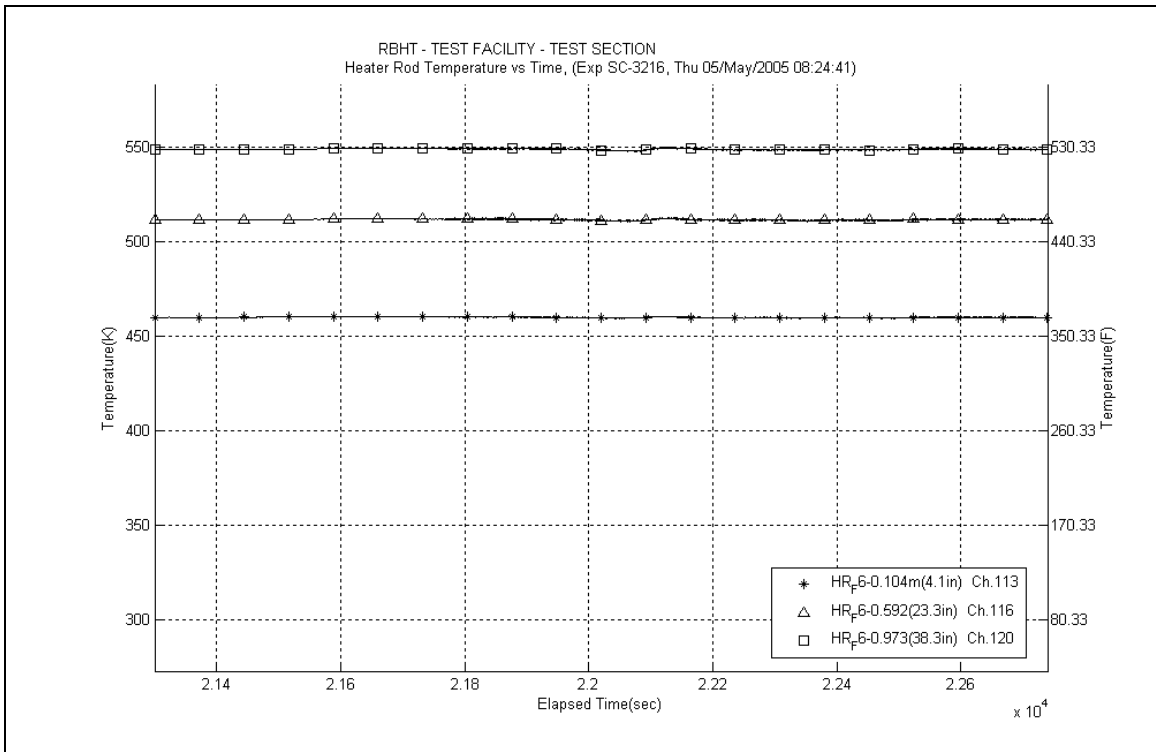
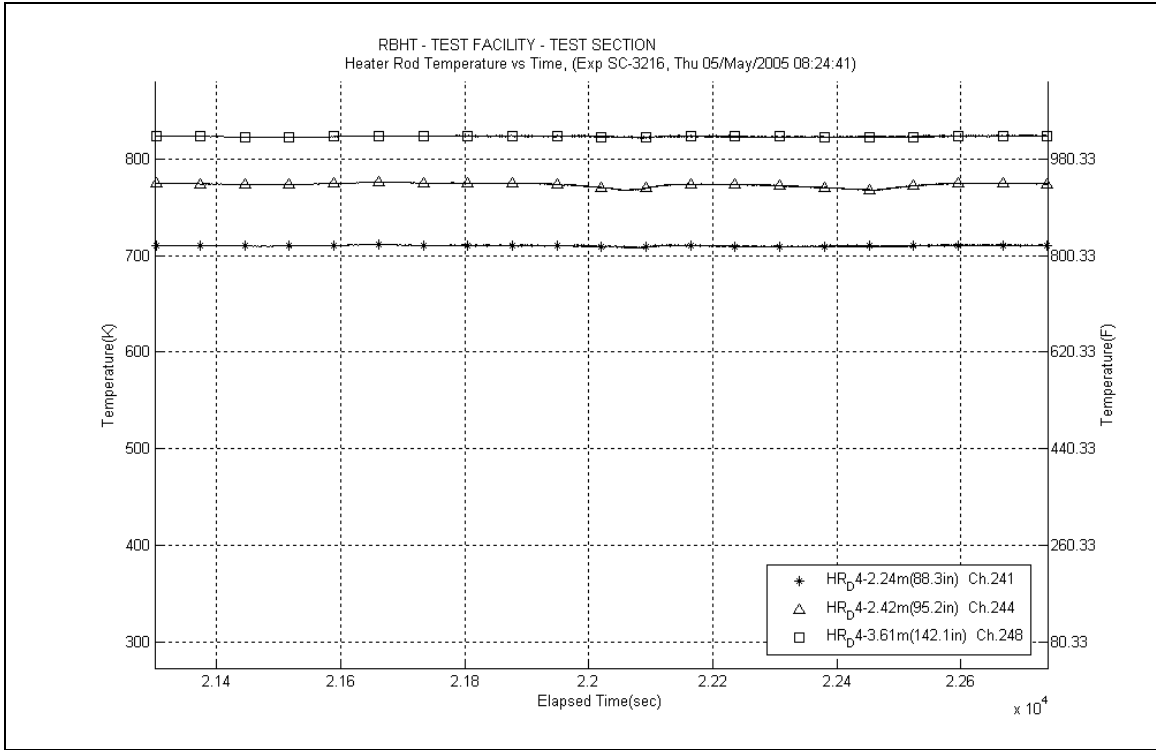
where x is the elevation (m) and T_{cl} is in (K)











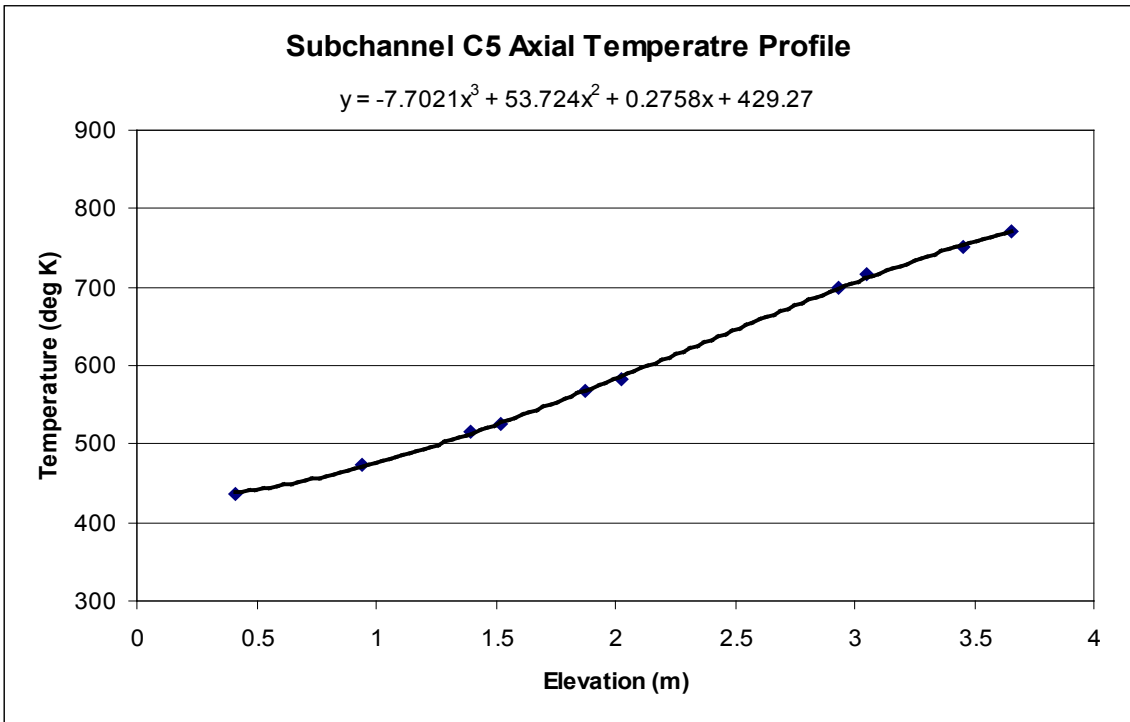
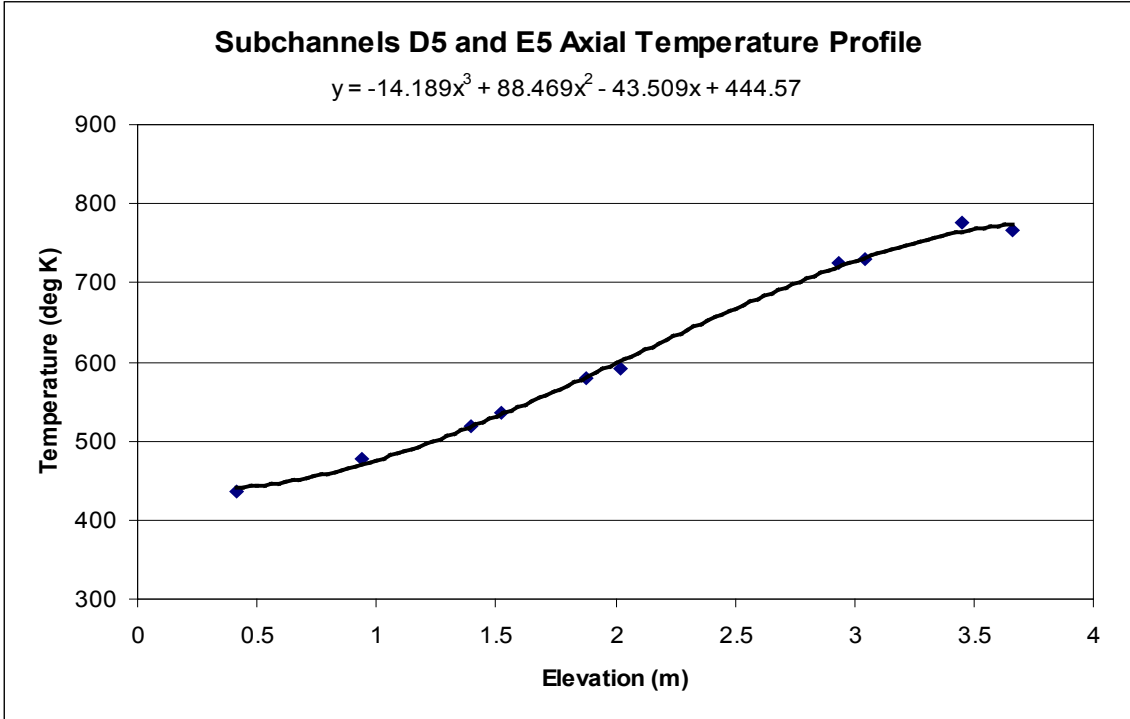


Table SC-3216-B.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ontc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	699.9	25477.4	631.9	1.20	643.3	12565	449.87	19.55	4.35%	102.87
RodD3_91.3	186	2.319	0.071	743.6	26016.8	642.5	1.20	659.3	12211	308.76	12.21	3.95%	68.15
RodD3_93.1	187	2.365	0.117	761.3	26339.1	648.8	1.20	667.5	12039	280.89	10.92	3.89%	60.91
RodD3_95.3	188	2.421	0.173	776.2	26737.6	656.4	1.20	676.4	11859	267.67	10.32	3.86%	56.95
RodD3_100.1	189	2.543	0.295	795.0	27600.8	672.6	1.20	693.0	11534	270.69	10.41	3.85%	55.60
RodD3_106.1	190	2.695	0.447	812.2	28684.9	692.1	1.20	712.1	11184	286.69	11.05	3.85%	56.62
RodD3_110	191	2.794	0.546	795.6	28330.5	704.2	1.20	719.4	11056	371.75	14.95	4.02%	72.35
RodD3_142.1	192	3.609	0.218	810.3	9897.8	772.9	1.20	779.1	10114	317.27	18.17	5.73%	55.02
RodC4_88.4	233	2.245	-0.003	702.5	25767.4	632.3	1.20	644.0	12548	440.44	18.93	4.30%	100.55
RodC4_91.1	234	2.314	0.066	741.4	26267.0	641.8	1.20	658.4	12232	316.38	12.53	3.96%	69.97
RodC4_93.4	235	2.372	0.124	760.4	26684.9	649.8	1.20	668.3	12024	289.46	11.27	3.89%	62.67
RodC4_95.3	236	2.421	0.173	772.5	27037.1	656.4	1.20	675.7	11872	279.47	10.80	3.87%	59.54
RodC4_100.1	237	2.543	0.295	787.0	27918.9	672.6	1.20	691.7	11559	292.84	11.34	3.87%	60.32
RodC4_106.1	238	2.695	0.447	800.8	29027.9	692.1	1.20	710.2	11217	320.46	12.51	3.90%	63.54
RodC4_110	239	2.794	0.546	782.8	28082.9	704.2	1.20	717.3	11093	428.66	17.86	4.17%	83.79
RodC4_142.2	240	3.612	0.221	825.7	10727.7	773.0	1.20	781.8	10076	244.36	11.67	4.78%	42.17
RodD4_88.3	241	2.243	-0.005	708.5	25672.0	631.9	1.20	644.7	12532	402.09	16.87	4.19%	91.65
RodD4_91.3	242	2.319	0.071	745.6	26216.5	642.5	1.20	659.7	12204	305.20	12.02	3.94%	67.31
RodD4_93.2	243	2.367	0.119	761.3	26563.2	649.1	1.20	667.8	12034	284.22	11.05	3.89%	61.59
RodD4_95.2	244	2.418	0.170	772.8	26932.4	656.0	1.20	675.5	11877	276.81	10.70	3.86%	59.00
RodD4_100.1	245	2.543	0.295	789.2	27825.1	672.6	1.20	692.1	11553	286.59	11.08	3.87%	58.99
RodD4_106.1	246	2.695	0.447	807.7	28918.8	692.1	1.20	711.4	11197	300.24	11.62	3.87%	59.39
RodD4_110	247	2.794	0.546	789.5	27930.3	704.2	1.20	718.4	11074	392.73	16.05	4.09%	76.59
RodD4_142.1	248	3.609	0.218	822.6	10370.1	772.9	1.20	781.2	10084	250.52	12.32	4.92%	43.28
RodE4_88.4	201	2.245	-0.003	702.5	25293.6	632.3	1.20	644.0	12548	432.16	18.61	4.31%	98.66
RodE4_91.2	202	2.316	0.069	740.3	25783.7	642.1	1.20	658.5	12229	315.14	12.54	3.98%	69.68
RodE4_95.3	204	2.421	0.173	768.5	26499.8	656.4	1.20	675.1	11885	283.71	11.05	3.89%	60.53
RodE4_100.9	205	2.563	0.315	785.0	27478.7	675.3	1.20	693.6	11524	300.53	11.74	3.91%	61.66
RodE4_142.3	208	3.614	0.224	818.9	10480.7	773.1	1.20	780.7	10091	274.29	13.99	5.10%	47.42
RodE3_63.4	193	1.610	0.417	639.4	20943.5	544.7	1.20	560.5	14767	265.42	10.59	3.99%	73.70
RodE3_113.6	194	2.885	0.022	803.8	25811.2	714.7	1.20	729.6	10883	347.91	14.10	4.05%	66.35
RodE3_115.5	195	2.934	0.070	820.1	24856.8	720.1	1.20	736.8	10763	298.26	11.82	3.96%	56.08
RodE3_118.5	196	3.010	0.146	830.8	23341.5	728.2	1.20	745.3	10626	273.08	10.77	3.94%	50.50
RodE3_122.7	197	3.117	0.253	826.9	21221.6	738.8	1.20	753.4	10497	288.89	11.72	4.06%	52.59
RodE3_126.5	198	3.213	0.349	822.2	19305.1	747.5	1.20	759.9	10398	309.88	13.08	4.22%	55.71
RodE3_131.7	199	3.345	-0.046	794.7	16681.6	757.9	1.20	764.0	10336	543.53	31.25	5.75%	96.96
RodE3_135.6	200	3.444	0.053	809.1	14715.3	764.5	1.20	771.9	10218	395.53	20.39	5.15%	69.52

Table SC-3216-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	635.5	20536.1	545.7	1.20	560.6	14761	274.26	11.08	4.04%	76.12
RodC5_113.6	226	2.885	0.022	800.6	25179.5	714.7	1.20	729.0	10891	351.93	14.42	4.10%	67.19
RodC5_115.7	227	2.939	0.075	820.8	24161.8	720.6	1.20	737.3	10754	289.52	11.50	3.97%	54.38
RodC5_122.7	229	3.117	0.253	829.0	20810.7	738.8	1.20	753.8	10492	276.85	11.20	4.05%	50.36
RodC5_126.7	230	3.218	0.354	828.9	18896.4	747.9	1.20	761.4	10375	279.75	11.58	4.14%	50.16
RodC5_131.6	231	3.343	-0.048	805.1	16546.6	757.7	1.20	765.6	10312	419.20	21.01	5.01%	74.56
RodC5_135.7	232	3.447	0.056	822.8	14582.9	764.6	1.20	774.3	10183	300.91	13.77	4.58%	52.65
RodE5_63.6	209	1.615	0.422	630.8	21044.3	545.3	1.20	559.6	14794	295.59	12.04	4.07%	82.25
RodE5_113.6	210	2.885	0.022	803.6	25973.3	714.7	1.20	729.5	10883	350.87	14.22	4.05%	66.92
RodE5_115.4	211	2.931	0.067	817.7	25086.3	719.8	1.20	736.1	10774	307.42	12.22	3.97%	57.88
RodE5_118.7	212	3.015	0.151	827.3	23438.8	728.7	1.20	745.2	10628	285.17	11.31	3.97%	52.75
RodE5_122.6	213	3.114	0.250	824.5	21502.4	738.5	1.20	752.8	10506	300.10	12.23	4.07%	54.69
RodE5_126.6	214	3.216	0.352	821.4	19514.5	747.7	1.20	760.0	10397	317.70	13.44	4.23%	57.12
RodE5_131.6	215	3.343	-0.048	797.7	17032.2	757.7	1.20	764.4	10330	510.42	27.90	5.47%	91.00
RodE5_135.6	216	3.444	0.053	815.5	15045.6	764.5	1.20	773.0	10203	354.15	17.09	4.83%	62.12
RodC3_79.8	177	2.027	0.227	676.4	23821.0	601.7	1.20	614.1	13260	382.37	16.17	4.23%	93.40
RodC3_85.6	178	2.174	0.374	686.8	24859.7	622.4	1.20	633.1	12799	462.55	20.46	4.42%	108.20
RodC3_88.5	179	2.248	0.000	697.6	25375.1	632.6	1.20	643.5	12560	468.95	20.69	4.41%	107.19
RodC3_92.4	180	2.347	0.099	742.7	26071.8	646.3	1.20	662.4	12147	324.80	12.96	3.99%	71.21
RodC3_94.4	181	2.398	0.150	755.0	26432.8	653.3	1.20	670.2	11984	311.70	12.32	3.95%	67.19
RodC3_97.2	182	2.469	0.221	769.8	26924.7	662.9	1.20	680.7	11773	302.23	11.85	3.92%	63.71
RodC3_108.8	183	2.764	0.516	801.1	28389.3	700.5	1.20	717.3	11093	338.78	13.41	3.96%	66.22
RodD5_50	217	1.270	0.076	593.1	18594.6	502.9	1.20	518.0	16219	247.36	9.96	4.03%	76.39
RodD5_54.1	218	1.374	0.180	612.5	19327.6	515.0	1.20	531.3	15736	237.82	9.44	3.97%	71.01
RodD5_56.9	219	1.445	0.251	619.2	19825.6	523.6	1.20	539.6	15448	249.09	9.92	3.98%	72.85
RodD5_60	220	1.524	0.330	626.8	20374.7	533.5	1.20	549.1	15131	262.17	10.49	4.00%	74.88
RodD5_66.1	221	1.679	0.485	645.3	21469.4	553.7	1.20	569.0	14504	281.42	11.30	4.01%	76.52
RodD5_69.9	222	1.775	-0.025	622.2	22146.9	566.8	1.20	576.0	14296	479.45	22.27	4.64%	128.17
RodD5_72.9	223	1.852	0.051	661.2	22684.8	577.3	1.20	591.2	13863	324.18	13.31	4.10%	83.55
RodD5_74.9	224	1.902	0.102	675.7	23040.8	584.3	1.20	599.5	13639	302.34	12.18	4.03%	76.41

Table SC-3216-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ontc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	567.6	16904.8	479.1	1.20	493.9	17172	229.38	9.28	4.04%	75.34
RodB5_52.9	154	1.344	0.150	604.5	19053.1	507.9	1.20	524.0	15995	236.74	9.41	3.98%	71.99
RodB5_55	155	1.397	0.203	610.6	19432.7	513.5	1.20	529.7	15792	240.11	9.54	3.97%	71.99
RodB5_57.8	156	1.468	0.274	616.0	19938.2	521.1	1.20	536.9	15539	252.12	10.06	3.99%	74.22
RodB5_64	157	1.626	0.432	634.4	21057.4	538.6	1.20	554.6	14953	263.80	10.50	3.98%	74.32
RodB5_73.9	158	1.877	0.077	667.8	22846.8	568.1	1.20	584.7	14045	275.19	10.91	3.97%	72.04
RodB5_75.9	159	1.928	0.128	677.8	23207.8	574.3	1.20	591.5	13855	268.94	10.59	3.94%	69.27
RodB5_76.9	160	1.953	0.153	682.0	23385.5	577.4	1.20	594.8	13765	268.12	10.54	3.93%	68.52
RodF5_41	105	1.041	0.343	561.9	16801.5	479.1	1.20	492.9	17212	243.56	10.00	4.11%	80.19
RodF5_53.1	106	1.349	0.155	599.3	18981.6	508.5	1.20	523.6	16011	250.89	10.10	4.03%	76.38
RodF5_55	107	1.397	0.203	605.6	19323.9	513.5	1.20	528.9	15821	251.69	10.10	4.01%	75.62
RodF5_57.8	108	1.468	0.274	613.4	19830.8	521.1	1.20	536.5	15554	257.90	10.35	4.01%	76.01
RodF5_64	109	1.626	0.432	630.7	20951.4	538.6	1.20	553.9	14972	273.00	10.96	4.01%	77.03
RodF5_73.8	110	1.875	0.074	654.8	22718.5	567.8	1.20	582.3	14114	313.60	12.78	4.08%	82.57
RodF5_75.8	111	1.925	0.125	663.8	23077.6	574.0	1.20	588.9	13927	308.36	12.48	4.05%	79.91
RodF5_76.8	112	1.951	0.150	666.4	23260.2	577.1	1.20	592.0	13844	312.42	12.66	4.05%	80.39
RodC2_41	57	1.041	0.343	562.0	16876.6	479.1	1.20	492.9	17211	244.37	10.03	4.10%	80.45
RodC2_53.1	58	1.349	0.155	602.4	19060.1	508.5	1.20	524.1	15992	243.53	9.73	4.00%	74.04
RodC2_55	59	1.397	0.203	607.3	19403.6	513.5	1.20	529.1	15811	248.18	9.92	4.00%	74.51
RodC2_57.8	60	1.468	0.274	612.3	19909.6	521.1	1.20	536.3	15560	262.08	10.54	4.02%	77.28
RodC2_63.9	61	1.623	0.429	630.6	21010.3	538.3	1.20	553.7	14980	273.06	10.95	4.01%	77.09
RodC2_73.8	62	1.875	0.074	657.5	22797.5	567.8	1.20	582.8	14101	305.10	12.35	4.05%	80.25
RodC2_75.8	63	1.925	0.125	667.9	23159.0	574.0	1.20	589.6	13908	295.89	11.86	4.01%	76.56
RodC2_76.8	64	1.951	0.150	670.9	23340.5	577.1	1.20	592.7	13823	298.66	11.98	4.01%	76.71
RodC6_40.9	137	1.039	0.340	564.5	16795.4	478.9	1.20	493.2	17201	235.37	9.59	4.08%	77.44
RodC6_52.8	138	1.341	0.147	604.2	19032.5	507.7	1.20	523.8	16005	236.58	9.41	3.98%	71.99
RodC6_54.8	139	1.392	0.198	611.3	19412.6	513.0	1.20	529.4	15804	236.98	9.39	3.96%	71.11
RodC6_57.8	140	1.468	0.274	619.7	19977.7	521.1	1.20	537.5	15518	243.17	9.63	3.96%	71.48
RodC6_63.8	141	1.621	0.427	639.2	21107.9	538.0	1.20	554.9	14943	250.37	9.87	3.94%	70.48
RodC6_73.7	142	1.872	0.072	671.3	22970.5	567.5	1.20	584.8	14043	265.57	10.45	3.93%	69.51
RodC6_75.8	143	1.925	0.125	680.1	23362.4	574.0	1.20	591.7	13852	264.11	10.35	3.92%	68.01
RodC6_76.8	144	1.951	0.150	684.7	23555.2	577.1	1.20	595.0	13760	262.58	10.27	3.91%	67.08

Table SC-3216-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	695.2	25268.6	613.6	1.20	627.2	12939	371.21	15.35	4.13%	88.01
RodB4_91.3	162	2.319	0.071	735.9	25774.3	622.8	1.20	641.6	12602	273.42	10.64	3.89%	62.75
RodB4_93.3	163	2.370	0.122	750.4	26125.4	629.1	1.20	649.3	12429	258.58	9.97	3.85%	58.34
RodB4_95.1	164	2.416	0.168	760.5	26440.7	634.8	1.20	655.8	12288	252.42	9.69	3.84%	56.14
RodB4_100	165	2.540	0.292	775.7	27296.3	650.4	1.20	671.2	11963	261.38	10.03	3.84%	56.22
RodB4_106	166	2.692	0.445	793.7	28342.0	669.1	1.20	689.9	11594	272.96	10.49	3.84%	56.44
RodB4_109.9	167	2.791	0.544	775.0	27437.9	681.1	1.20	696.8	11463	350.62	14.08	4.02%	71.47
RodB4_142.3	168	3.614	0.224	818.6	10658.4	768.4	1.20	776.8	10147	254.78	12.43	4.88%	44.37
RodF4_85.6	98	2.174	0.374	689.7	24938.5	604.7	1.20	618.8	13142	352.03	14.41	4.09%	85.07
RodF4_88.4	99	2.245	-0.003	696.5	25440.7	613.6	1.20	627.4	12934	367.86	15.14	4.12%	87.17
RodF4_92.4	100	2.347	0.099	739.7	26154.3	626.3	1.20	645.2	12522	276.77	10.75	3.89%	63.02
RodF4_94.3	101	2.395	0.147	752.9	26489.5	632.3	1.20	652.4	12361	263.69	10.16	3.85%	59.09
RodF4_97.2	102	2.469	0.221	767.5	27009.0	641.5	1.20	662.5	12144	257.21	9.86	3.83%	56.38
RodF4_108.8	103	2.764	0.516	798.5	28524.4	677.8	1.20	697.9	11443	283.43	10.91	3.85%	57.64
RodF4_111	104	2.819	-0.044	767.0	27363.9	684.5	1.20	698.2	11437	398.09	16.40	4.12%	80.90
RodD2_103.2	65	2.621	0.373	782.5	28223.7	660.4	1.20	680.8	11772	277.41	10.67	3.84%	58.47
RodD2_106	66	2.692	0.445	791.8	28728.1	669.1	1.20	689.6	11600	280.94	10.80	3.84%	58.13
RodD2_112.6	67	2.860	-0.004	780.5	26357.9	689.3	1.20	704.5	11321	346.71	13.98	4.03%	69.55
RodD2_114.9	68	2.918	0.055	799.9	25132.4	696.2	1.20	713.5	11160	290.77	11.45	3.94%	57.27
RodD2_117.4	69	2.982	0.118	808.6	23803.1	703.6	1.20	721.1	11027	272.00	10.69	3.93%	52.76
RodD2_120.8	70	3.068	0.204	808.3	21995.3	713.4	1.20	729.2	10888	278.06	11.13	4.00%	53.07
RodD2_124.8	71	3.170	0.306	804.7	19864.4	724.6	1.20	738.0	10743	297.81	12.37	4.15%	55.86
RodD2_128.6	72	3.266	0.403	800.6	17842.4	734.9	1.20	745.9	10616	326.22	14.34	4.40%	60.26
RodD6_103.1	129	2.619	0.371	780.2	28265.8	660.1	1.20	680.1	11784	282.40	10.88	3.85%	59.61
RodD6_106	130	2.692	0.445	790.0	28782.8	669.1	1.20	689.3	11606	285.81	11.00	3.85%	59.17
RodD6_112.9	131	2.868	0.004	784.7	26255.0	690.2	1.20	706.0	11294	333.62	13.36	4.00%	66.73
RodD6_114.9	132	2.918	0.055	806.9	25189.8	696.2	1.20	714.6	11139	273.10	10.65	3.90%	53.66
RodD6_116.8	133	2.967	0.103	814.9	24166.7	701.8	1.20	720.7	11034	256.51	9.97	3.89%	49.80
RodD6_120.9	134	3.071	0.207	812.9	21962.4	713.7	1.20	730.2	10872	265.67	10.54	3.97%	50.60
RodD6_124.8	135	3.170	0.306	812.0	19864.5	724.6	1.20	739.2	10724	273.01	11.11	4.07%	51.09
RodD6_128.7	136	3.269	0.405	812.8	17771.1	735.2	1.20	748.1	10580	274.96	11.51	4.19%	50.57

Table SC-3216-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ontc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	587.4	18654.1	500.7	1.20	515.2	16324	258.25	10.48	4.06%	80.32
RodE2_54	74	1.372	0.178	604.2	19364.8	510.8	1.20	526.4	15910	248.94	9.95	4.00%	75.25
RodE2_56.9	75	1.445	0.251	613.5	19892.7	518.6	1.20	534.4	15625	251.70	10.03	3.99%	74.56
RodE2_59.9	76	1.521	0.328	621.4	20442.0	526.9	1.20	542.7	15343	259.65	10.36	3.99%	75.34
RodE2_66	77	1.676	0.483	636.6	21554.7	544.4	1.20	559.8	14787	280.56	11.24	4.01%	78.03
RodE2_69.8	78	1.773	-0.027	614.3	22249.5	555.7	1.20	565.5	14612	455.41	20.69	4.54%	124.90
RodE2_72.9	79	1.852	0.051	653.8	22813.3	565.1	1.20	579.9	14184	308.46	12.50	4.05%	81.70
RodE2_74.9	80	1.902	0.102	668.7	23181.1	571.2	1.20	587.4	13969	285.42	11.35	3.98%	74.23
RodB3_50.2	169	1.275	0.081	582.4	18548.2	501.0	1.20	514.6	16348	273.49	11.27	4.12%	85.20
RodB3_54.1	170	1.374	0.180	593.8	19254.6	511.1	1.20	524.9	15964	279.52	11.47	4.10%	84.82
RodB3_56.9	171	1.445	0.251	602.5	19763.8	518.6	1.20	532.6	15689	282.75	11.57	4.09%	84.14
RodB3_60.1	172	1.527	0.333	608.8	20336.5	527.5	1.20	541.0	15398	300.27	12.37	4.12%	87.49
RodB3_66.1	173	1.679	0.485	630.4	21419.6	544.7	1.20	559.0	14812	300.07	12.22	4.07%	83.62
RodB3_69.9	174	1.775	-0.025	612.5	22106.3	556.0	1.20	565.4	14613	469.20	21.63	4.61%	128.70
RodB3_73	175	1.854	0.054	648.8	22664.2	565.4	1.20	579.3	14201	325.94	13.40	4.11%	86.45
RodB3_75	176	1.905	0.105	662.4	23027.8	571.5	1.20	586.7	13991	304.08	12.27	4.04%	79.24
RodF3_50.1	89	1.273	0.079	589.8	18549.5	500.7	1.20	515.6	16309	249.84	10.09	4.04%	77.63
RodF3_54	90	1.372	0.178	605.3	19268.0	510.8	1.20	526.6	15903	244.86	9.77	3.99%	73.99
RodF3_57	91	1.448	0.254	611.8	19821.5	518.9	1.20	534.4	15627	256.13	10.26	4.00%	75.88
RodF3_60	92	1.524	0.330	620.0	20374.9	527.2	1.20	542.7	15343	263.43	10.55	4.00%	76.44
RodF3_66.1	93	1.679	0.485	631.1	21501.5	544.7	1.20	559.1	14809	298.72	12.13	4.06%	83.22
RodF3_70	94	1.778	-0.022	617.4	22218.8	566.3	1.20	566.5	14580	436.09	19.52	4.48%	119.31
RodF3_73	95	1.854	0.054	654.3	22772.6	565.4	1.20	580.2	14175	307.49	12.46	4.05%	81.38
RodF3_75	96	1.905	0.105	668.8	23143.3	571.5	1.20	587.7	13961	285.50	11.36	3.98%	74.20
RodE6_50.2	121	1.275	0.081	587.5	18538.9	501.0	1.20	515.4	16315	257.09	10.45	4.06%	79.91
RodE6_54.1	122	1.374	0.180	602.5	19233.6	511.1	1.20	526.3	15912	252.43	10.14	4.02%	76.32
RodE6_57	123	1.448	0.254	610.2	19753.2	518.9	1.20	534.1	15636	259.53	10.43	4.02%	76.94
RodE6_60.2	124	1.529	0.335	619.4	20323.1	527.8	1.20	543.0	15330	266.02	10.68	4.02%	77.12
RodE6_66.1	125	1.679	0.485	638.2	21376.3	544.7	1.20	560.3	14772	274.55	10.98	4.00%	76.26
RodE6_70	126	1.778	-0.022	615.9	22074.4	556.3	1.20	566.2	14588	444.37	20.08	4.52%	121.65
RodE6_73.1	127	1.857	0.056	652.8	22627.7	565.7	1.20	580.2	14174	311.73	12.70	4.07%	82.49
RodE6_75	128	1.905	0.105	665.2	22967.5	571.5	1.20	587.1	13978	294.19	11.80	4.01%	76.57

RBHT Steam Cooling Test SC-3216-C

Matrix test # 21

Test date – 5/5/2005

Steady state time window: 25200 - 26460 sec

Inlet flow: 3.12 m³/min (110.3 ft³/min)

Inlet steam temperature: 424 K (303 °F)

Upper plenum pressure: 409.5 kPa (59.4 psia)

Bundle power: 93.5 kW

Outlet steam temperature: 790 K (963 °F)

Bundle inlet Reynolds number: 17631

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution.

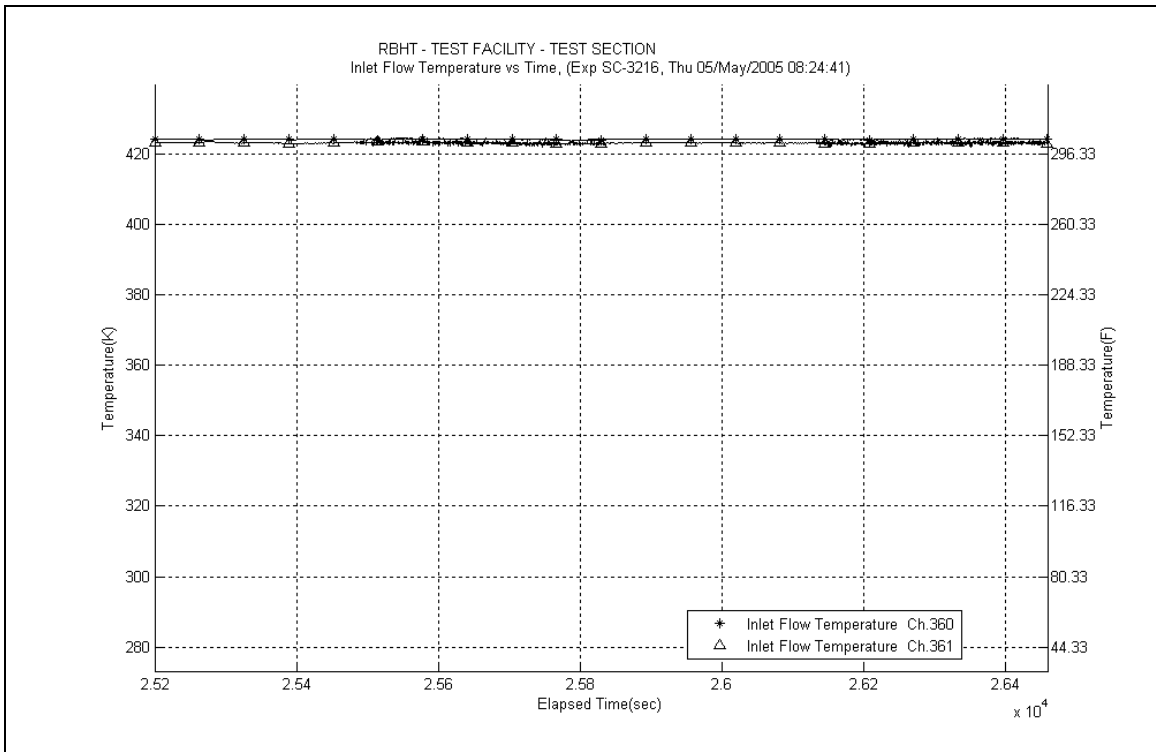
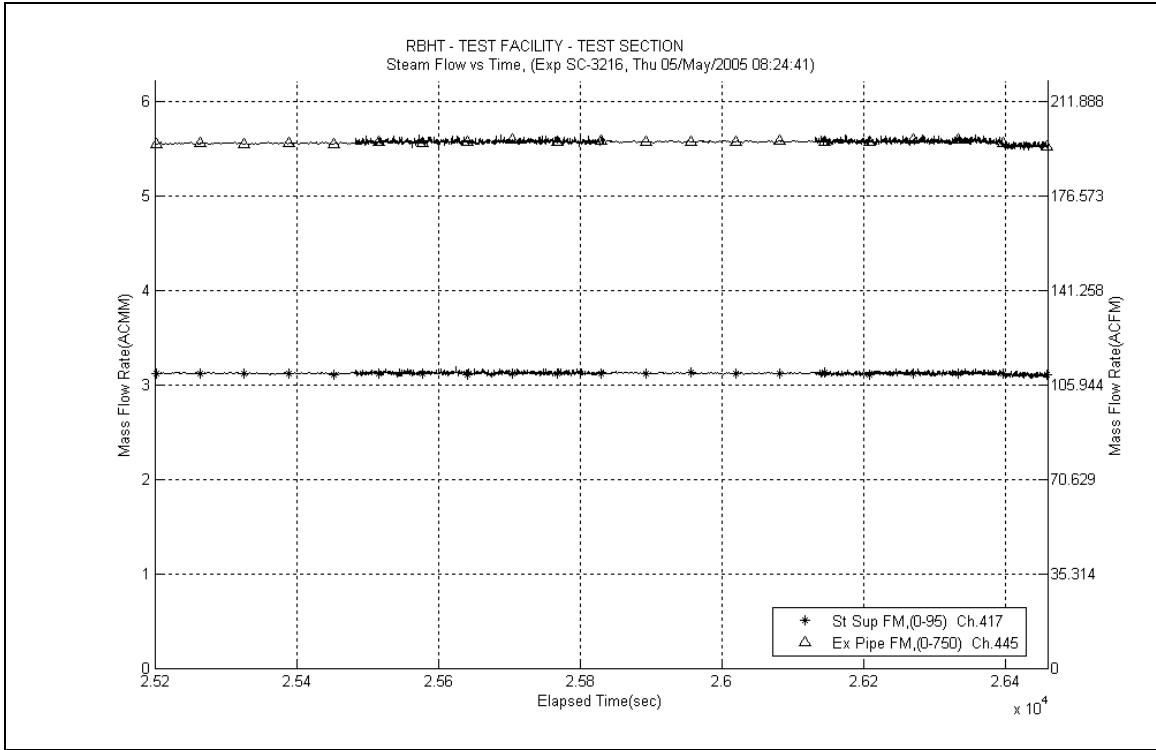
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

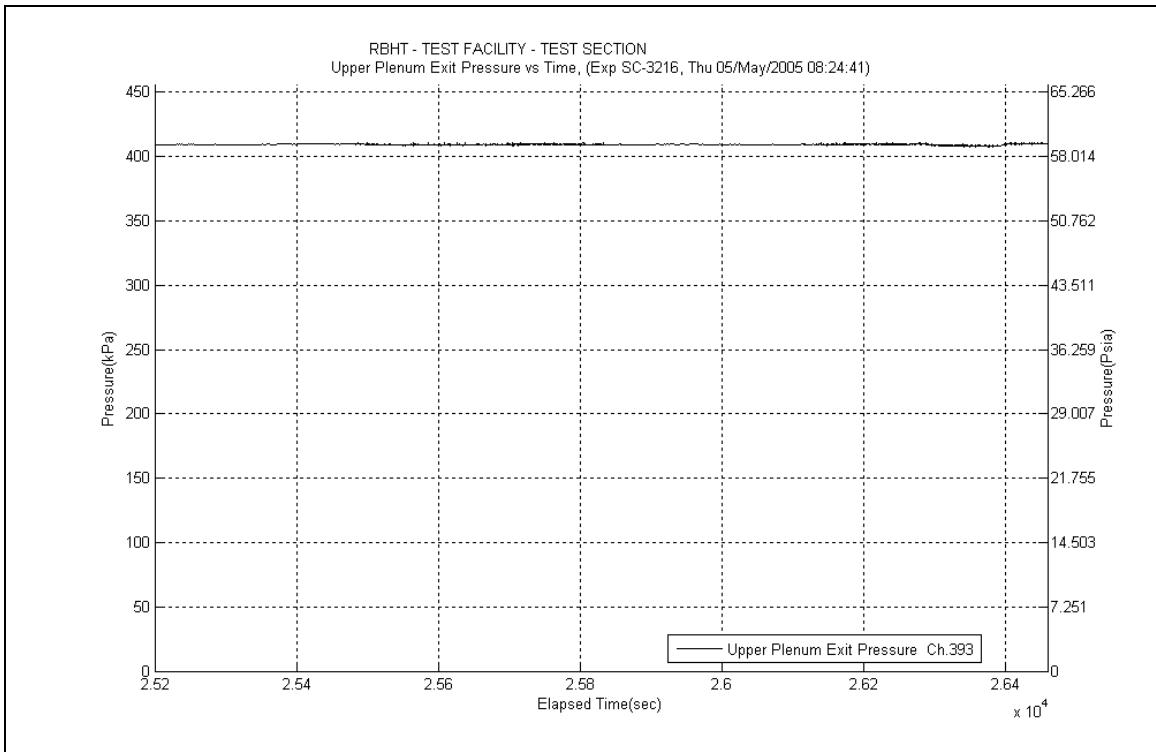
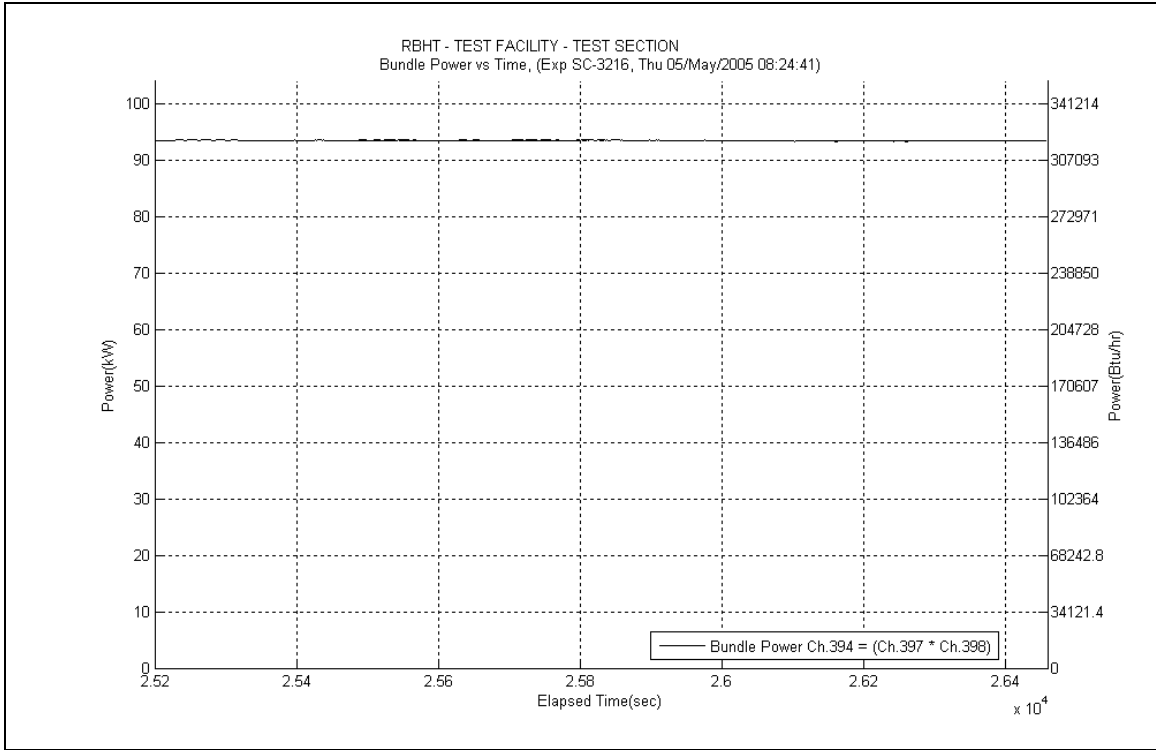
$$T_{cl} = -15.612x^3 + 96.934x^2 - 52.418x + 451.41$$

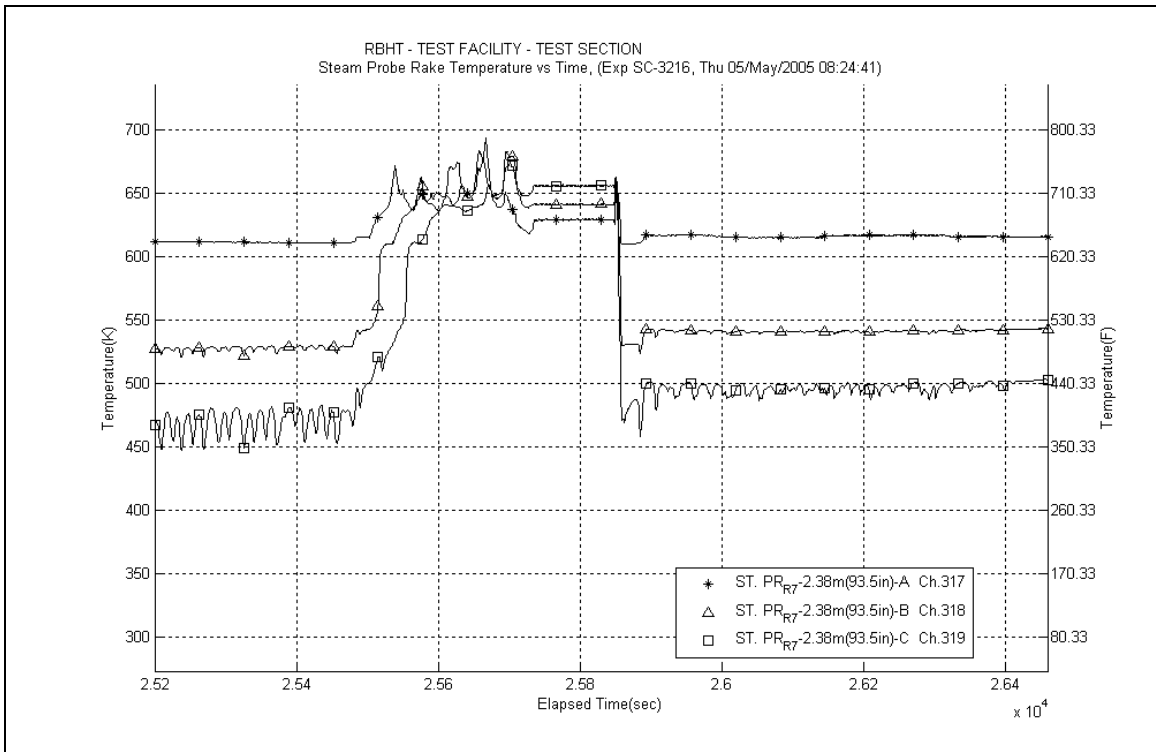
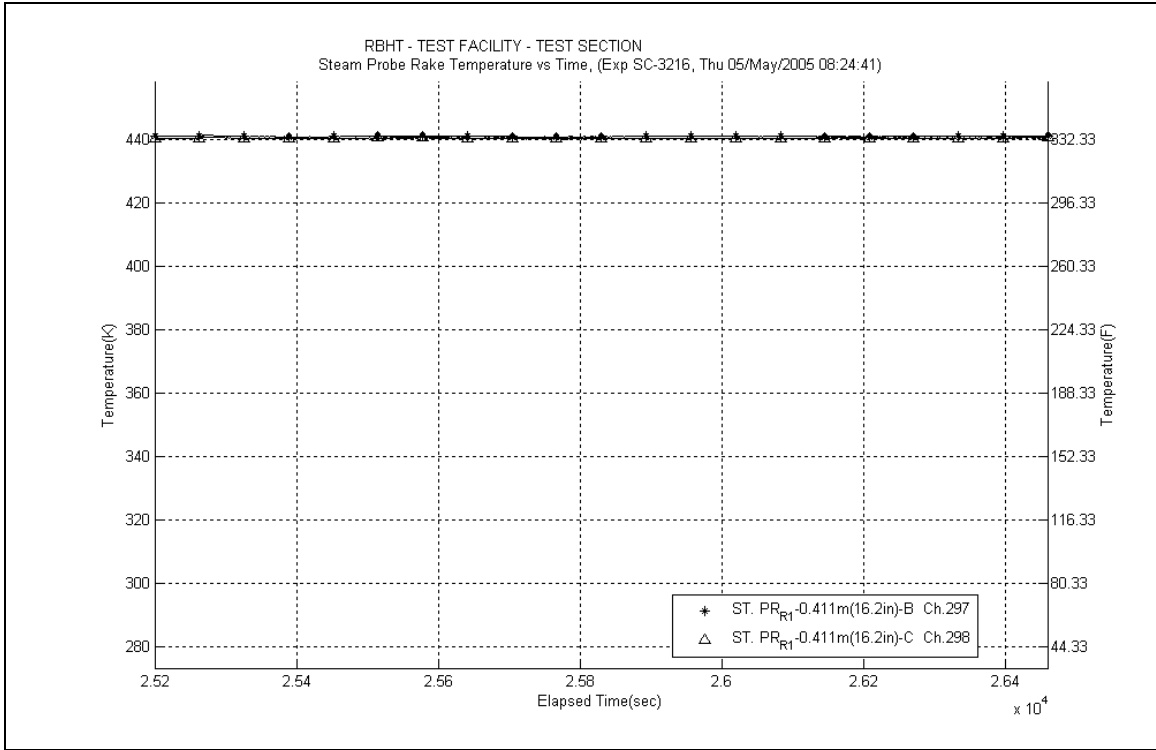
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

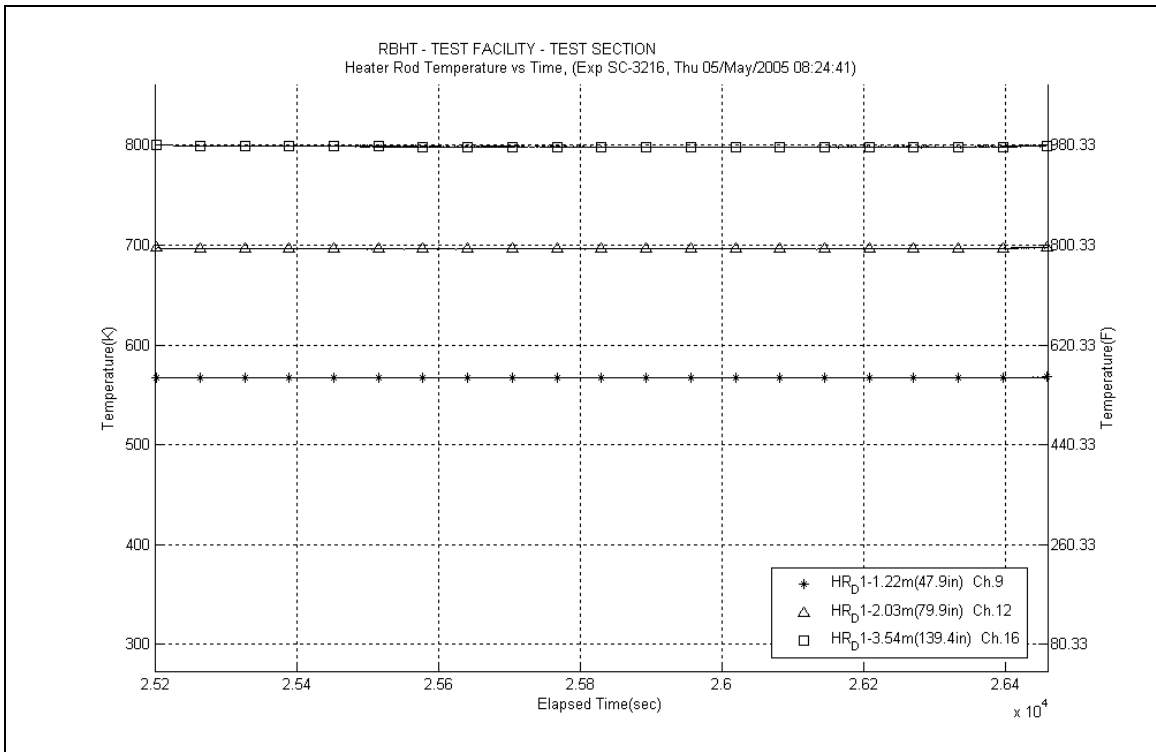
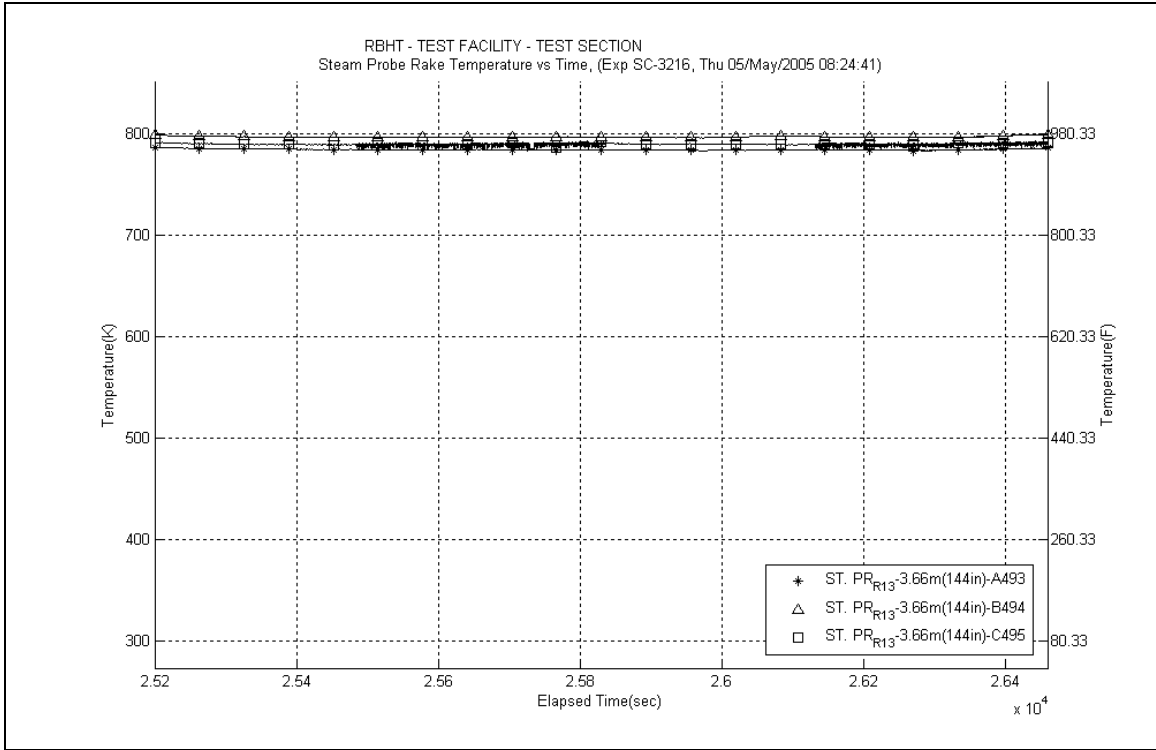
$$T_{cl} = -9.0768x^3 + 62.294x^2 - 9.6212x + 436.62$$

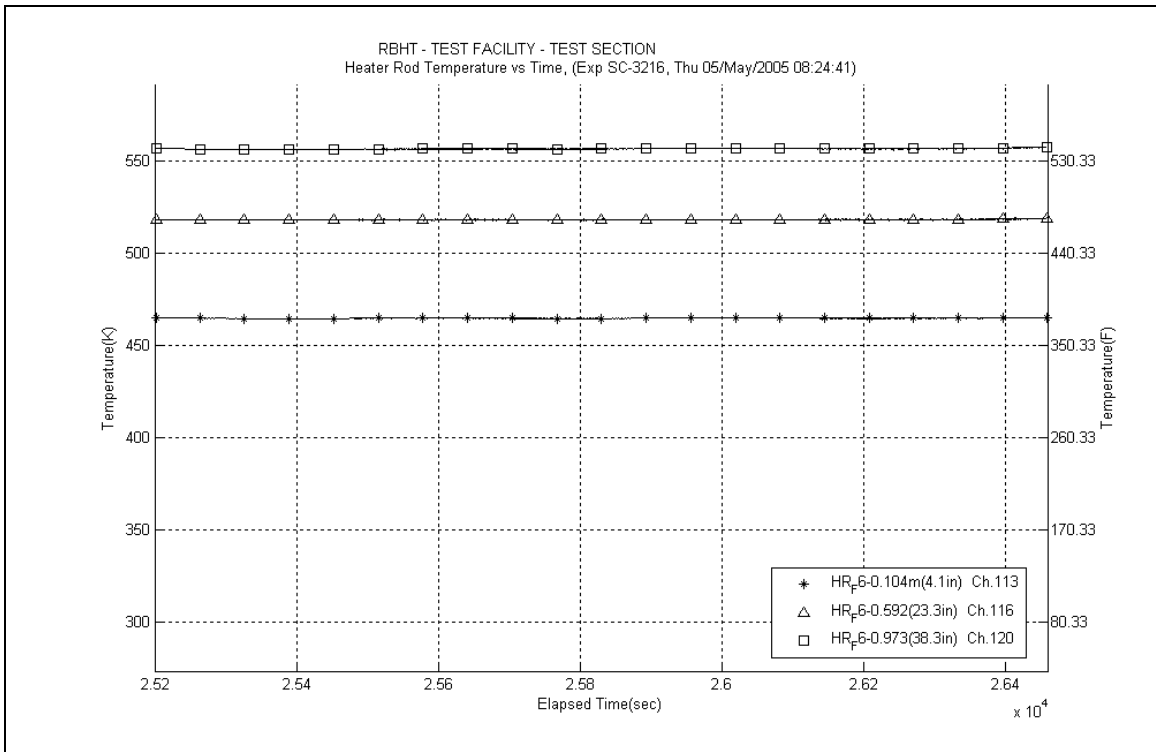
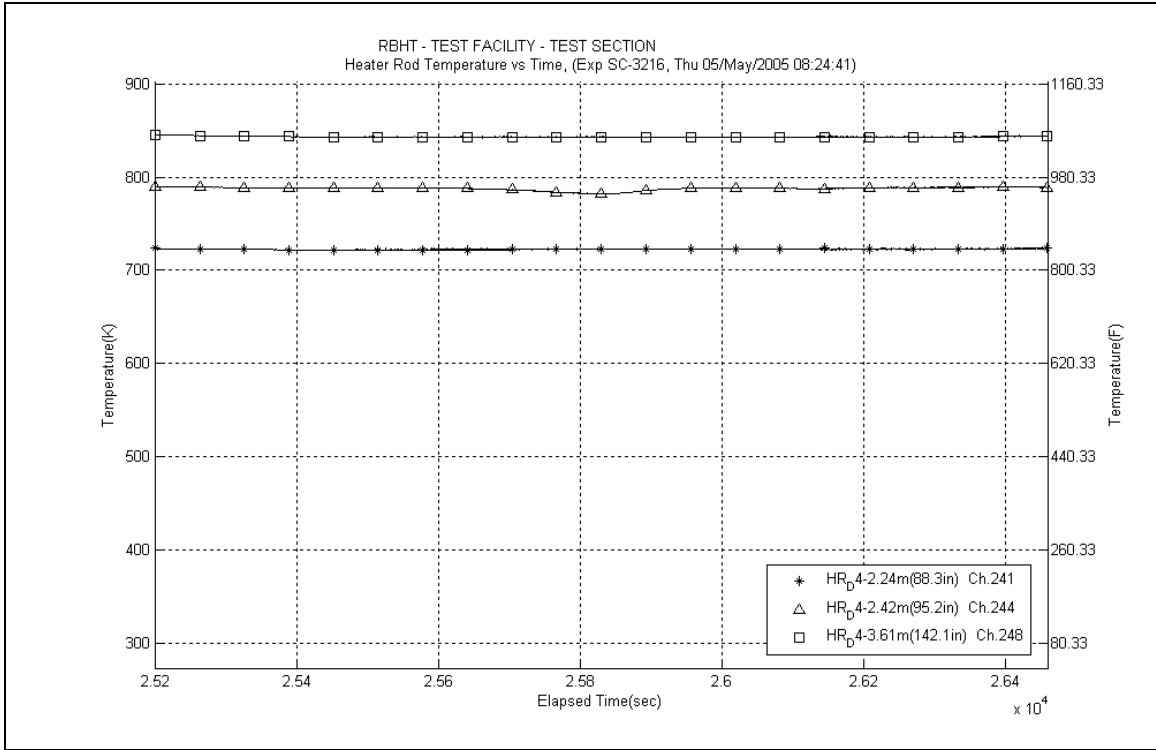
where x is the elevation (m) and T_{cl} is in (K)











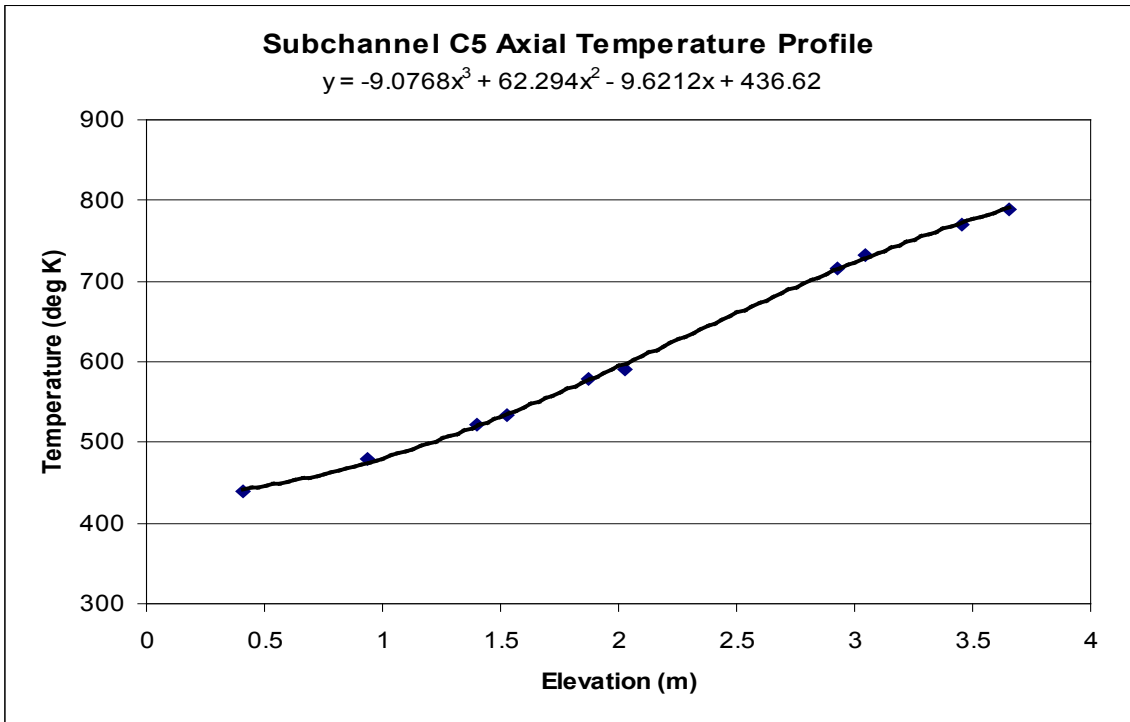
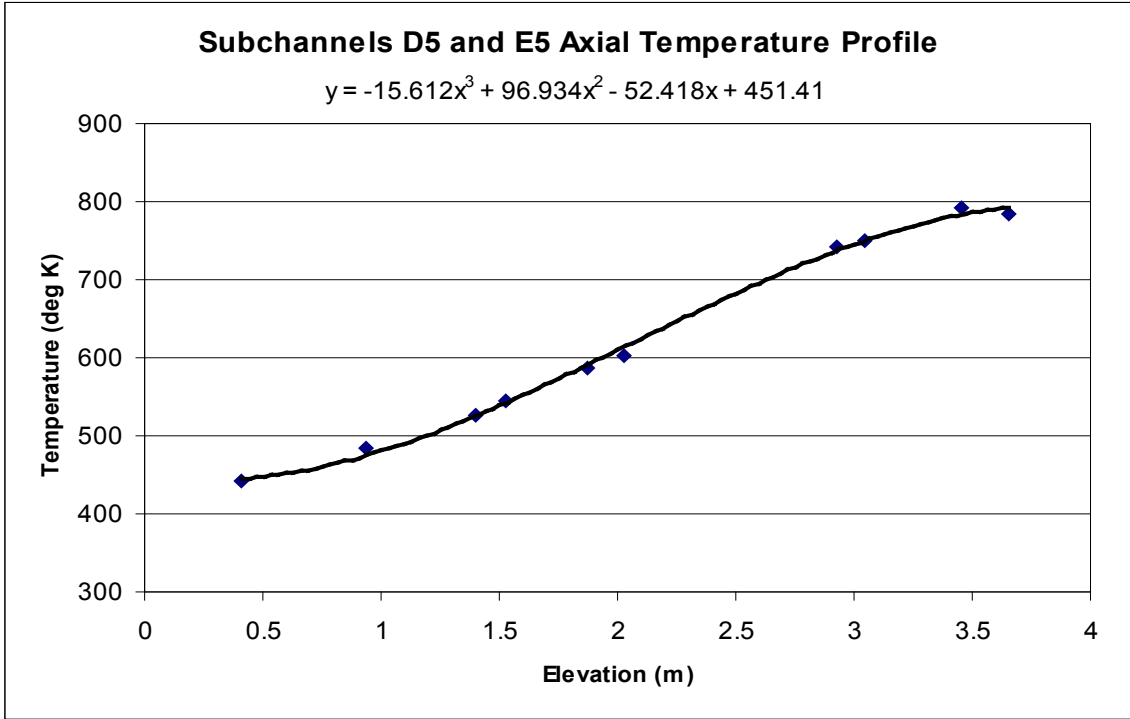


Table SC-3216-C.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ontc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	712.0	25061.1	645.3	1.20	656.4	12042	451.15	19.76	4.38%	99.94
RodD3_91.3	186	2.319	0.071	756.8	25598.3	656.4	1.20	673.2	11698	305.97	12.14	3.97%	65.39
RodD3_93.1	187	2.365	0.117	774.3	25914.8	663.1	1.20	681.6	11532	279.58	10.91	3.90%	58.69
RodD3_95.3	188	2.421	0.173	789.2	26331.2	671.1	1.20	690.8	11357	267.49	10.35	3.87%	55.09
RodD3_100.1	189	2.543	0.295	800.5	27175.5	688.2	1.20	706.9	11063	290.27	11.31	3.90%	57.83
RodD3_106.1	190	2.695	0.447	828.0	28270.2	708.6	1.20	728.5	10693	284.15	10.98	3.86%	54.22
RodD3_110	191	2.794	0.546	810.5	27903.0	721.1	1.20	736.0	10569	374.94	15.18	4.05%	70.48
RodD3_142.1	192	3.609	0.218	830.2	9779.8	790.9	1.20	797.5	9668	299.10	16.68	5.58%	50.08
RodC4_88.4	233	2.245	-0.003	715.6	25350.0	645.7	1.20	657.3	12023	435.11	18.76	4.31%	96.20
RodC4_91.1	234	2.314	0.066	755.3	25843.0	655.7	1.20	672.3	11715	311.32	12.35	3.97%	66.65
RodC4_93.4	235	2.372	0.124	774.9	26302.3	664.2	1.20	682.6	11512	284.91	11.11	3.90%	59.69
RodC4_95.3	236	2.421	0.173	787.8	26613.1	671.1	1.20	690.5	11362	273.51	10.59	3.87%	56.36
RodC4_100.1	237	2.543	0.295	795.6	27440.9	688.2	1.20	706.1	11077	306.56	12.01	3.92%	61.18
RodC4_106.1	238	2.695	0.447	818.4	28539.1	708.6	1.20	726.9	10719	311.81	12.17	3.90%	59.68
RodC4_110	239	2.794	0.546	799.9	27614.1	721.1	1.20	734.3	10598	420.83	17.56	4.17%	79.38
RodC4_142.2	240	3.612	0.221	846.1	10598.7	791.0	1.20	800.2	9632	231.00	10.84	4.69%	38.49
RodD4_88.3	241	2.243	-0.005	720.6	25258.0	645.3	1.20	657.9	12012	402.51	16.99	4.22%	88.89
RodD4_91.3	242	2.319	0.071	759.2	25803.8	656.4	1.20	673.6	11690	301.24	11.89	3.95%	64.32
RodD4_93.2	243	2.367	0.119	775.0	26139.0	663.4	1.20	682.0	11524	281.06	10.95	3.90%	58.95
RodD4_95.2	244	2.418	0.170	787.0	26506.5	670.7	1.20	690.1	11370	273.53	10.60	3.87%	56.41
RodD4_100.1	245	2.543	0.295	802.0	27385.5	688.2	1.20	707.1	11058	288.70	11.22	3.89%	57.49
RodD4_106.1	246	2.695	0.447	822.9	28465.0	708.6	1.20	727.6	10707	298.80	11.60	3.88%	57.11
RodD4_110	247	2.794	0.546	803.5	27486.6	721.1	1.20	734.9	10588	400.46	16.53	4.13%	75.45
RodD4_142.1	248	3.609	0.218	843.0	10247.7	790.9	1.20	799.6	9640	236.01	11.37	4.82%	39.37
RodE4_88.4	201	2.245	-0.003	714.7	24880.0	645.7	1.20	657.2	12026	432.79	18.77	4.34%	95.72
RodE4_91.2	202	2.316	0.069	753.8	25361.9	656.1	1.20	672.4	11714	311.54	12.43	3.99%	66.70
RodE4_95.3	204	2.421	0.173	783.0	26070.6	671.1	1.20	689.7	11377	279.60	10.91	3.90%	57.71
RodE4_100.9	205	2.563	0.315	801.1	27037.3	691.0	1.20	709.3	11020	294.68	11.53	3.91%	58.43
RodE4_142.3	208	3.614	0.224	838.8	10355.6	791.1	1.20	799.1	9647	260.38	13.04	5.01%	43.47
RodE3_63.4	193	1.610	0.417	650.1	20609.8	553.2	1.20	569.3	14229	255.17	10.19	3.99%	68.95
RodE3_113.6	194	2.885	0.022	820.4	25422.0	732.2	1.20	746.9	10398	345.60	14.06	4.07%	63.61
RodE3_115.5	195	2.934	0.070	837.0	24482.3	737.7	1.20	754.3	10284	296.03	11.77	3.98%	53.72
RodE3_118.5	196	3.010	0.146	848.4	22997.8	746.1	1.20	763.2	10150	269.77	10.66	3.95%	48.13
RodE3_122.7	197	3.117	0.253	845.8	20915.2	757.0	1.20	771.8	10024	282.61	11.46	4.06%	49.61
RodE3_126.5	198	3.213	0.349	841.4	19028.5	765.9	1.20	778.4	9929	302.34	12.74	4.21%	52.42
RodE3_131.7	199	3.345	-0.046	813.2	16444.7	776.4	1.20	782.5	9872	535.50	30.80	5.75%	92.15
RodE3_135.6	200	3.444	0.053	828.0	14514.4	782.9	1.20	790.4	9763	386.17	19.82	5.13%	65.50

Table SC-3216-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±htc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	646.4	20210.1	554.2	1.20	569.6	14222	263.08	10.60	4.03%	71.04
RodC5_113.6	226	2.885	0.022	817.2	24775.3	732.2	1.20	746.3	10406	349.58	14.38	4.11%	64.41
RodC5_115.7	227	2.939	0.075	838.2	23795.3	738.3	1.20	754.9	10274	285.91	11.39	3.98%	51.82
RodC5_122.7	229	3.117	0.253	847.5	20501.4	757.0	1.20	772.1	10020	271.72	11.00	4.05%	47.68
RodC5_126.7	230	3.218	0.354	847.6	18621.1	766.3	1.20	779.8	9910	274.92	11.39	4.14%	47.54
RodC5_131.6	231	3.343	-0.048	823.0	16306.8	776.2	1.20	784.0	9852	417.67	21.06	5.04%	71.68
RodC5_135.7	232	3.447	0.056	841.4	14386.0	783.0	1.20	792.8	9731	295.62	13.52	4.57%	49.92
RodE5_63.6	209	1.615	0.422	640.3	20700.3	553.9	1.20	568.3	14260	287.28	11.69	4.07%	77.82
RodE5_113.6	210	2.885	0.022	819.5	25564.9	732.2	1.20	746.7	10400	351.05	14.30	4.07%	64.63
RodE5_115.4	211	2.931	0.067	834.0	24688.2	737.4	1.20	753.5	10295	306.64	12.24	3.99%	55.72
RodE5_118.7	212	3.015	0.151	844.0	23083.8	746.6	1.20	762.9	10155	284.56	11.33	3.98%	50.80
RodE5_122.6	213	3.114	0.250	841.7	21178.8	756.7	1.20	770.9	10037	298.96	12.23	4.09%	52.57
RodE5_126.6	214	3.216	0.352	839.4	19230.6	766.1	1.20	778.3	9931	314.56	13.35	4.24%	54.56
RodE5_131.6	215	3.343	-0.048	815.0	16783.1	776.2	1.20	782.6	9870	519.41	28.95	5.57%	89.36
RodE5_135.6	216	3.444	0.053	833.3	14835.5	782.9	1.20	791.3	9751	353.30	17.16	4.86%	59.83
RodC3_79.8	177	2.027	0.227	688.6	23433.8	613.4	1.20	625.9	12726	373.85	15.81	4.23%	88.59
RodC3_85.6	178	2.174	0.374	698.8	24454.0	635.2	1.20	645.8	12271	461.26	20.53	4.45%	104.58
RodC3_88.5	179	2.248	0.000	709.3	24963.0	646.1	1.20	656.6	12039	473.89	21.14	4.46%	104.94
RodC3_92.4	180	2.347	0.099	756.7	25675.9	660.5	1.20	676.5	11631	320.22	12.81	4.00%	67.95
RodC3_94.4	181	2.398	0.150	769.6	26105.9	667.8	1.20	684.8	11471	307.85	12.19	3.96%	64.20
RodC3_97.2	182	2.469	0.221	785.1	26490.4	677.9	1.20	695.8	11264	296.58	11.65	3.93%	60.45
RodC3_108.8	183	2.764	0.516	820.8	27935.7	717.3	1.20	734.6	10593	323.95	12.79	3.95%	61.07
RodD5_50	217	1.270	0.076	601.5	18287.8	509.2	1.20	524.6	15693	237.74	9.55	4.02%	71.56
RodD5_54.1	218	1.374	0.180	623.0	19008.5	521.9	1.20	538.8	15198	225.69	8.92	3.95%	65.64
RodD5_56.9	219	1.445	0.251	629.8	19503.9	531.0	1.20	547.5	14909	236.86	9.40	3.97%	67.45
RodD5_60	220	1.524	0.330	637.1	20051.7	541.4	1.20	557.4	14594	251.37	10.03	3.99%	69.90
RodD5_66.1	221	1.679	0.485	656.1	21121.9	562.8	1.20	578.3	13968	271.56	10.92	4.02%	71.83
RodD5_69.9	222	1.775	-0.025	632.2	21781.7	576.5	1.20	585.8	13756	469.57	21.80	4.64%	122.04
RodD5_72.9	223	1.852	0.051	673.1	22311.6	587.6	1.20	601.8	13325	313.29	12.83	4.10%	78.44
RodD5_74.9	224	1.902	0.102	688.6	22668.0	595.0	1.20	610.6	13100	290.80	11.69	4.02%	71.35

Table SC-3216-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ontc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	576.4	16628.3	483.9	1.20	499.3	16655	215.62	8.66	4.02%	69.00
RodB5_52.9	154	1.344	0.150	615.3	18743.9	514.1	1.20	531.0	15465	222.31	8.79	3.95%	65.88
RodB5_55	155	1.397	0.203	622.1	19118.8	520.0	1.20	537.0	15257	224.75	8.87	3.95%	65.64
RodB5_57.8	156	1.468	0.274	627.5	19618.9	528.0	1.20	544.6	15003	236.60	9.38	3.96%	67.84
RodB5_64	157	1.626	0.432	645.7	20718.4	546.6	1.20	563.1	14416	250.82	9.95	3.97%	68.79
RodB5_73.9	158	1.877	0.077	679.7	22475.2	578.0	1.20	595.0	13507	265.14	10.50	3.96%	67.45
RodB5_75.9	159	1.928	0.128	690.8	22830.1	584.6	1.20	602.3	13314	257.76	10.13	3.93%	64.47
RodB5_76.9	160	1.953	0.153	695.4	23010.6	587.9	1.20	605.8	13223	256.73	10.07	3.92%	63.70
RodF5_41	105	1.041	0.343	568.7	16518.6	483.9	1.20	498.0	16708	233.83	9.57	4.09%	75.07
RodF5_53.1	106	1.349	0.155	608.3	18668.9	514.7	1.20	530.3	15490	239.45	9.60	4.01%	71.09
RodF5_55	107	1.397	0.203	614.8	19006.7	520.0	1.20	535.8	15299	240.56	9.62	4.00%	70.47
RodF5_57.8	108	1.468	0.274	622.6	19506.4	528.0	1.20	543.8	15030	247.49	9.90	4.00%	71.11
RodF5_64	109	1.626	0.432	640.1	20608.0	546.6	1.20	562.2	14445	264.48	10.60	4.01%	72.69
RodF5_73.8	110	1.875	0.074	665.5	22333.0	577.7	1.20	592.3	13578	305.14	12.43	4.07%	78.10
RodF5_75.8	111	1.925	0.125	675.2	22703.7	584.2	1.20	599.4	13389	299.40	12.11	4.04%	75.38
RodF5_76.8	112	1.951	0.150	678.1	22880.6	587.5	1.20	602.6	13305	303.04	12.26	4.05%	75.73
RodC2_41	57	1.041	0.343	569.0	16599.3	483.9	1.20	498.1	16706	234.13	9.57	4.09%	75.15
RodC2_53.1	58	1.349	0.155	611.9	18747.7	514.7	1.20	530.9	15469	231.41	9.21	3.98%	68.60
RodC2_55	59	1.397	0.203	616.9	19084.0	520.0	1.20	536.2	15287	236.33	9.41	3.98%	69.17
RodC2_57.8	60	1.468	0.274	621.7	19581.9	528.0	1.20	543.7	15034	250.78	10.05	4.01%	72.07
RodC2_63.9	61	1.623	0.429	640.0	20668.1	546.3	1.20	561.9	14453	264.63	10.60	4.01%	72.78
RodC2_73.8	62	1.875	0.074	668.4	22431.3	577.7	1.20	592.8	13565	296.68	12.00	4.04%	75.85
RodC2_75.8	63	1.925	0.125	679.7	22789.5	584.2	1.20	600.1	13370	286.54	11.47	4.00%	72.02
RodC2_76.8	64	1.951	0.150	682.9	22964.3	587.5	1.20	603.4	13284	288.88	11.57	4.00%	72.06
RodC6_40.9	137	1.039	0.340	572.3	16519.4	483.7	1.20	498.4	16691	223.75	9.07	4.05%	71.76
RodC6_52.8	138	1.341	0.147	613.6	18727.0	513.9	1.20	530.5	15483	225.38	8.93	3.96%	66.88
RodC6_54.8	139	1.392	0.198	621.2	19097.6	519.4	1.20	536.4	15279	225.27	8.89	3.95%	65.89
RodC6_57.8	140	1.468	0.274	630.3	19653.7	528.0	1.20	545.1	14988	230.72	9.10	3.94%	66.08
RodC6_63.8	141	1.621	0.427	650.4	20764.6	546.0	1.20	563.4	14408	238.56	9.40	3.94%	65.38
RodC6_73.7	142	1.872	0.072	683.7	22601.1	577.4	1.20	595.1	13504	255.11	10.02	3.93%	64.88
RodC6_75.8	143	1.925	0.125	693.2	22989.8	584.2	1.20	602.4	13311	253.16	9.90	3.91%	63.30
RodC6_76.8	144	1.951	0.150	698.2	23175.9	587.5	1.20	606.0	13219	251.34	9.81	3.90%	62.33

Table SC-3216-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±dhtc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	707.8	24860.5	626.3	1.20	639.9	12403	366.36	15.19	4.15%	84.15
RodB4_91.3	162	2.319	0.071	749.6	25366.8	636.1	1.20	655.0	12072	268.13	10.45	3.90%	59.58
RodB4_93.3	163	2.370	0.122	764.8	25793.6	642.9	1.20	663.2	11901	253.76	9.79	3.86%	55.40
RodB4_95.1	164	2.416	0.168	775.8	26033.7	648.9	1.20	670.1	11760	246.20	9.46	3.84%	52.96
RodB4_100	165	2.540	0.292	784.6	26781.3	665.3	1.20	685.2	11462	269.54	10.44	3.87%	56.16
RodB4_106	166	2.692	0.445	813.1	27869.7	685.1	1.20	706.5	11070	261.36	10.03	3.84%	52.12
RodB4_109.9	167	2.791	0.544	790.3	26992.0	697.7	1.20	713.2	10953	350.07	14.13	4.03%	68.87
RodB4_142.3	168	3.614	0.224	838.8	10521.9	787.1	1.20	795.7	9692	244.17	11.77	4.82%	41.02
RodF4_85.6	98	2.174	0.374	701.7	24538.5	616.9	1.20	631.0	12606	347.02	14.24	4.10%	81.30
RodF4_88.4	99	2.245	-0.003	708.5	25027.1	626.3	1.20	640.0	12401	365.60	15.11	4.13%	83.96
RodF4_92.4	100	2.347	0.099	753.3	25739.8	639.8	1.20	658.7	11993	272.21	10.60	3.89%	60.00
RodF4_94.3	101	2.395	0.147	767.2	26068.6	646.2	1.20	666.4	11835	258.52	9.98	3.86%	56.05
RodF4_97.2	102	2.469	0.221	782.9	26581.2	656.0	1.20	677.1	11619	251.32	9.64	3.84%	53.26
RodF4_108.8	103	2.764	0.516	813.6	28060.1	694.2	1.20	714.1	10936	281.95	10.90	3.86%	55.36
RodF4_111	104	2.819	-0.044	782.1	26925.9	701.2	1.20	714.7	10925	399.58	16.57	4.15%	78.36
RodD2_103.2	65	2.621	0.373	798.7	27817.2	675.9	1.20	696.4	11252	272.03	10.47	3.85%	55.38
RodD2_106	66	2.692	0.445	807.6	28301.3	685.1	1.20	705.5	11087	277.36	10.68	3.85%	55.41
RodD2_112.6	67	2.860	-0.004	797.0	25968.7	706.3	1.20	721.4	10811	343.60	13.90	4.04%	66.48
RodD2_114.9	68	2.918	0.055	816.7	24757.4	713.5	1.20	730.7	10656	287.78	11.37	3.95%	54.67
RodD2_117.4	69	2.982	0.118	825.4	23446.8	721.2	1.20	738.5	10529	270.09	10.65	3.94%	50.52
RodD2_120.8	70	3.068	0.204	826.1	21672.1	731.4	1.20	747.2	10393	274.57	11.01	4.01%	50.51
RodD2_124.8	71	3.170	0.306	822.4	19584.2	743.0	1.20	756.2	10254	295.99	12.34	4.17%	53.51
RodD2_128.6	72	3.266	0.403	819.0	17599.5	753.5	1.20	764.4	10132	322.72	14.22	4.41%	57.44
RodD6_103.1	129	2.619	0.371	796.1	27819.0	675.6	1.20	695.7	11265	277.16	10.69	3.86%	56.50
RodD6_106	130	2.692	0.445	805.6	28328.1	685.1	1.20	705.2	11093	282.12	10.88	3.86%	56.40
RodD6_112.9	131	2.868	0.004	800.1	25855.1	707.3	1.20	722.7	10789	334.25	13.45	4.02%	64.51
RodD6_114.9	132	2.918	0.055	823.0	24797.9	713.5	1.20	731.8	10639	271.65	10.63	3.91%	51.50
RodD6_116.8	133	2.967	0.103	831.7	23798.2	719.3	1.20	738.1	10536	254.07	9.90	3.90%	47.57
RodD6_120.9	134	3.071	0.207	831.6	21633.2	731.7	1.20	748.3	10375	259.85	10.32	3.97%	47.69
RodD6_124.8	135	3.170	0.306	830.3	19571.8	743.0	1.20	757.5	10235	269.01	10.97	4.08%	48.51
RodD6_128.7	136	3.269	0.405	830.9	17515.2	753.8	1.20	766.6	10099	272.42	11.44	4.20%	48.29

Table SC-3216-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±ontc (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	595.3	18347.6	506.5	1.20	521.3	15810	248.07	10.04	4.05%	75.26
RodE2_54	74	1.372	0.178	613.1	19051.0	517.2	1.20	533.2	15389	238.42	9.50	3.99%	70.28
RodE2_56.9	75	1.445	0.251	622.9	19572.8	525.4	1.20	541.7	15100	240.93	9.57	3.97%	69.58
RodE2_59.9	76	1.521	0.328	630.9	20111.1	534.2	1.20	550.3	14817	249.72	9.94	3.98%	70.63
RodE2_66	77	1.676	0.483	646.4	21205.4	552.8	1.20	568.4	14257	271.83	10.88	4.00%	73.62
RodE2_69.8	78	1.773	-0.027	623.1	21884.1	564.8	1.20	574.5	14077	450.04	20.51	4.56%	120.12
RodE2_72.9	79	1.852	0.051	663.9	22418.3	574.8	1.20	589.6	13651	301.86	12.24	4.06%	77.75
RodE2_74.9	80	1.902	0.102	679.4	22802.2	581.3	1.20	597.6	13436	278.97	11.11	3.98%	70.53
RodB3_50.2	169	1.275	0.081	591.3	18240.5	506.8	1.20	520.9	15827	259.18	10.61	4.09%	78.72
RodB3_54.1	170	1.374	0.180	603.2	18930.2	517.5	1.20	531.8	15438	264.89	10.80	4.08%	78.36
RodB3_56.9	171	1.445	0.251	612.3	19429.3	525.4	1.20	539.9	15159	268.30	10.91	4.07%	77.81
RodB3_60.1	172	1.527	0.333	618.6	19995.9	534.8	1.20	548.8	14867	286.54	11.75	4.10%	81.34
RodB3_66.1	173	1.679	0.485	641.2	21064.3	553.1	1.20	567.8	14276	287.10	11.64	4.06%	77.87
RodB3_69.9	174	1.775	-0.025	622.1	21734.1	565.1	1.20	574.6	14074	457.26	21.04	4.60%	122.02
RodB3_73	175	1.854	0.054	659.7	22289.3	575.1	1.20	589.2	13663	316.07	12.98	4.11%	81.49
RodB3_75	176	1.905	0.105	673.9	22646.9	581.6	1.20	597.0	13453	294.43	11.87	4.03%	74.55
RodF3_50.1	89	1.273	0.079	598.5	18244.9	506.5	1.20	521.9	15791	238.11	9.57	4.02%	72.15
RodF3_54	90	1.372	0.178	614.9	18954.1	517.2	1.20	533.5	15379	232.81	9.26	3.98%	68.58
RodF3_57	91	1.448	0.254	621.9	19500.3	525.7	1.20	541.7	15098	243.38	9.70	3.99%	70.27
RodF3_60	92	1.524	0.330	630.1	20045.8	534.5	1.20	550.5	14813	251.52	10.03	3.99%	71.11
RodF3_66.1	93	1.679	0.485	641.4	21150.7	553.1	1.20	567.8	14274	287.32	11.64	4.05%	77.92
RodF3_70	94	1.778	-0.022	626.8	21858.1	565.4	1.20	575.7	14044	427.50	19.14	4.48%	113.80
RodF3_73	95	1.854	0.054	664.9	22386.1	575.1	1.20	590.1	13639	299.19	12.12	4.05%	76.99
RodF3_75	96	1.905	0.105	680.5	22775.3	581.6	1.20	598.1	13424	276.36	10.99	3.98%	69.79
RodE6_50.2	121	1.275	0.081	595.4	18226.0	506.8	1.20	521.6	15802	246.90	10.00	4.05%	74.87
RodE6_54.1	122	1.374	0.180	612.2	18917.2	517.5	1.20	533.3	15387	239.71	9.59	4.00%	70.65
RodE6_57	123	1.448	0.254	620.3	19428.1	525.7	1.20	541.5	15107	246.55	9.86	4.00%	71.23
RodE6_60.2	124	1.529	0.335	629.5	19991.0	535.1	1.20	550.8	14801	254.20	10.17	4.00%	71.80
RodE6_66.1	125	1.679	0.485	649.1	21027.7	553.1	1.20	569.1	14236	262.92	10.52	4.00%	71.08
RodE6_70	126	1.778	-0.022	626.0	21706.7	565.4	1.20	575.5	14048	429.77	19.34	4.50%	114.43
RodE6_73.1	127	1.857	0.056	664.3	22237.7	575.4	1.20	590.2	13635	300.06	12.19	4.06%	77.18
RodE6_75	128	1.905	0.105	677.4	22591.7	581.6	1.20	597.6	13437	282.90	11.32	4.00%	71.53

RBHT Steam Cooling Test SC-3242-A

Matrix test # 6

Test date – 8/5/2005

Steady state time window: 8900 - 9400 sec
Inlet flow: 2.27 m³/min (80.1 ft³/min)
Inlet steam temperature: 412 K (282 °F)
Upper plenum pressure: 271.7 kPa (39.4 psia)
Bundle power: 50.0 kW
Outlet steam temperature: 600 K (621 °F)
Bundle inlet Reynolds number: 8919

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution. Experiment SC-3242 was run with the traversing probes withdrawn. Centerline steam temperatures used are from experiment SC-3209-A.

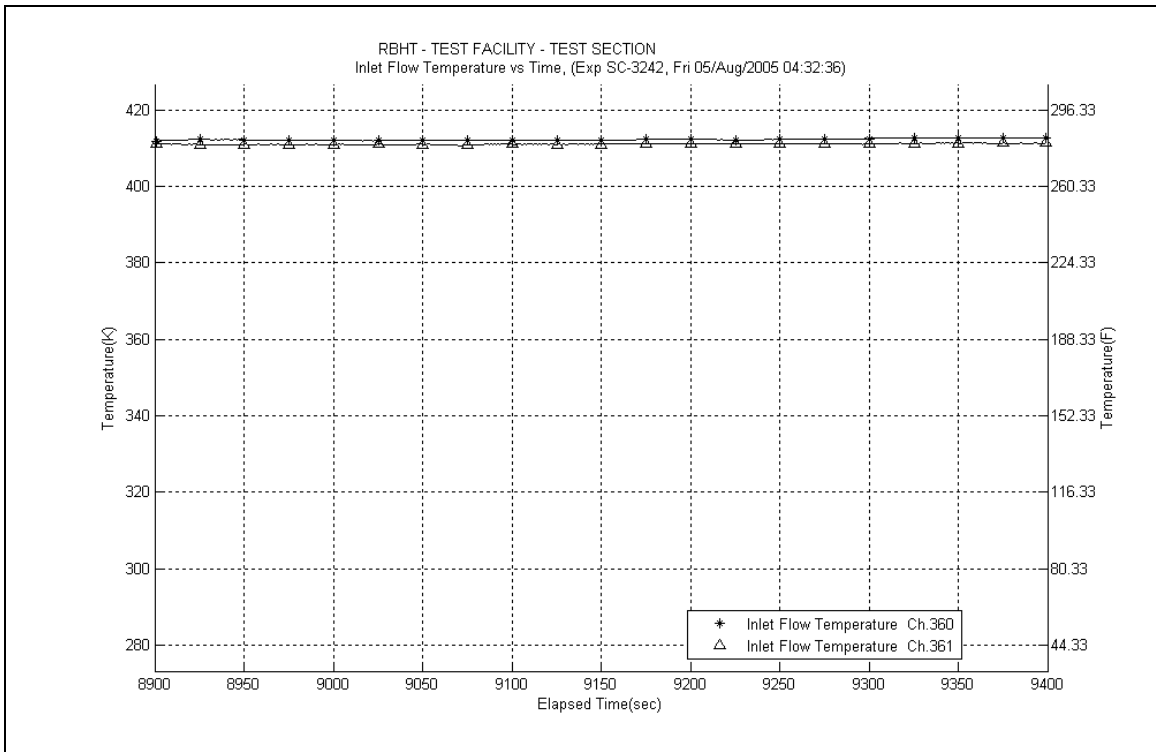
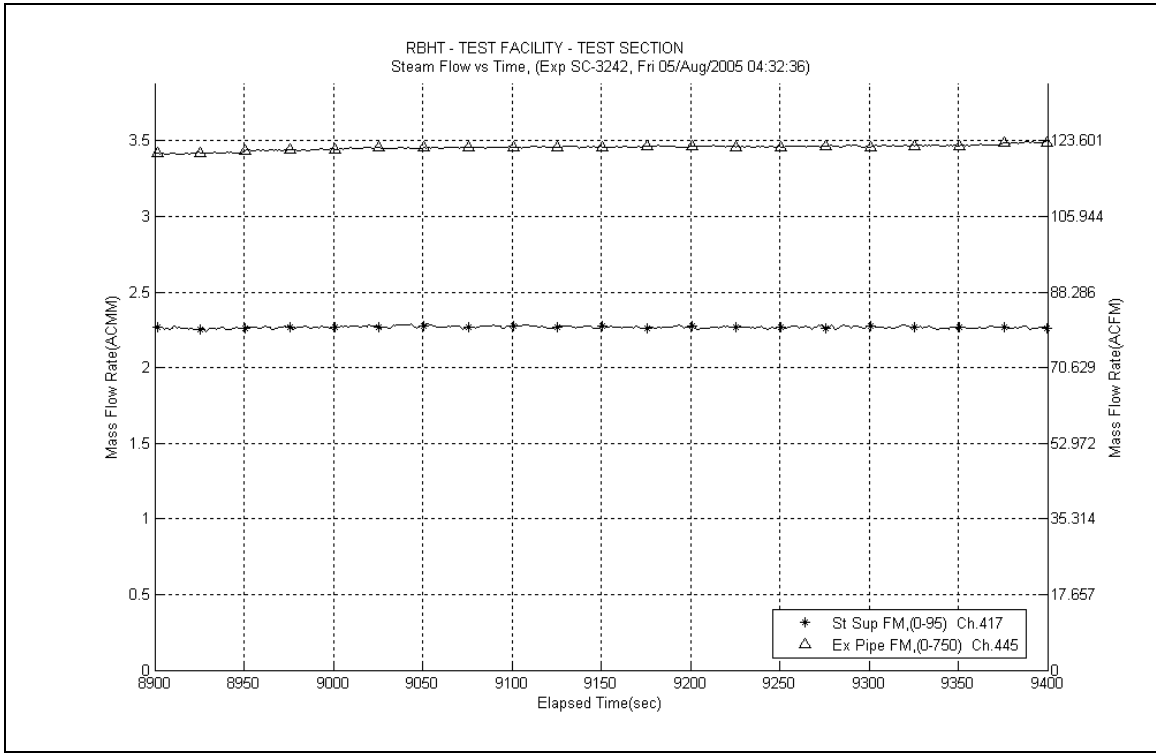
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

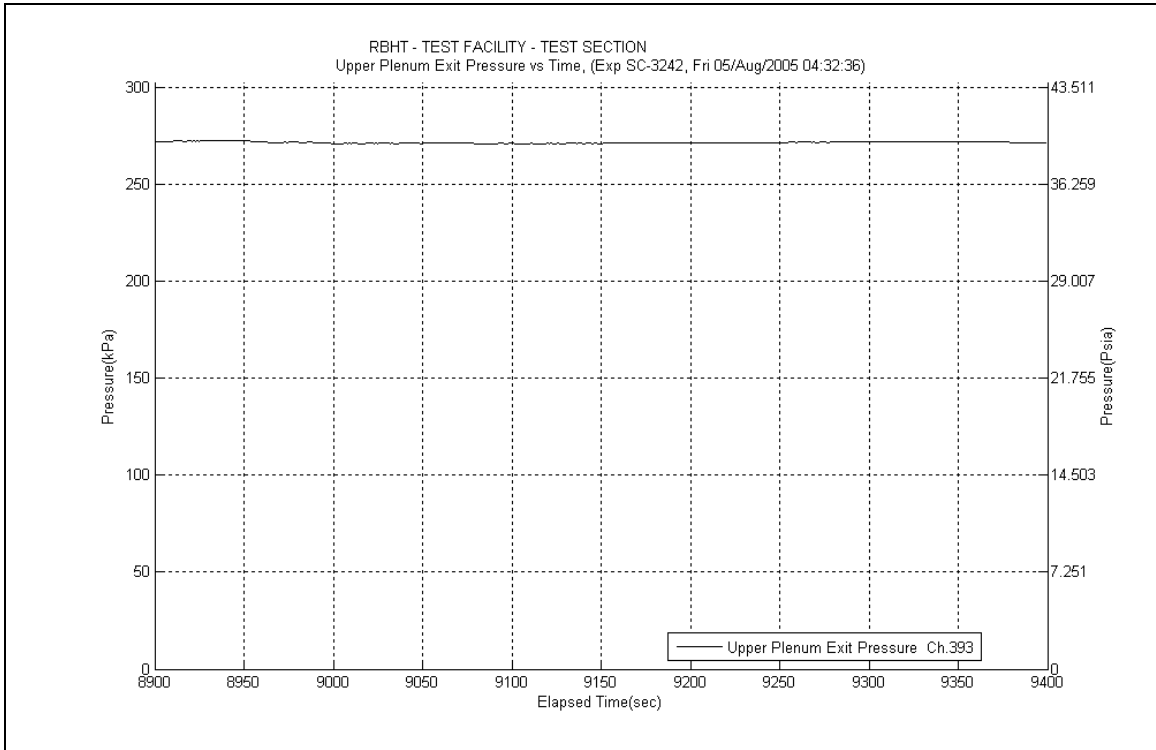
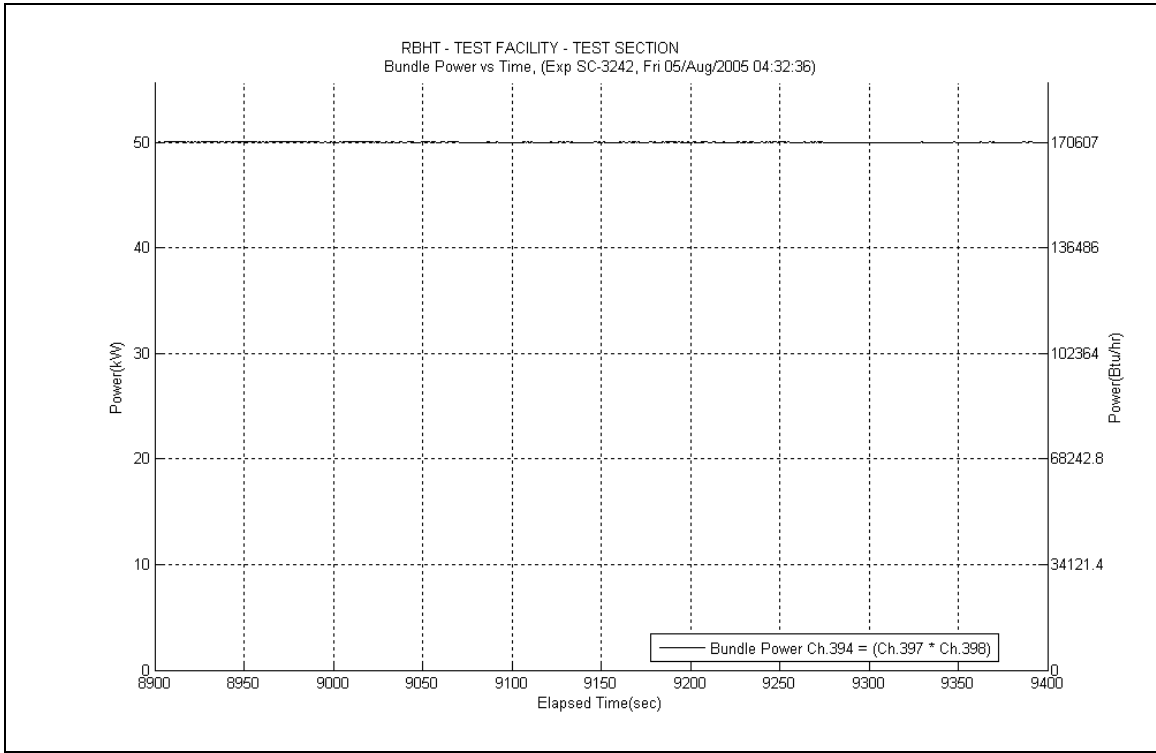
$$T_{cl} = -15.264x^3 + 96.728x^2 - 46.606x + 437.45$$

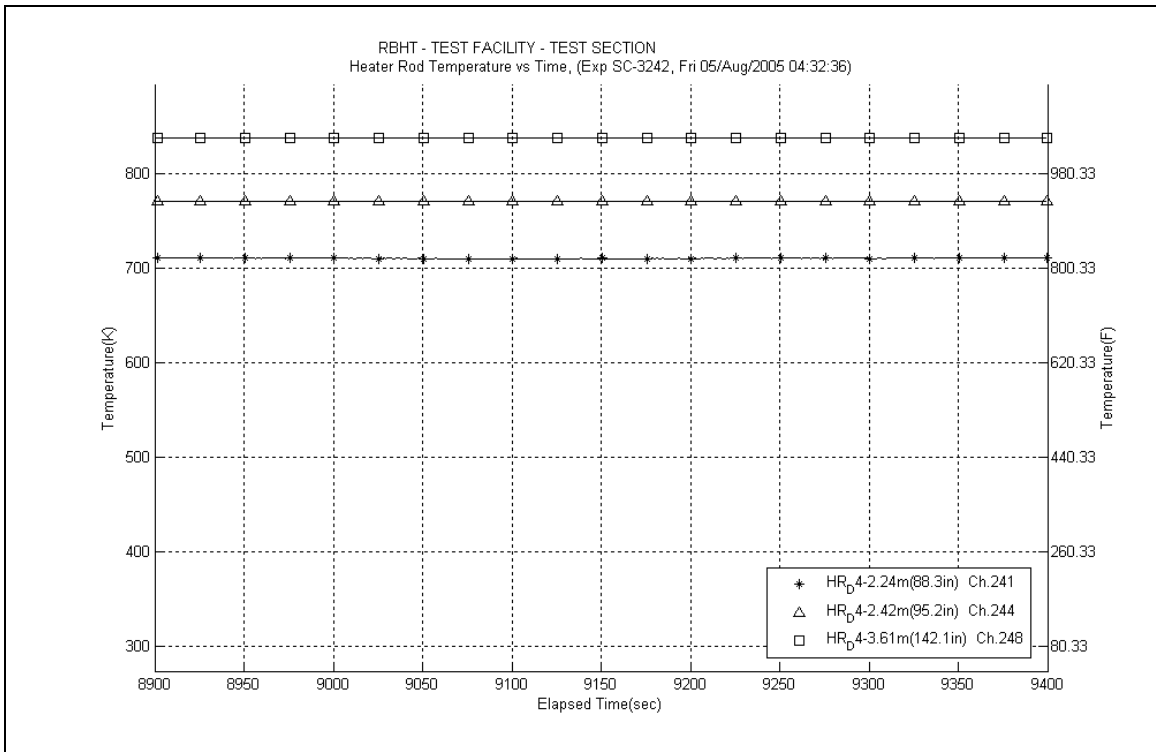
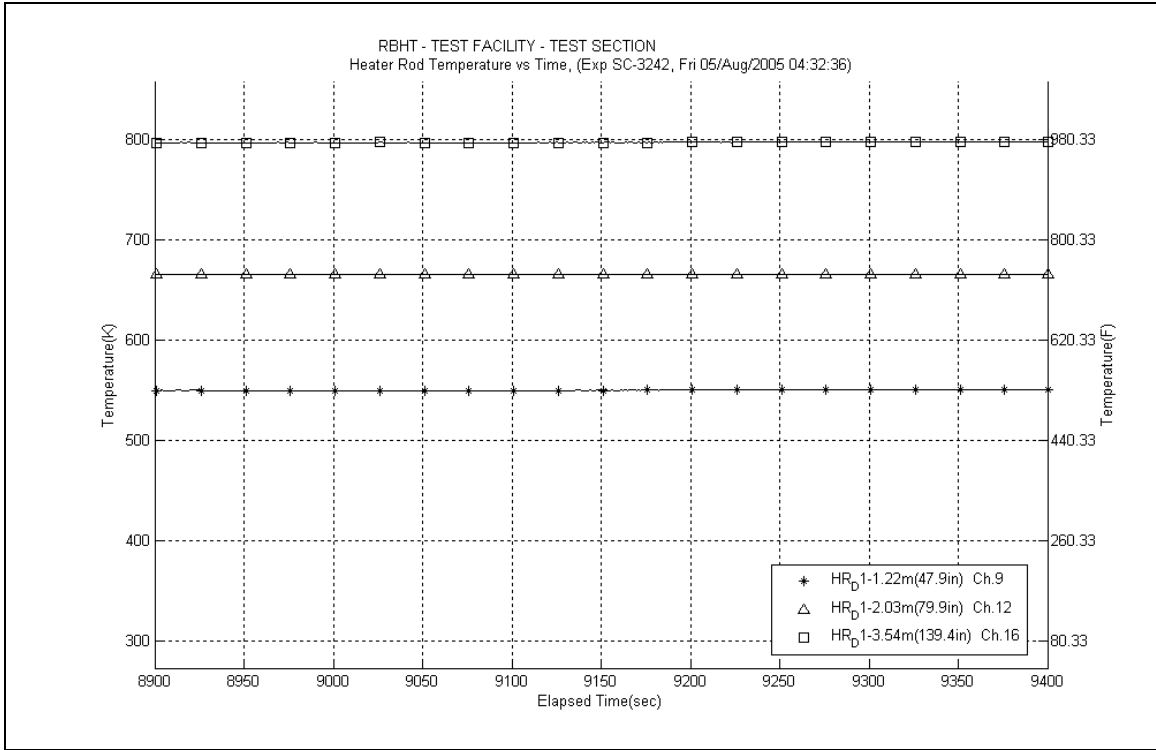
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

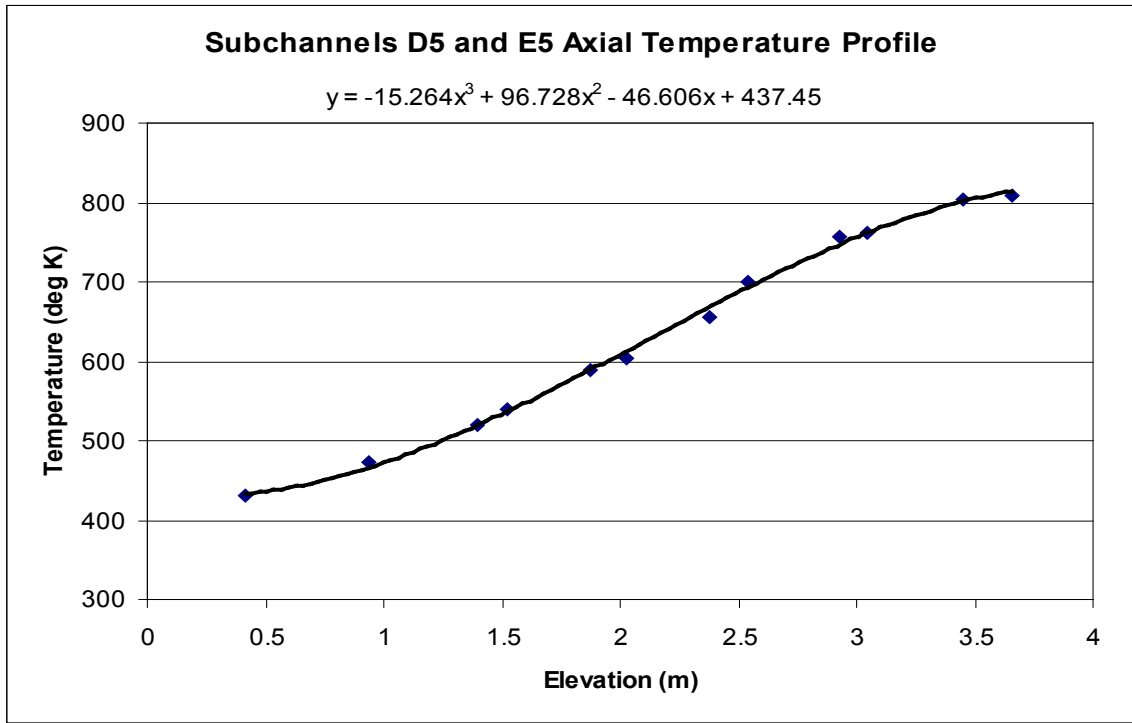
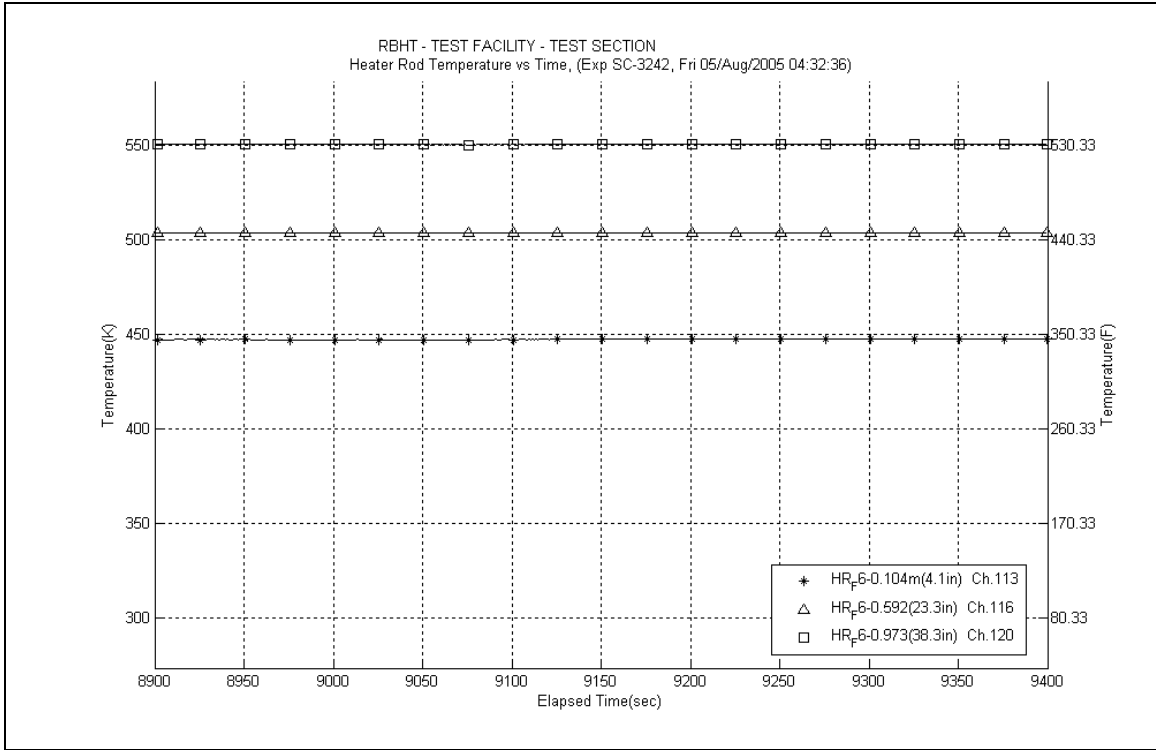
$$T_{cl} = -10.909x^3 + 72.459x^2 - 16.805x + 428.65$$

where x is the elevation (m) and T_{cl} is in (K)









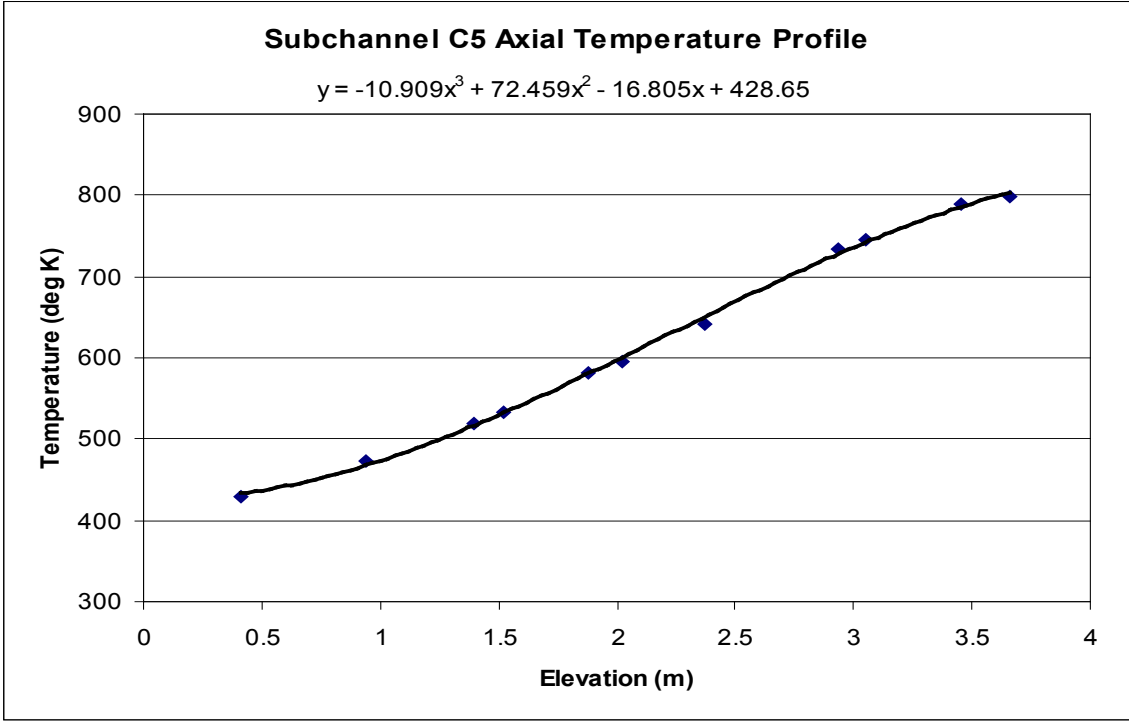


Table SC-3242-A.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	699.4	13389.2	647.3	1.20	656.0	5915	308.19	18.79	6.10%	68.52
RodD3_91.3	186	2.319	0.071	737.3	13674.0	659.2	1.20	672.2	5751	210.10	11.45	5.45%	45.10
RodD3_93.1	187	2.365	0.117	753.4	13845.8	666.3	1.20	680.8	5668	190.78	10.06	5.27%	40.21
RodD3_95.3	188	2.421	0.173	768.9	14053.4	674.9	1.20	690.6	5576	179.50	9.17	5.11%	37.06
RodD3_100.1	189	2.543	0.295	794.4	14507.4	693.4	1.20	710.2	5402	172.39	8.34	4.84%	34.18
RodD3_106.1	190	2.695	0.447	814.4	15077.9	715.6	1.20	732.1	5220	183.20	8.43	4.60%	34.77
RodD3_110	191	2.794	0.546	797.0	14889.7	729.4	1.20	740.7	5152	264.30	12.83	4.85%	49.32
RodD3_142.1	192	3.609	0.218	829.5	5199.7	811.6	1.27	815.4	4632	371.09	40.00	10.78%	60.24
RodC4_88.4	233	2.245	-0.003	704.6	13543.1	647.7	1.20	657.2	5902	285.56	16.93	5.93%	63.33
RodC4_91.1	234	2.314	0.066	737.3	13807.9	658.4	1.20	671.6	5757	209.90	11.39	5.43%	45.12
RodC4_93.4	235	2.372	0.124	753.9	14028.7	667.5	1.20	681.9	5657	194.73	10.19	5.24%	40.95
RodC4_95.3	236	2.421	0.173	767.1	14213.9	674.9	1.20	690.3	5579	184.97	9.43	5.10%	38.22
RodC4_100.1	237	2.543	0.295	789.9	14678.3	693.4	1.20	709.5	5408	182.40	8.83	4.84%	36.22
RodC4_106.1	238	2.695	0.447	810.3	15265.4	715.6	1.20	731.4	5225	193.47	8.92	4.61%	36.77
RodC4_110	239	2.794	0.546	791.5	14771.9	729.4	1.20	739.8	5159	285.54	14.21	4.98%	53.38
RodC4_142.2	240	3.612	0.221	840.2	5636.6	811.8	1.27	817.9	4617	251.94	19.94	7.91%	40.73
RodD4_88.3	241	2.243	-0.005	709.3	13496.2	647.3	1.20	657.6	5898	261.32	15.23	5.83%	57.89
RodD4_91.3	242	2.319	0.071	742.5	13783.0	659.2	1.20	673.1	5742	198.65	10.69	5.38%	42.56
RodD4_93.2	243	2.367	0.119	757.3	13966.6	666.7	1.20	681.8	5658	185.02	9.66	5.22%	38.92
RodD4_95.2	244	2.418	0.170	769.3	14158.6	674.5	1.20	690.3	5579	179.17	9.12	5.09%	37.01
RodD4_142.1	248	3.609	0.218	837.2	5450.3	811.6	1.27	817.1	4622	271.24	22.90	8.44%	43.90
RodE4_88.4	201	2.245	-0.003	704.4	13290.9	647.7	1.20	657.1	5903	281.06	16.82	5.98%	62.33
RodE4_91.2	202	2.316	0.069	736.7	13548.3	658.8	1.20	671.8	5755	208.63	11.44	5.48%	44.82
RodE4_95.3	204	2.421	0.173	767.8	13925.0	674.9	1.20	690.4	5578	179.80	9.24	5.14%	37.14
RodE4_100.9	205	2.563	0.315	794.7	14438.1	696.4	1.20	712.8	5380	176.24	8.53	4.84%	34.76
RodE4_142.3	208	3.614	0.224	832.7	5507.8	811.9	1.27	816.3	4627	337.72	32.51	9.63%	54.74
RodE3_63.4	193	1.610	0.417	639.9	11008.8	549.5	1.20	564.6	7049	146.11	11.00	7.53%	40.16
RodE3_113.6	194	2.885	0.022	801.1	13570.3	741.6	1.20	751.5	5069	273.59	13.84	5.06%	49.99
RodE3_115.5	195	2.934	0.070	814.6	13064.4	747.8	1.27	762.1	4991	248.99	14.75	5.92%	44.58
RodE3_118.5	196	3.010	0.146	826.7	12268.5	757.3	1.27	772.1	4919	224.89	13.22	5.88%	39.51
RodE3_122.7	197	3.117	0.253	833.6	11154.2	769.7	1.27	783.4	4841	221.90	13.22	5.96%	38.18
RodE3_126.5	198	3.213	0.349	834.0	10149.5	780.0	1.27	791.5	4786	239.19	14.77	6.17%	40.54
RodE3_131.7	199	3.345	-0.046	812.2	8770.1	792.6	1.27	796.8	4751	569.82	56.97	10.00%	95.66
RodE3_135.6	200	3.444	0.053	823.8	7738.1	800.7	1.27	805.7	4694	426.61	38.12	8.93%	70.48

Table SC-3242-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	$\pm\sigma_{hc}$ (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	643.8	10795.8	550.6	1.20	566.1	7026	138.95	10.57	7.61%	38.05
RodC5_113.6	226	2.885	0.022	802.8	13236.8	741.6	1.20	751.8	5067	259.54	13.11	5.05%	47.39
RodC5_115.7	227	2.939	0.075	820.4	12705.3	748.5	1.27	763.9	4978	224.60	13.20	5.88%	40.08
RodC5_122.7	229	3.117	0.253	839.6	10942.0	769.7	1.27	784.6	4832	199.20	11.73	5.89%	34.19
RodC5_126.7	230	3.218	0.354	840.0	9932.5	780.5	1.27	793.2	4774	212.48	12.87	6.06%	35.90
RodC5_131.6	231	3.343	-0.048	821.3	8697.2	792.3	1.27	798.6	4740	381.59	29.87	7.83%	63.85
RodC5_135.7	232	3.447	0.056	833.9	7666.5	800.9	1.27	808.0	4679	296.04	21.70	7.33%	48.70
RodE5_63.6	209	1.615	0.422	638.8	11049.0	550.2	1.20	565.0	7043	149.65	11.23	7.50%	41.09
RodE5_113.6	210	2.885	0.022	799.5	13639.9	741.6	1.20	751.3	5071	282.77	14.41	5.09%	51.69
RodE5_115.4	211	2.931	0.067	808.5	13172.5	747.5	1.20	757.7	5023	259.01	12.97	5.01%	46.77
RodE5_118.7	212	3.015	0.151	815.9	12308.9	757.9	1.27	770.3	4932	270.08	16.41	6.08%	47.61
RodE5_122.6	213	3.114	0.250	824.2	11288.7	769.4	1.27	781.1	4856	261.88	16.10	6.15%	45.24
RodE5_126.6	214	3.216	0.352	828.7	10245.7	780.2	1.27	790.6	4792	269.05	17.07	6.34%	45.68
RodE5_131.6	215	3.343	-0.048	809.0	8940.5	792.3	1.27	795.9	4757	682.08	76.81	11.26%	114.68
RodE5_135.6	216	3.444	0.053	823.0	7898.5	800.7	1.27	805.5	4695	451.59	41.26	9.14%	74.63
RodC3_79.8	177	2.027	0.227	702.0	12523.4	613.3	1.20	628.1	6220	169.40	10.35	6.11%	40.08
RodC3_85.6	178	2.174	0.374	692.4	13067.2	636.5	1.20	645.8	6022	280.63	17.28	6.16%	63.81
RodC3_88.5	179	2.248	0.000	696.2	13339.8	648.1	1.20	656.1	5913	332.41	20.75	6.24%	73.89
RodC3_92.4	180	2.347	0.099	739.6	13708.2	663.5	1.20	676.2	5712	216.18	11.73	5.43%	46.01
RodC3_94.4	181	2.398	0.150	752.8	13893.5	671.4	1.20	685.0	5628	204.68	10.78	5.27%	42.76
RodC3_97.2	182	2.469	0.221	769.0	14156.4	682.3	1.20	696.7	5520	195.80	9.95	5.08%	39.91
RodC3_108.8	183	2.764	0.516	801.5	14927.1	725.2	1.20	737.9	5173	234.79	11.15	4.75%	44.05
RodD5_50	217	1.270	0.076	590.1	9775.1	503.0	1.20	517.5	7818	134.68	12.33	9.15%	41.64
RodD5_54.1	218	1.374	0.180	614.3	10161.9	516.4	1.20	532.8	7552	124.61	10.67	8.56%	37.07
RodD5_56.9	219	1.445	0.251	626.7	10423.7	526.1	1.20	542.8	7385	124.23	10.19	8.21%	36.03
RodD5_60	220	1.524	0.330	636.0	10713.1	537.1	1.20	553.5	7216	129.89	10.20	7.85%	36.69
RodD5_66.1	221	1.679	0.485	650.4	11266.0	559.6	1.20	574.8	6902	149.22	10.81	7.25%	40.01
RodD5_69.9	222	1.775	-0.025	629.7	11641.1	574.2	1.20	583.4	6781	251.79	18.28	7.26%	66.12
RodD5_72.9	223	1.852	0.051	665.2	11923.7	585.9	1.20	599.1	6573	180.45	12.10	6.70%	45.65
RodD5_74.9	224	1.902	0.102	683.1	12110.7	593.8	1.20	608.7	6452	162.70	10.52	6.47%	40.25

Table SC-3242-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	564.2	8888.5	477.4	1.20	491.9	8308	122.83	13.02	10.60%	40.55
RodB5_52.9	154	1.344	0.150	605.3	10016.6	510.4	1.20	526.2	7663	126.67	11.09	8.75%	38.31
RodB5_55	155	1.397	0.203	614.5	10215.9	516.8	1.20	533.1	7546	125.56	10.63	8.47%	37.32
RodB5_57.8	156	1.468	0.274	626.3	10481.8	525.6	1.20	542.4	7392	124.97	10.14	8.11%	36.29
RodB5_64	157	1.626	0.432	642.3	11069.9	545.9	1.20	562.0	7087	137.91	10.26	7.44%	38.15
RodB5_73.9	158	1.877	0.077	671.1	12008.6	580.3	1.20	595.4	6621	158.56	10.38	6.54%	40.47
RodB5_75.9	159	1.928	0.128	685.0	12199.6	587.4	1.20	603.7	6514	149.93	9.51	6.35%	37.53
RodB5_76.9	160	1.953	0.153	691.1	12293.2	591.0	1.20	607.7	6464	147.34	9.22	6.26%	36.54
RodF5_41	105	1.041	0.343	561.8	8829.4	477.4	1.20	491.5	8317	125.61	13.40	10.67%	41.51
RodF5_53.1	106	1.349	0.155	600.4	9975.7	511.0	1.20	525.9	7669	133.96	11.77	8.79%	40.54
RodF5_55	107	1.397	0.203	609.0	10157.0	516.8	1.20	532.2	7561	132.21	11.28	8.53%	39.39
RodF5_57.8	108	1.468	0.274	619.3	10423.3	525.6	1.20	541.2	7411	133.55	10.92	8.17%	38.89
RodF5_64	109	1.626	0.432	633.8	11012.5	545.9	1.20	560.6	7108	150.41	11.29	7.50%	41.75
RodF5_73.8	110	1.875	0.074	659.5	11940.3	579.9	1.20	593.2	6650	179.92	11.96	6.65%	46.16
RodF5_75.8	111	1.925	0.125	674.8	12130.4	587.0	1.20	601.7	6540	165.81	10.66	6.43%	41.70
RodF5_76.8	112	1.951	0.150	681.0	12226.4	590.6	1.20	605.7	6489	162.26	10.27	6.33%	40.42
RodC2_41	57	1.041	0.343	559.6	8865.4	477.4	1.20	491.1	8324	129.45	13.77	10.64%	42.82
RodC2_53.1	58	1.349	0.155	602.6	10017.7	511.0	1.20	526.3	7663	131.35	11.49	8.75%	39.72
RodC2_55	59	1.397	0.203	609.2	10198.1	516.8	1.20	532.2	7561	132.56	11.27	8.50%	39.49
RodC2_57.8	60	1.468	0.274	619.9	10463.7	525.6	1.20	541.3	7409	133.22	10.85	8.15%	38.79
RodC2_63.9	61	1.623	0.429	630.2	11041.0	545.6	1.20	559.7	7121	156.56	11.76	7.51%	43.55
RodC2_73.8	62	1.875	0.074	657.0	11982.6	579.9	1.20	592.8	6655	186.47	12.41	6.66%	47.89
RodC2_75.8	63	1.925	0.125	668.6	12169.7	587.0	1.20	600.6	6553	178.95	11.56	6.46%	45.11
RodC2_76.8	64	1.951	0.150	674.0	12267.5	590.6	1.20	604.5	6504	176.47	11.23	6.36%	44.08
RodC6_40.9	137	1.039	0.340	563.8	8825.9	477.2	1.20	491.6	8314	122.26	13.05	10.67%	40.39
RodC6_52.8	138	1.341	0.147	604.8	10002.8	510.1	1.20	525.9	7669	126.72	11.11	8.77%	38.35
RodC6_54.8	139	1.392	0.198	613.8	10201.3	516.2	1.20	532.5	7556	125.42	10.65	8.49%	37.34
RodC6_57.8	140	1.468	0.274	626.2	10499.4	525.6	1.20	542.4	7392	125.25	10.15	8.10%	36.37
RodC6_63.8	141	1.621	0.427	642.4	11094.1	545.3	1.20	561.5	7095	137.13	10.19	7.43%	37.98
RodC6_73.7	142	1.872	0.072	670.7	12072.4	579.5	1.20	594.7	6629	158.98	10.38	6.53%	40.64
RodC6_75.8	143	1.925	0.125	679.8	12279.4	587.0	1.20	602.5	6529	158.87	10.09	6.35%	39.87
RodC6_76.8	144	1.951	0.150	687.1	12375.4	590.6	1.20	606.7	6476	153.96	9.62	6.25%	38.27

Table SC-3242-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	$\pm\sigma_{hc}$ (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	700.2	13283.7	632.7	1.20	644.0	6042	236.32	13.65	5.77%	53.95
RodB4_91.3	162	2.319	0.071	735.3	13547.3	643.3	1.20	658.6	5887	176.71	9.47	5.36%	39.06
RodB4_93.3	163	2.370	0.122	750.7	13731.8	650.6	1.20	667.3	5800	164.64	8.57	5.20%	35.72
RodB4_95.1	164	2.416	0.168	761.9	13897.7	657.1	1.20	674.6	5728	159.15	8.09	5.08%	33.99
RodB4_100	165	2.540	0.292	786.1	14351.8	674.7	1.20	693.2	5552	154.62	7.44	4.82%	31.75
RodB4_106	166	2.692	0.445	801.0	14898.7	695.7	1.20	713.3	5375	169.93	7.80	4.59%	33.48
RodB4_109.9	167	2.791	0.544	781.2	14427.6	709.1	1.20	721.1	5309	239.87	11.57	4.82%	46.53
RodB4_142.3	168	3.614	0.224	835.5	5598.2	799.4	1.27	807.1	4685	196.82	13.91	7.07%	32.43
RodF4_85.6	98	2.174	0.374	695.5	13107.9	622.5	1.20	634.7	6145	215.55	12.60	5.85%	50.24
RodF4_88.4	99	2.245	-0.003	698.9	13372.9	632.7	1.20	643.8	6045	242.60	14.01	5.78%	55.41
RodF4_92.4	100	2.347	0.099	739.3	13747.5	647.3	1.20	662.6	5846	179.26	9.47	5.28%	39.28
RodF4_94.3	101	2.395	0.147	752.6	13924.1	654.2	1.20	670.6	5767	169.74	8.73	5.14%	36.56
RodF4_97.2	102	2.469	0.221	767.7	14195.5	664.7	1.20	681.8	5658	165.27	8.21	4.97%	34.76
RodF4_108.8	103	2.764	0.516	802.4	14996.3	705.3	1.20	721.5	5306	185.33	8.43	4.55%	35.92
RodF4_111	104	2.819	-0.044	778.3	14381.1	712.8	1.20	723.7	5288	263.17	12.93	4.91%	50.78
RodD2_103.2	65	2.621	0.373	779.6	14835.0	686.0	1.20	701.6	5477	190.19	9.03	4.75%	38.38
RodD2_106	66	2.692	0.445	786.0	15101.1	695.7	1.20	710.8	5397	200.82	9.37	4.66%	39.77
RodD2_112.6	67	2.860	-0.004	772.3	13853.8	718.1	1.20	727.1	5260	306.56	15.97	5.21%	58.75
RodD2_114.9	68	2.918	0.055	792.1	13208.5	725.6	1.20	736.7	5183	238.49	11.69	4.90%	44.85
RodD2_117.4	69	2.982	0.118	803.3	12511.1	733.6	1.20	745.2	5117	215.49	10.44	4.85%	39.85
RodD2_120.8	70	3.068	0.204	817.3	11562.7	744.1	1.20	756.3	5033	189.57	9.08	4.79%	34.32
RodD2_124.8	71	3.170	0.306	820.8	10441.6	756.0	1.27	769.9	4935	204.87	12.20	5.96%	36.15
RodD2_128.6	72	3.266	0.403	818.9	9384.9	766.7	1.27	777.9	4879	228.50	14.27	6.24%	39.72
RodD6_103.1	129	2.619	0.371	788.7	14858.7	685.6	1.20	702.8	5466	173.05	8.12	4.69%	34.84
RodD6_106	130	2.692	0.445	795.1	15130.5	695.7	1.20	712.3	5384	182.71	8.40	4.60%	36.07
RodD6_112.9	131	2.868	0.004	783.4	13805.2	719.1	1.20	729.8	5238	257.71	12.74	4.94%	49.13
RodD6_114.9	132	2.918	0.055	800.2	13235.5	725.6	1.20	738.0	5173	212.84	10.15	4.77%	39.92
RodD6_116.8	133	2.967	0.103	811.4	12699.3	731.7	1.20	745.0	5119	191.16	8.99	4.70%	35.37
RodD6_120.9	134	3.071	0.207	821.5	11539.6	744.4	1.20	757.3	5026	179.71	8.51	4.74%	32.47
RodD6_124.8	135	3.170	0.306	825.4	10436.9	756.0	1.27	770.9	4928	191.32	11.26	5.89%	33.69
RodD6_128.7	136	3.269	0.405	825.5	9335.8	766.9	1.27	779.5	4867	202.98	12.34	6.08%	35.17

Table SC-3242-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{h,c} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	583.0	9803.7	502.1	1.20	515.6	7853	145.47	13.32	9.16%	45.20
RodE2_54	74	1.372	0.178	605.4	10177.2	513.8	1.20	529.0	7615	133.23	11.43	8.58%	40.01
RodE2_56.9	75	1.445	0.251	618.5	10454.8	522.8	1.20	538.7	7452	131.06	10.75	8.20%	38.41
RodE2_59.9	76	1.521	0.328	627.9	10742.0	532.4	1.20	548.3	7297	134.96	10.60	7.85%	38.62
RodE2_66	77	1.676	0.483	638.8	11327.4	552.7	1.20	567.1	7012	157.96	11.45	7.25%	43.16
RodE2_69.8	78	1.773	-0.027	618.6	11691.0	565.8	1.20	574.6	6904	265.88	19.43	7.31%	71.32
RodE2_72.9	79	1.852	0.051	650.9	11988.7	576.7	1.20	589.1	6704	193.95	13.04	6.73%	50.25
RodE2_74.9	80	1.902	0.102	662.7	12181.1	583.8	1.20	597.0	6600	185.31	12.08	6.52%	47.12
RodB3_50.2	169	1.275	0.081	581.3	9742.1	502.4	1.20	515.6	7854	148.28	13.65	9.21%	46.08
RodB3_54.1	170	1.374	0.180	599.0	10113.1	514.1	1.20	528.2	7629	142.82	12.35	8.65%	42.97
RodB3_56.9	171	1.445	0.251	610.8	10379.6	522.8	1.20	537.5	7473	141.43	11.71	8.28%	41.58
RodB3_60.1	172	1.527	0.333	619.0	10682.0	533.0	1.20	547.4	7312	149.17	11.81	7.92%	42.78
RodB3_66.1	173	1.679	0.485	633.3	11252.6	553.1	1.20	566.4	7022	168.30	12.31	7.32%	46.05
RodB3_69.9	174	1.775	-0.025	616.8	11613.6	566.2	1.20	574.6	6904	275.04	20.32	7.39%	73.78
RodB3_73	175	1.854	0.054	652.8	11910.0	577.1	1.20	589.7	6696	188.71	12.71	6.73%	48.82
RodB3_75	176	1.905	0.105	668.5	12099.4	584.2	1.20	598.2	6584	172.09	11.18	6.50%	43.63
RodF3_50.1	89	1.273	0.079	586.2	9750.8	502.1	1.20	516.1	7843	139.10	12.77	9.18%	43.16
RodF3_54	90	1.372	0.178	606.2	10130.2	513.8	1.20	529.2	7613	131.54	11.33	8.61%	39.49
RodF3_57	91	1.448	0.254	617.4	10420.5	523.1	1.20	538.8	7451	132.65	10.91	8.22%	38.87
RodF3_60	92	1.524	0.330	625.6	10711.0	532.7	1.20	548.2	7299	138.40	10.90	7.87%	39.61
RodF3_66.1	93	1.679	0.485	632.4	11301.7	553.1	1.20	566.3	7024	170.91	12.48	7.30%	46.78
RodF3_70	94	1.778	-0.022	620.8	11678.1	566.5	1.20	575.6	6890	258.05	18.76	7.27%	69.06
RodF3_73	95	1.854	0.054	654.4	11968.5	577.1	1.20	590.0	6693	185.75	12.44	6.70%	48.02
RodF3_75	96	1.905	0.105	672.1	12162.9	584.2	1.20	598.8	6576	166.08	10.72	6.45%	42.04
RodE6_50.2	121	1.275	0.081	583.8	9740.9	502.4	1.20	516.0	7846	143.69	13.21	9.20%	44.60
RodE6_54.1	122	1.374	0.180	604.6	10106.9	514.1	1.20	529.2	7613	133.92	11.55	8.63%	40.20
RodE6_57	123	1.448	0.254	616.2	10378.8	523.1	1.20	538.6	7454	133.83	11.05	8.25%	39.23
RodE6_60.2	124	1.529	0.335	625.3	10678.8	533.4	1.20	548.7	7291	139.39	10.99	7.88%	39.85
RodE6_66.1	125	1.679	0.485	639.6	11232.8	553.1	1.20	567.5	7006	155.84	11.36	7.29%	42.53
RodE6_70	126	1.778	-0.022	621.2	11598.1	566.5	1.20	575.6	6889	254.54	18.56	7.29%	68.11
RodE6_73.1	127	1.857	0.056	654.4	11888.1	577.4	1.20	590.2	6689	185.41	12.47	6.73%	47.90
RodE6_75	128	1.905	0.105	669.3	12066.8	584.2	1.20	598.4	6582	170.17	11.07	6.51%	43.13

RBHT Steam Cooling Test SC-3242-B

Matrix test # 7

Test date – 8/5/2005

Steady state time window: 14700 - 15000 sec

Inlet flow: 3.55 m³/min (125.2 ft³/min)

Inlet steam temperature: 417 K (291 °F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 70.0 kW

Outlet steam temperature: 610 K (639 °F)

Bundle inlet Reynolds number: 13553

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution. Experiment SC-3242 was run with the traversing probes withdrawn. Centerline steam temperatures used are from experiment SC-3214-A.

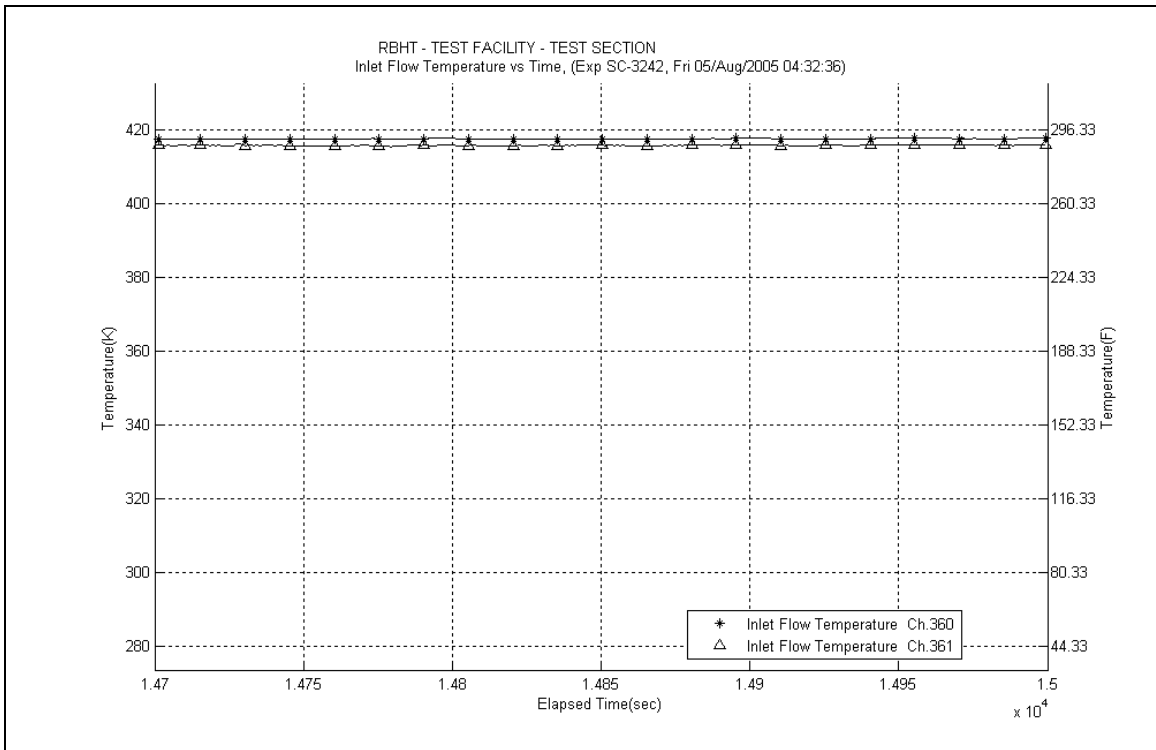
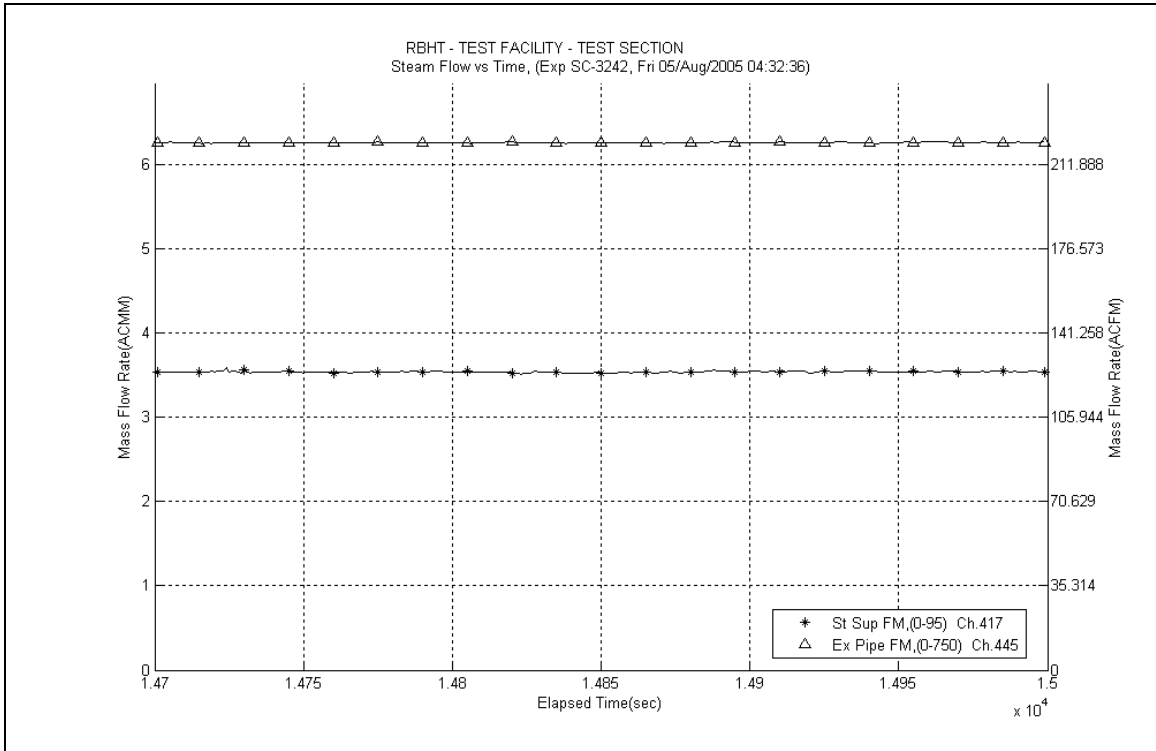
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

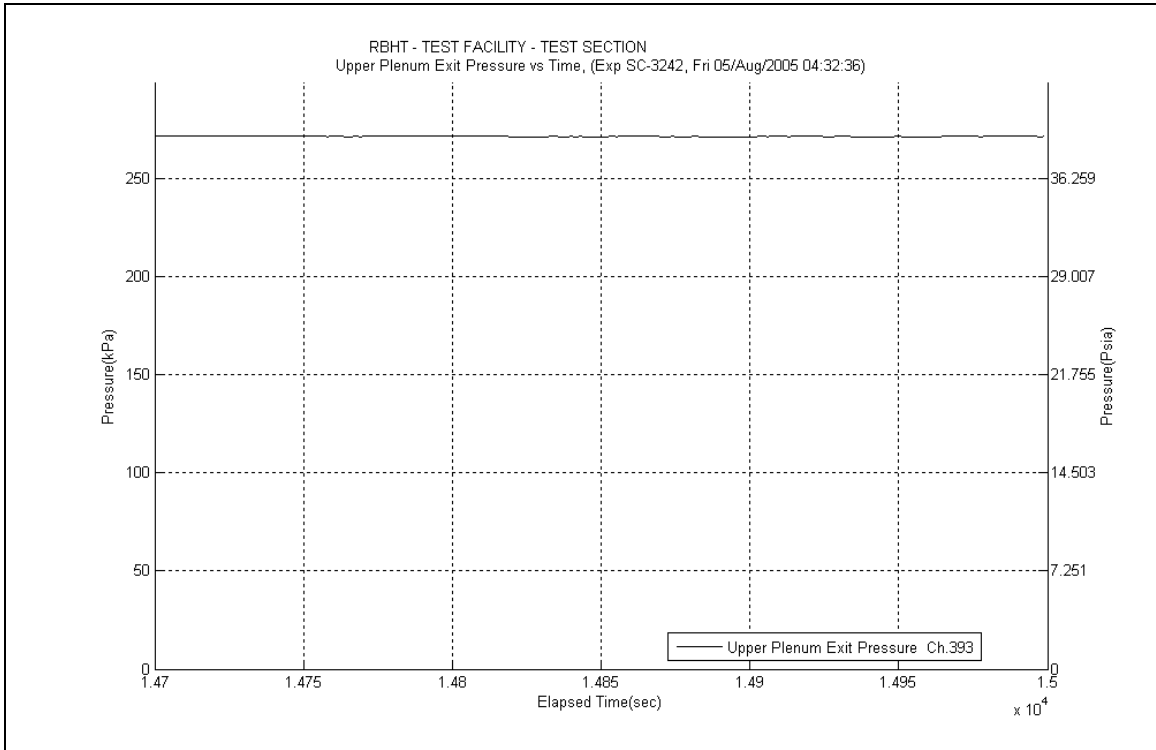
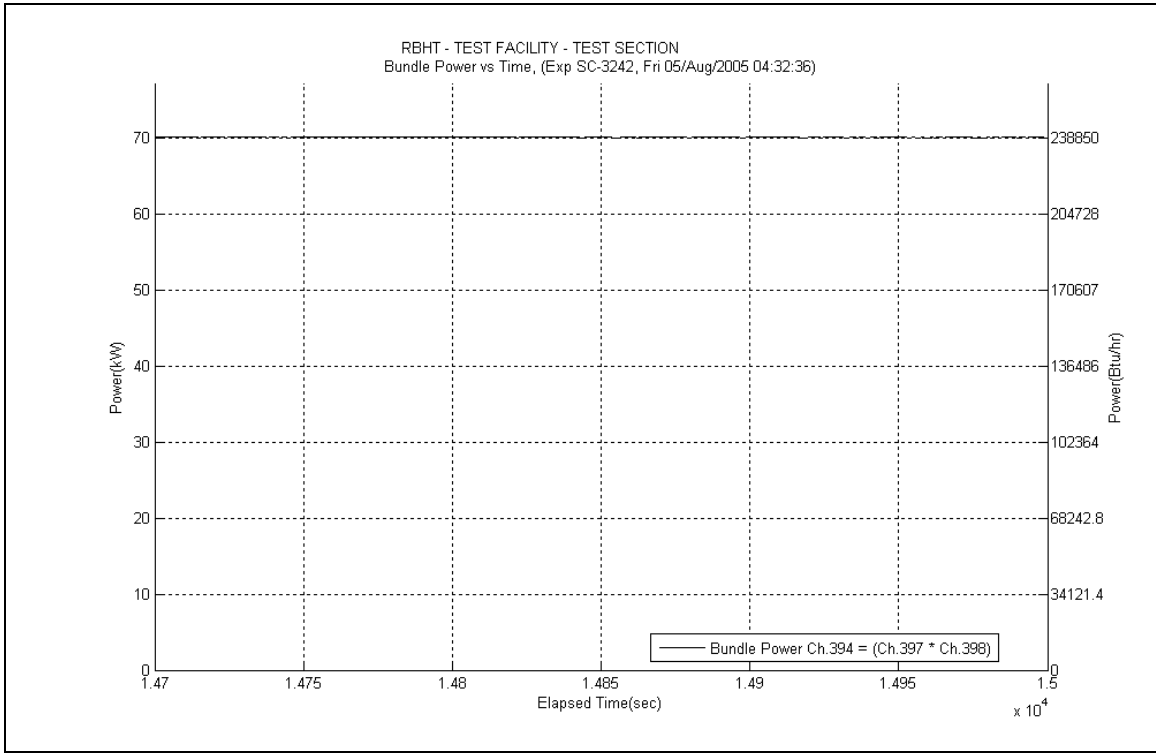
$$T_{cl} = -13.233x^3 + 84.376x^2 - 38.8x + 441.58$$

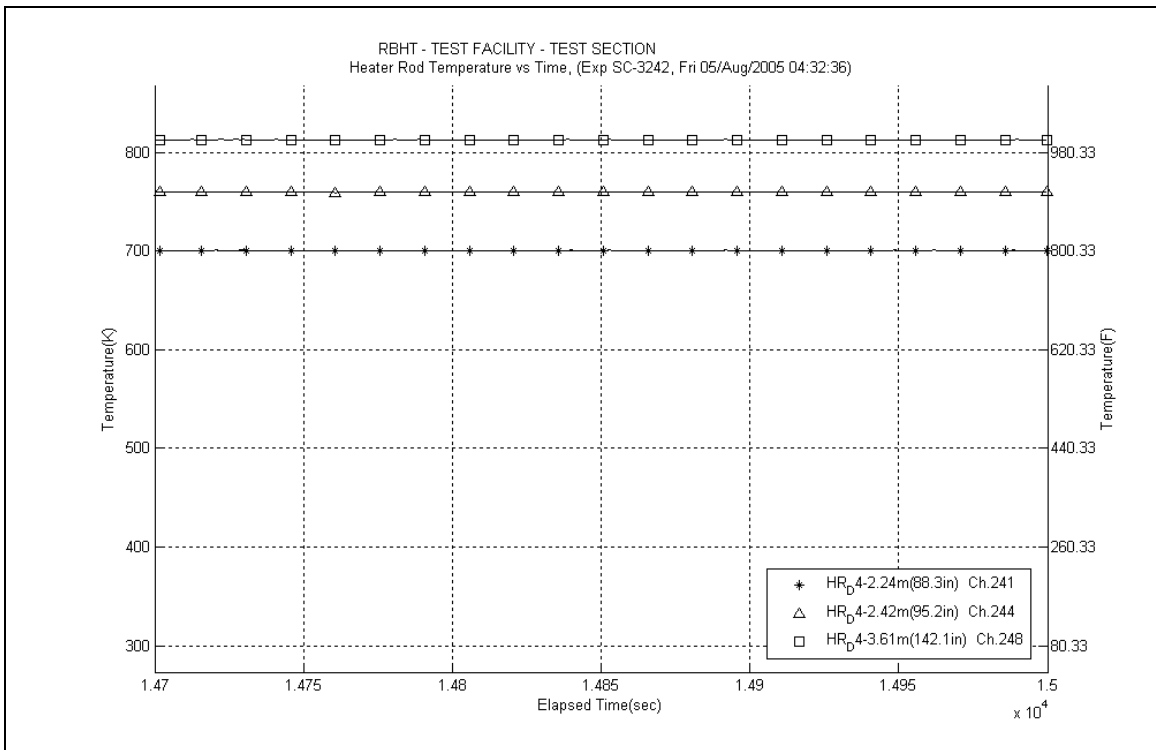
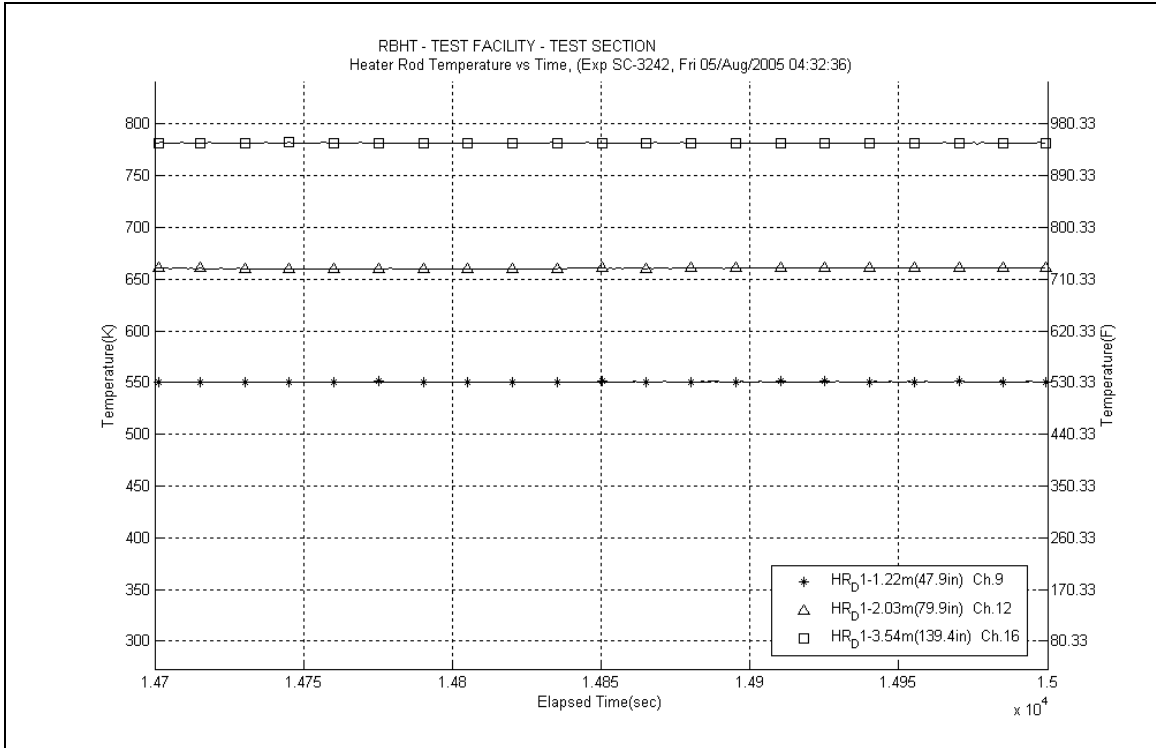
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

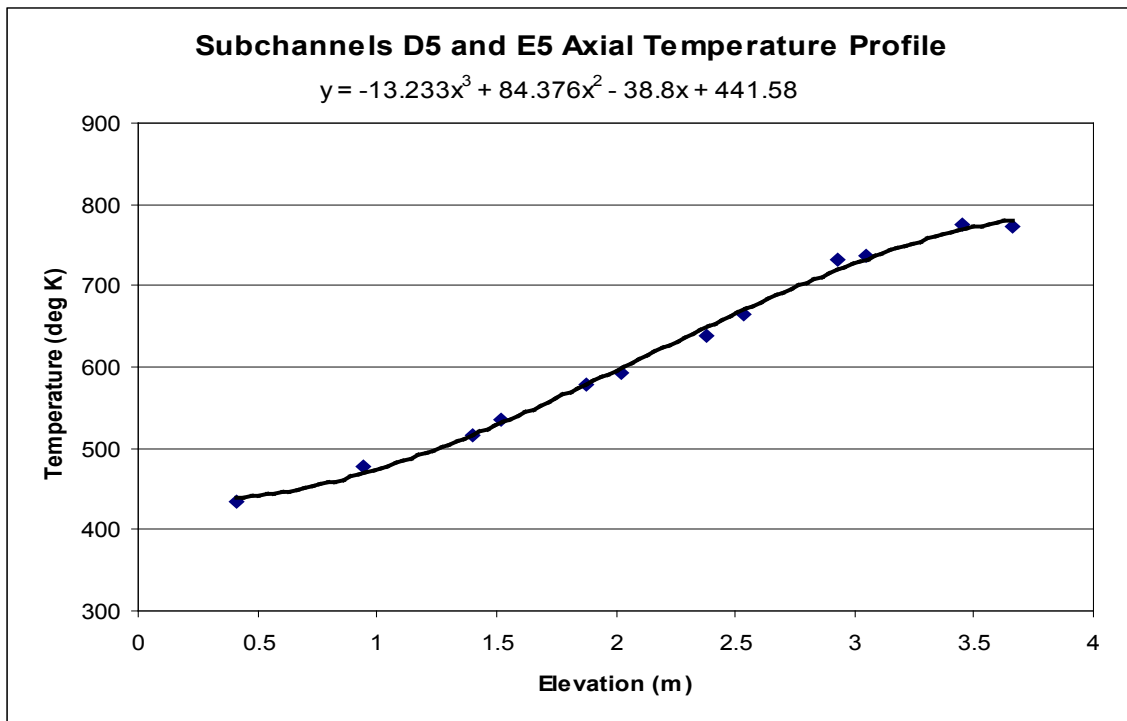
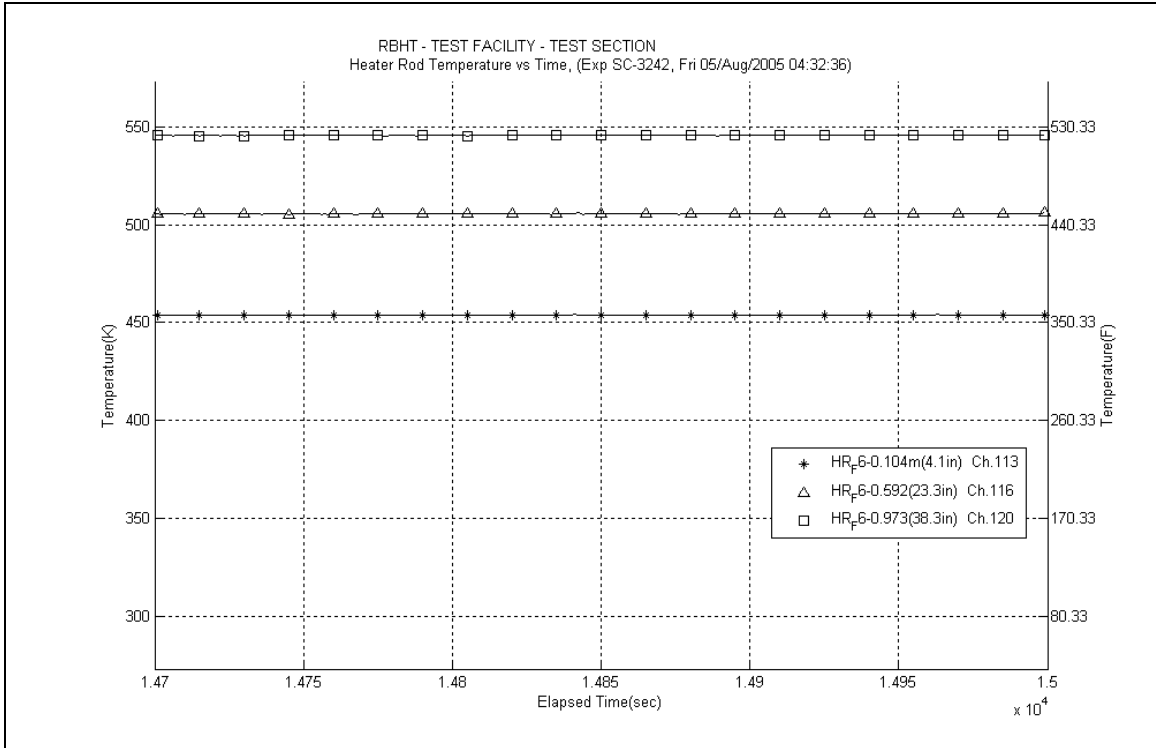
$$T_{cl} = -9.9912x^3 + 67.516x^2 - 20.267x + 434.51$$

where x is the elevation (m) and T_{cl} is in (K)









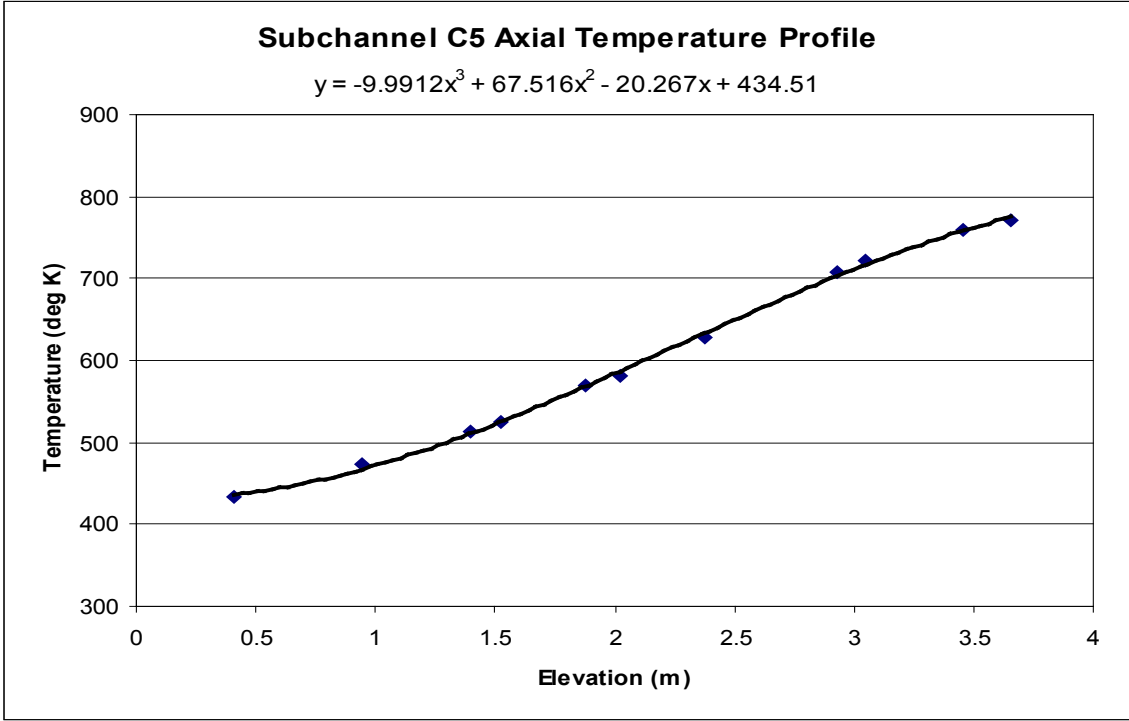


Table SC-3242-B.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	$\pm\sigma_{hc}$ (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	689.7	18745.6	629.7	1.20	639.7	9384	375.08	19.45	5.19%	86.45
RodD3_91.3	186	2.319	0.071	729.6	19144.1	640.3	1.20	655.2	9127	257.25	12.00	4.66%	57.29
RodD3_93.1	187	2.365	0.117	746.3	19384.2	646.7	1.20	663.3	9000	233.44	10.58	4.53%	51.08
RodD3_95.3	188	2.421	0.173	761.8	19675.5	654.4	1.20	672.3	8861	219.72	9.72	4.42%	47.16
RodD3_100.1	189	2.543	0.295	783.8	20313.6	670.9	1.20	689.7	8606	215.83	9.20	4.26%	44.65
RodD3_106.1	190	2.695	0.447	800.0	21110.0	690.8	1.20	709.0	8340	231.93	9.60	4.14%	46.10
RodD3_110	191	2.794	0.546	781.4	20848.2	703.2	1.20	716.2	8245	319.92	13.90	4.35%	62.66
RodD3_142.1	192	3.609	0.218	806.4	7285.8	778.5	1.20	783.2	7462	313.02	22.18	7.09%	53.88
RodC4_88.4	233	2.245	-0.003	694.1	18964.1	630.0	1.20	640.7	9366	355.33	18.03	5.07%	81.71
RodC4_91.1	234	2.314	0.066	730.5	19330.7	639.6	1.20	654.8	9134	255.20	11.84	4.64%	56.89
RodC4_93.4	235	2.372	0.124	748.0	19642.5	647.7	1.20	664.4	8982	235.07	10.59	4.50%	51.31
RodC4_95.3	236	2.421	0.173	761.2	19900.3	654.4	1.20	672.2	8863	223.49	9.86	4.41%	47.98
RodC4_100.1	237	2.543	0.295	780.1	20553.3	670.9	1.20	689.1	8615	225.80	9.63	4.27%	46.77
RodC4_106.1	238	2.695	0.447	794.4	21366.1	690.8	1.20	708.1	8353	247.54	10.29	4.16%	49.30
RodC4_110	239	2.794	0.546	773.4	20675.3	703.2	1.20	714.9	8262	353.34	15.81	4.47%	69.39
RodC4_142.2	240	3.612	0.221	815.7	7899.8	778.6	1.20	784.8	7445	255.49	14.98	5.86%	43.84
RodD4_88.3	241	2.243	-0.005	699.5	18895.1	629.7	1.20	641.3	9356	324.90	16.17	4.98%	74.61
RodD4_91.3	242	2.319	0.071	733.4	19297.3	640.3	1.20	655.8	9117	248.68	11.49	4.62%	55.31
RodD4_93.2	243	2.367	0.119	747.8	19552.2	647.0	1.20	663.8	8991	232.89	10.51	4.51%	50.90
RodD4_95.2	244	2.418	0.170	758.7	19820.5	654.0	1.20	671.5	8874	227.25	10.06	4.43%	48.86
RodD4_142.1	248	3.609	0.218	812.5	7636.7	778.5	1.20	784.2	7452	269.41	16.70	6.20%	46.28
RodE4_88.4	201	2.245	-0.003	695.1	18608.8	630.0	1.20	640.9	9363	343.32	17.45	5.08%	78.92
RodE4_91.2	202	2.316	0.069	730.3	18969.5	640.0	1.20	655.0	9130	252.15	11.78	4.67%	56.18
RodE4_95.3	204	2.421	0.173	758.1	19494.8	654.4	1.20	671.6	8871	225.56	10.05	4.45%	48.48
RodE4_100.9	205	2.563	0.315	778.8	20214.7	673.6	1.20	691.1	8586	230.49	9.89	4.29%	47.54
RodE4_142.3	208	3.614	0.224	809.4	7714.9	778.8	1.20	783.9	7455	301.84	19.96	6.61%	51.88
RodE3_63.4	193	1.610	0.417	632.6	15413.2	542.6	1.20	557.6	11023	205.70	12.34	6.00%	57.51
RodE3_113.6	194	2.885	0.022	787.2	18998.6	714.2	1.20	726.4	8115	312.47	13.87	4.44%	59.97
RodE3_115.5	195	2.934	0.070	802.1	18294.3	719.8	1.20	733.5	8026	266.84	11.50	4.31%	50.49
RodE3_118.5	196	3.010	0.146	813.8	17180.2	728.3	1.20	742.6	7917	241.38	10.32	4.27%	44.87
RodE3_122.7	197	3.117	0.253	815.2	15621.7	739.6	1.20	752.2	7804	247.99	10.88	4.39%	45.25
RodE3_126.5	198	3.213	0.349	813.3	14210.7	749.0	1.20	759.7	7717	265.26	12.17	4.59%	47.71
RodE3_131.7	199	3.345	-0.046	788.9	12281.2	760.6	1.20	765.3	7655	521.65	36.39	6.98%	92.83
RodE3_135.6	200	3.444	0.053	803.1	10833.1	768.2	1.20	774.0	7560	371.84	22.52	6.06%	65.10

Table SC-3242-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	632.7	15117.8	543.6	1.20	558.5	11003	203.69	12.35	6.06%	56.83
RodC5_113.6	226	2.885	0.022	788.5	18531.3	714.2	1.20	726.6	8113	299.42	13.29	4.44%	57.44
RodC5_115.7	227	2.939	0.075	808.1	17790.6	720.4	1.20	735.0	8008	243.48	10.40	4.27%	45.94
RodC5_122.7	229	3.117	0.253	820.2	15324.1	739.6	1.20	753.0	7794	228.21	9.90	4.34%	41.57
RodC5_126.7	230	3.218	0.354	820.3	13913.7	749.5	1.20	761.3	7700	235.86	10.55	4.47%	42.29
RodC5_131.6	231	3.343	-0.048	797.7	12184.8	760.4	1.20	766.6	7640	391.55	22.85	5.84%	69.51
RodC5_135.7	232	3.447	0.056	813.2	10739.7	768.4	1.20	775.8	7540	287.27	15.18	5.28%	50.12
RodE5_63.6	209	1.615	0.422	629.1	15485.3	543.3	1.20	557.6	11024	216.59	13.00	6.00%	60.56
RodE5_113.6	210	2.885	0.022	787.1	19114.7	714.2	1.20	726.3	8116	314.89	13.96	4.43%	60.44
RodE5_115.4	211	2.931	0.067	796.4	18457.2	719.5	1.20	732.3	8041	288.13	12.60	4.37%	54.65
RodE5_118.7	212	3.015	0.151	802.9	17252.0	728.9	1.20	741.2	7933	279.73	12.34	4.41%	52.14
RodE5_122.6	213	3.114	0.250	807.7	15825.5	739.4	1.20	750.8	7820	277.72	12.50	4.50%	50.82
RodE5_126.6	214	3.216	0.352	807.6	14364.9	749.3	1.20	759.0	7726	295.29	13.97	4.73%	53.18
RodE5_131.6	215	3.343	-0.048	783.9	12536.1	760.4	1.20	764.3	7666	640.01	51.12	7.99%	114.11
RodE5_135.6	216	3.444	0.053	801.9	11074.9	768.2	1.20	773.8	7562	393.59	24.31	6.18%	68.93
RodC3_79.8	177	2.027	0.227	690.3	17529.3	599.4	1.20	614.5	9832	231.47	11.81	5.10%	56.49
RodC3_85.6	178	2.174	0.374	679.3	18291.0	620.1	1.20	629.9	9552	370.88	19.67	5.30%	87.38
RodC3_88.5	179	2.248	0.000	686.6	18672.2	630.4	1.20	639.8	9382	398.39	21.06	5.29%	91.81
RodC3_92.4	180	2.347	0.099	731.1	19183.8	644.2	1.20	658.7	9072	265.00	12.34	4.66%	58.57
RodC3_94.4	181	2.398	0.150	743.8	19447.0	651.2	1.20	666.7	8947	252.02	11.46	4.55%	54.75
RodC3_97.2	182	2.469	0.221	760.3	19814.7	660.9	1.20	677.5	8783	239.22	10.57	4.42%	50.77
RodC3_108.8	183	2.764	0.516	787.6	20891.9	699.4	1.20	714.1	8272	284.54	12.10	4.25%	55.97
RodD5_50	217	1.270	0.076	587.0	13685.2	501.3	1.20	515.6	12102	191.54	13.55	7.07%	59.52
RodD5_54.1	218	1.374	0.180	609.1	14223.4	513.3	1.20	529.2	11730	178.13	11.86	6.66%	53.47
RodD5_56.9	219	1.445	0.251	617.9	14593.0	521.8	1.20	537.8	11507	182.13	11.71	6.43%	53.50
RodD5_60	220	1.524	0.330	624.1	15000.7	531.6	1.20	547.0	11278	194.50	12.08	6.21%	55.83
RodD5_66.1	221	1.679	0.485	641.4	15801.6	551.7	1.20	566.6	10817	211.36	12.29	5.82%	57.81
RodD5_69.9	222	1.775	-0.025	621.3	16301.7	564.6	1.20	574.1	10651	344.90	20.74	6.01%	92.64
RodD5_72.9	223	1.852	0.051	658.6	16696.4	575.0	1.20	589.0	10334	239.62	13.14	5.48%	62.10
RodD5_74.9	224	1.902	0.102	675.8	16959.1	582.0	1.20	597.7	10158	216.99	11.51	5.31%	55.08

Table SC-3242-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	561.4	12442.1	475.3	1.20	489.7	12873	173.58	13.94	8.03%	57.63
RodB5_52.9	154	1.344	0.150	600.4	14023.3	504.9	1.20	520.8	11956	176.33	11.95	6.78%	54.06
RodB5_55	155	1.397	0.203	607.6	14302.0	510.7	1.20	526.9	11793	177.19	11.68	6.59%	53.50
RodB5_57.8	156	1.468	0.274	614.7	14673.8	518.7	1.20	534.7	11588	183.29	11.67	6.37%	54.26
RodB5_64	157	1.626	0.432	631.5	15497.5	537.1	1.20	552.8	11137	196.84	11.67	5.93%	55.70
RodB5_73.9	158	1.877	0.077	664.8	16812.7	568.3	1.20	584.4	10430	208.97	11.16	5.34%	54.75
RodB5_75.9	159	1.928	0.128	677.2	17078.8	574.8	1.20	591.9	10275	200.14	10.43	5.21%	51.51
RodB5_76.9	160	1.953	0.153	682.6	17209.0	578.1	1.20	595.5	10201	197.52	10.17	5.15%	50.40
RodF5_41	105	1.041	0.343	557.3	12362.0	475.3	1.20	489.0	12894	181.03	14.66	8.10%	60.20
RodF5_53.1	106	1.349	0.155	594.6	13969.6	505.5	1.20	520.3	11970	188.03	12.82	6.82%	57.72
RodF5_55	107	1.397	0.203	601.4	14222.5	510.7	1.20	525.8	11821	188.29	12.51	6.65%	57.00
RodF5_57.8	108	1.468	0.274	609.0	14594.4	518.7	1.20	533.7	11612	193.78	12.44	6.42%	57.51
RodF5_64	109	1.626	0.432	625.2	15418.3	537.1	1.20	551.8	11163	209.92	12.56	5.99%	59.55
RodF5_73.8	110	1.875	0.074	654.1	16720.4	568.0	1.20	582.3	10473	232.78	12.64	5.43%	61.29
RodF5_75.8	111	1.925	0.125	667.5	16985.8	574.5	1.20	590.0	10313	218.96	11.56	5.28%	56.61
RodF5_76.8	112	1.951	0.150	671.9	17118.3	577.7	1.20	593.4	10243	218.05	11.39	5.22%	55.91
RodC2_41	57	1.041	0.343	555.0	12419.3	475.3	1.20	488.6	12907	187.18	15.13	8.08%	62.31
RodC2_53.1	58	1.349	0.155	595.0	14027.0	505.5	1.20	520.4	11968	187.97	12.77	6.80%	57.69
RodC2_55	59	1.397	0.203	600.1	14279.5	510.7	1.20	525.6	11827	191.77	12.73	6.64%	58.09
RodC2_57.8	60	1.468	0.274	606.6	14651.8	518.7	1.20	533.3	11623	199.97	12.84	6.42%	59.40
RodC2_63.9	61	1.623	0.429	620.6	15461.9	536.8	1.20	550.7	11187	221.34	13.30	6.01%	62.95
RodC2_73.8	62	1.875	0.074	652.0	16776.3	568.0	1.20	582.0	10480	239.40	13.02	5.44%	63.09
RodC2_75.8	63	1.925	0.125	662.8	17041.3	574.5	1.20	589.2	10330	231.50	12.28	5.30%	59.96
RodC2_76.8	64	1.951	0.150	667.5	17175.8	577.7	1.20	592.7	10258	229.59	12.04	5.24%	58.97
RodC6_40.9	137	1.039	0.340	558.0	12360.3	475.1	1.20	488.9	12897	178.96	14.49	8.10%	59.53
RodC6_52.8	138	1.341	0.147	597.9	14010.0	504.7	1.20	520.2	11973	180.25	12.25	6.80%	55.35
RodC6_54.8	139	1.392	0.198	605.2	14286.4	510.2	1.20	526.0	11816	180.39	11.93	6.61%	54.59
RodC6_57.8	140	1.468	0.274	614.9	14702.0	518.7	1.20	534.7	11587	183.38	11.66	6.36%	54.29
RodC6_63.8	141	1.621	0.427	632.4	15533.5	536.5	1.20	552.4	11146	194.36	11.51	5.92%	55.05
RodC6_73.7	142	1.872	0.072	664.7	16903.6	567.6	1.20	583.8	10442	209.06	11.14	5.33%	54.85
RodC6_75.8	143	1.925	0.125	672.9	17195.9	574.5	1.20	590.9	10295	209.57	10.93	5.21%	54.06
RodC6_76.8	144	1.951	0.150	680.0	17334.8	577.7	1.20	594.8	10216	203.48	10.47	5.15%	52.01

Table SC-3242-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	688.6	18598.1	616.3	1.20	628.3	9581	308.67	15.32	4.96%	72.99
RodB4_91.3	162	2.319	0.071	726.5	18971.6	626.0	1.20	642.7	9332	226.58	10.42	4.60%	51.87
RodB4_93.3	163	2.370	0.122	741.2	19228.0	632.7	1.20	650.8	9199	212.60	9.55	4.49%	47.81
RodB4_95.1	164	2.416	0.168	751.1	19460.3	638.7	1.20	657.4	9092	207.79	9.18	4.42%	46.05
RodB4_100	165	2.540	0.292	769.5	20089.2	654.9	1.20	674.0	8836	210.43	8.99	4.27%	45.00
RodB4_106	166	2.692	0.445	785.8	20860.8	674.4	1.20	692.9	8560	224.61	9.30	4.14%	46.15
RodB4_109.9	167	2.791	0.544	764.1	20195.0	686.7	1.20	699.6	8467	313.17	13.72	4.38%	63.46
RodB4_142.3	168	3.614	0.224	811.8	7848.2	771.5	1.20	778.2	7514	233.86	13.10	5.60%	40.62
RodF4_85.6	98	2.174	0.374	686.3	18352.4	606.9	1.20	620.1	9728	277.58	13.77	4.96%	66.87
RodF4_88.4	99	2.245	-0.003	690.8	18721.7	616.3	1.20	628.7	9574	301.70	14.84	4.92%	71.28
RodF4_92.4	100	2.347	0.099	732.3	19246.0	629.7	1.20	646.8	9265	224.98	10.22	4.54%	51.04
RodF4_94.3	101	2.395	0.147	745.0	19495.9	636.0	1.20	654.2	9144	214.70	9.55	4.45%	47.92
RodF4_97.2	102	2.469	0.221	759.0	19875.3	645.7	1.20	664.5	8980	210.39	9.14	4.34%	45.91
RodF4_108.8	103	2.764	0.516	790.7	20990.4	683.3	1.20	701.2	8446	234.39	9.63	4.11%	47.34
RodF4_111	104	2.819	-0.044	761.5	20134.5	690.1	1.20	702.0	8434	338.54	15.10	4.46%	68.26
RodD2_103.2	65	2.621	0.373	766.0	20763.9	665.3	1.20	682.1	8715	247.53	10.52	4.25%	52.02
RodD2_106	66	2.692	0.445	773.4	21138.1	674.4	1.20	690.9	8589	256.05	10.75	4.20%	52.84
RodD2_112.6	67	2.860	-0.004	760.4	19394.8	695.1	1.20	706.0	8381	356.23	16.31	4.58%	71.25
RodD2_114.9	68	2.918	0.055	781.0	18495.1	702.1	1.20	715.2	8258	281.24	12.24	4.35%	55.20
RodD2_117.4	69	2.982	0.118	791.8	17516.8	709.5	1.20	723.2	8155	255.29	11.01	4.31%	49.31
RodD2_120.8	70	3.068	0.204	800.7	16187.3	719.3	1.20	732.9	8034	238.69	10.32	4.32%	45.22
RodD2_124.8	71	3.170	0.306	800.8	14624.2	730.4	1.20	742.2	7922	249.54	11.18	4.48%	46.43
RodD2_128.6	72	3.266	0.403	798.8	13137.1	740.5	1.20	750.2	7827	270.27	12.85	4.75%	49.51
RodD6_103.1	129	2.619	0.371	770.3	20802.0	665.0	1.20	682.6	8709	237.17	10.01	4.22%	49.80
RodD6_106	130	2.692	0.445	778.1	21182.6	674.4	1.20	691.7	8578	244.93	10.20	4.17%	50.46
RodD6_112.9	131	2.868	0.004	769.1	19327.4	696.0	1.20	708.2	8351	317.34	14.07	4.43%	63.19
RodD6_114.9	132	2.918	0.055	788.0	18540.3	702.1	1.20	716.4	8243	258.82	11.05	4.27%	50.68
RodD6_116.8	133	2.967	0.103	799.0	17789.1	707.7	1.20	722.9	8159	233.96	9.88	4.22%	45.21
RodD6_120.9	134	3.071	0.207	805.0	16166.1	719.6	1.20	733.9	8022	227.12	9.71	4.28%	42.95
RodD6_124.8	135	3.170	0.306	805.4	14624.9	730.4	1.20	742.9	7912	234.11	10.32	4.41%	43.49
RodD6_128.7	136	3.269	0.405	804.9	13084.3	740.7	1.20	751.4	7813	244.73	11.27	4.60%	44.72

Table SC-3242-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	581.2	13727.3	497.5	1.20	511.4	12220	196.72	13.90	7.06%	61.77
RodE2_54	74	1.372	0.178	599.8	14251.4	508.0	1.20	523.3	11890	186.27	12.43	6.67%	56.76
RodE2_56.9	75	1.445	0.251	610.8	14640.3	516.1	1.20	531.9	11661	185.49	11.91	6.42%	55.31
RodE2_59.9	76	1.521	0.328	616.0	15043.8	524.8	1.20	540.0	11453	197.95	12.30	6.21%	57.83
RodE2_66	77	1.676	0.483	631.3	15861.9	543.2	1.20	557.9	11017	216.03	12.57	5.82%	60.36
RodE2_69.8	78	1.773	-0.027	612.4	16372.1	555.1	1.20	564.7	10861	343.17	20.57	5.99%	94.31
RodE2_72.9	79	1.852	0.051	648.0	16788.6	565.0	1.20	578.9	10547	242.83	13.26	5.46%	64.47
RodE2_74.9	80	1.902	0.102	661.4	17057.3	571.5	1.20	586.5	10385	227.77	12.11	5.32%	59.37
RodB3_50.2	169	1.275	0.081	577.4	13649.1	497.7	1.20	511.0	12232	205.55	14.63	7.12%	64.61
RodB3_54.1	170	1.374	0.180	592.2	14167.5	508.2	1.20	522.2	11918	202.39	13.64	6.74%	61.83
RodB3_56.9	171	1.445	0.251	601.2	14539.0	516.1	1.20	530.3	11703	204.88	13.33	6.50%	61.33
RodB3_60.1	172	1.527	0.333	607.1	14964.7	525.4	1.20	539.0	11478	219.74	13.81	6.29%	64.36
RodB3_66.1	173	1.679	0.485	623.8	15761.3	543.5	1.20	556.9	11041	235.71	13.89	5.89%	66.03
RodB3_69.9	174	1.775	-0.025	608.3	16266.0	555.4	1.20	564.2	10870	369.50	22.63	6.12%	101.65
RodB3_73	175	1.854	0.054	645.9	16678.1	565.4	1.20	578.8	10548	248.40	13.65	5.50%	65.96
RodB3_75	176	1.905	0.105	661.2	16943.6	571.8	1.20	586.7	10380	227.61	12.14	5.33%	59.30
RodF3_50.1	89	1.273	0.079	584.7	13650.5	497.5	1.20	512.0	12203	187.80	13.28	7.07%	58.89
RodF3_54	90	1.372	0.178	601.2	14180.1	508.0	1.20	523.5	11884	182.44	12.20	6.69%	55.56
RodF3_57	91	1.448	0.254	609.8	14587.1	516.4	1.20	531.9	11659	187.45	12.07	6.44%	55.88
RodF3_60	92	1.524	0.330	616.6	14994.7	525.1	1.20	540.3	11444	196.50	12.22	6.22%	57.35
RodF3_66.1	93	1.679	0.485	626.7	15821.6	543.5	1.20	557.4	11029	228.26	13.37	5.86%	63.86
RodF3_70	94	1.778	-0.022	615.8	16351.3	555.8	1.20	565.8	10836	326.93	19.38	5.93%	89.60
RodF3_73	95	1.854	0.054	653.5	16757.3	565.4	1.20	580.0	10521	228.23	12.40	5.43%	60.42
RodF3_75	96	1.905	0.105	671.7	17028.9	571.8	1.20	588.5	10344	204.70	10.76	5.26%	53.11
RodE6_50.2	121	1.275	0.081	581.1	13642.9	497.7	1.20	511.6	12214	196.26	13.92	7.09%	61.60
RodE6_54.1	122	1.374	0.180	598.4	14155.8	508.2	1.20	523.3	11890	188.41	12.64	6.71%	57.41
RodE6_57	123	1.448	0.254	606.7	14536.6	516.4	1.20	531.4	11673	193.21	12.50	6.47%	57.67
RodE6_60.2	124	1.529	0.335	613.2	14957.1	525.7	1.20	540.3	11446	205.02	12.80	6.24%	59.85
RodE6_66.1	125	1.679	0.485	631.2	15732.7	543.5	1.20	558.1	11012	215.36	12.59	5.84%	60.14
RodE6_70	126	1.778	-0.022	613.8	16245.2	555.8	1.20	565.4	10843	335.66	20.10	5.99%	92.07
RodE6_73.1	127	1.857	0.056	650.3	16654.0	565.7	1.20	579.8	10527	236.21	12.93	5.47%	62.57
RodE6_75	128	1.905	0.105	664.7	16905.2	571.8	1.20	587.3	10368	218.41	11.61	5.32%	56.82

RBHT Steam Cooling Test SC-3242-C

Matrix test # 8

Test date – 8/5/2005

Steady state time window: 16100 - 16400 sec

Inlet flow: 4.81 m³/min (169.8 ft³/min)

Inlet steam temperature: 418 K (294 °F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 95.1 kW

Outlet steam temperature: 620 K (657 °F)

Bundle inlet Reynolds number: 18216

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution. Experiment SC-3242 was run with the traversing probes withdrawn. Centerline steam temperatures used are from experiment SC-3214-B.

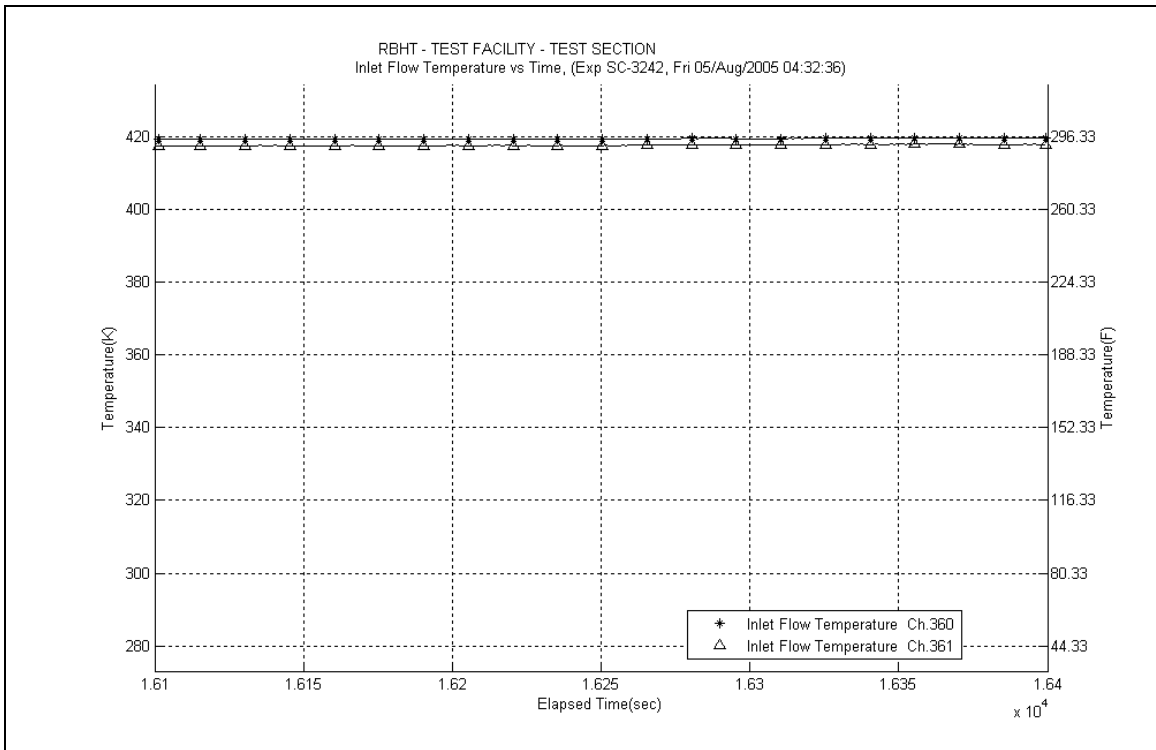
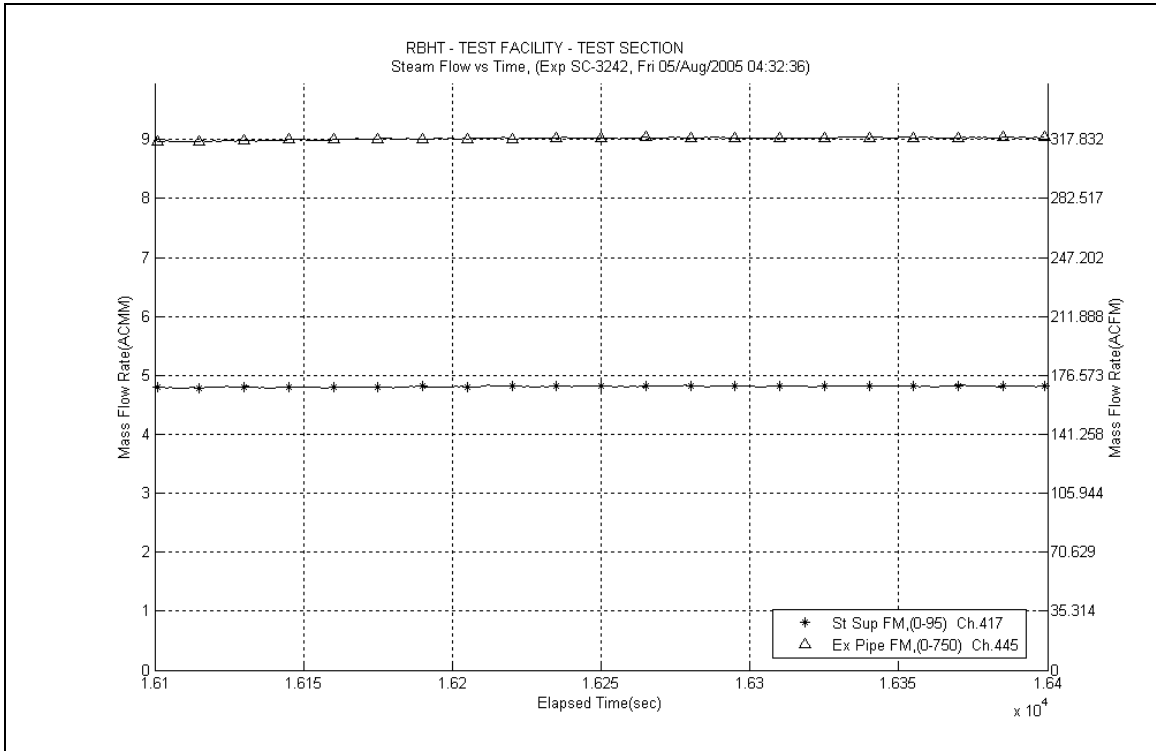
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

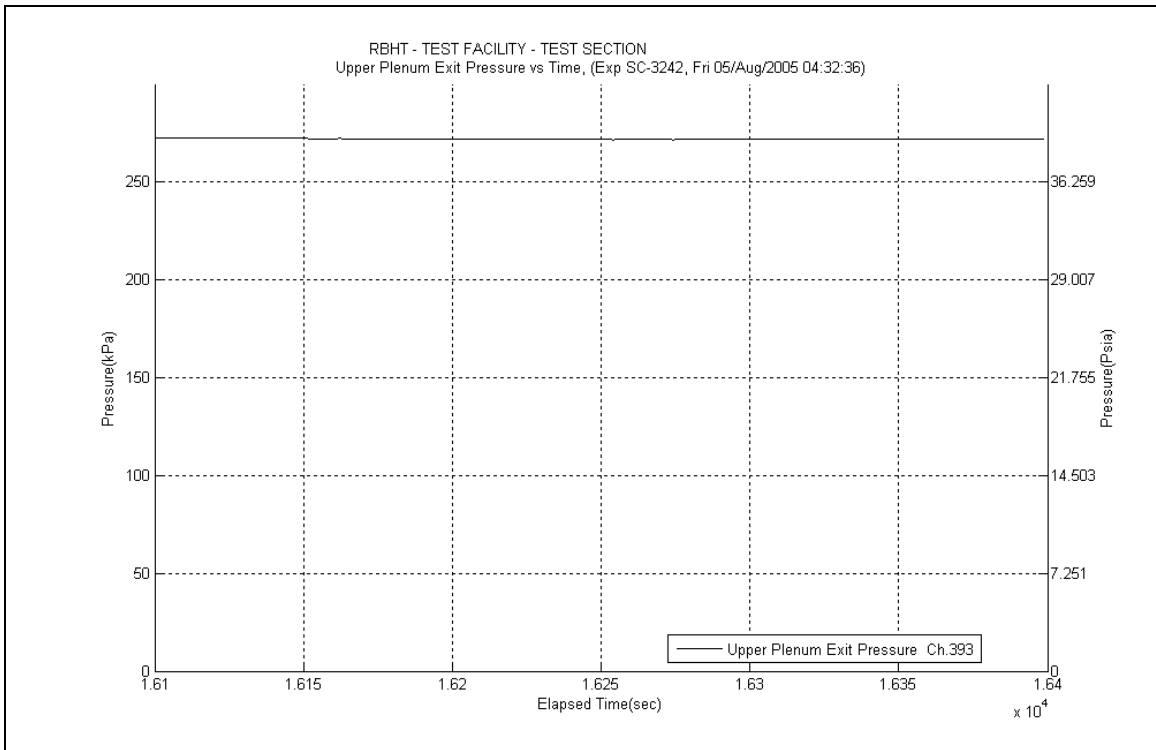
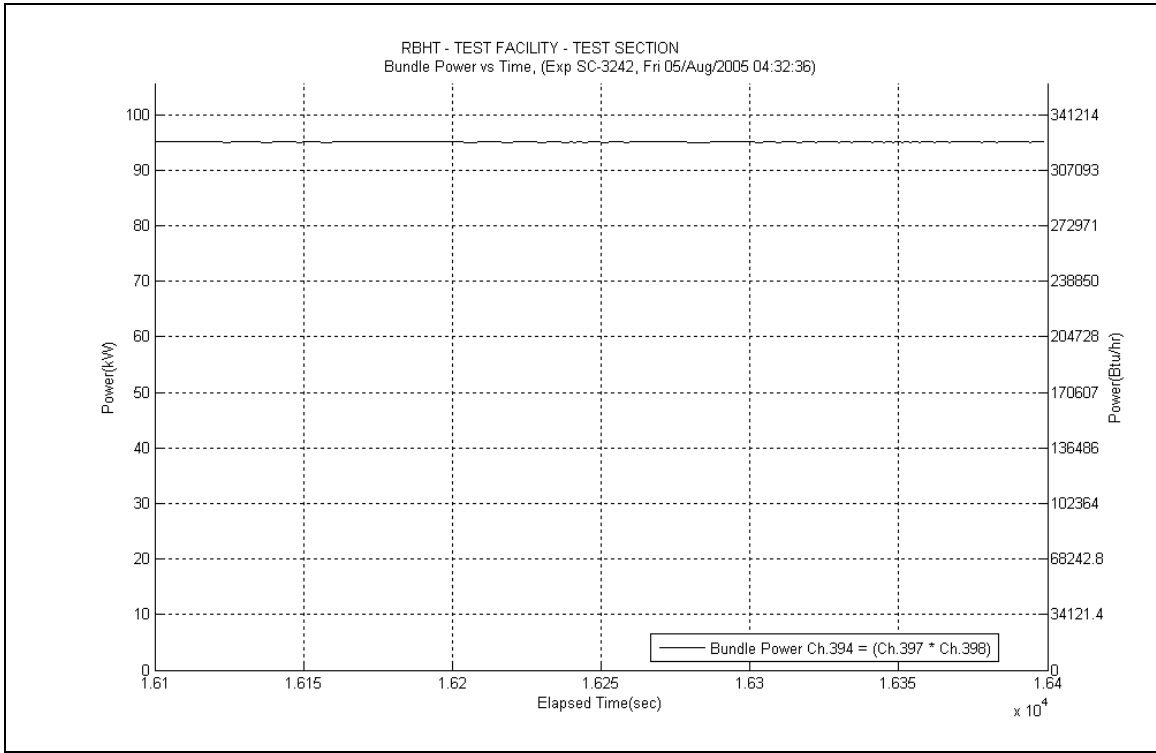
$$T_{cl} = -13.119x^3 + 83.696x^2 - 39.122x + 442.54$$

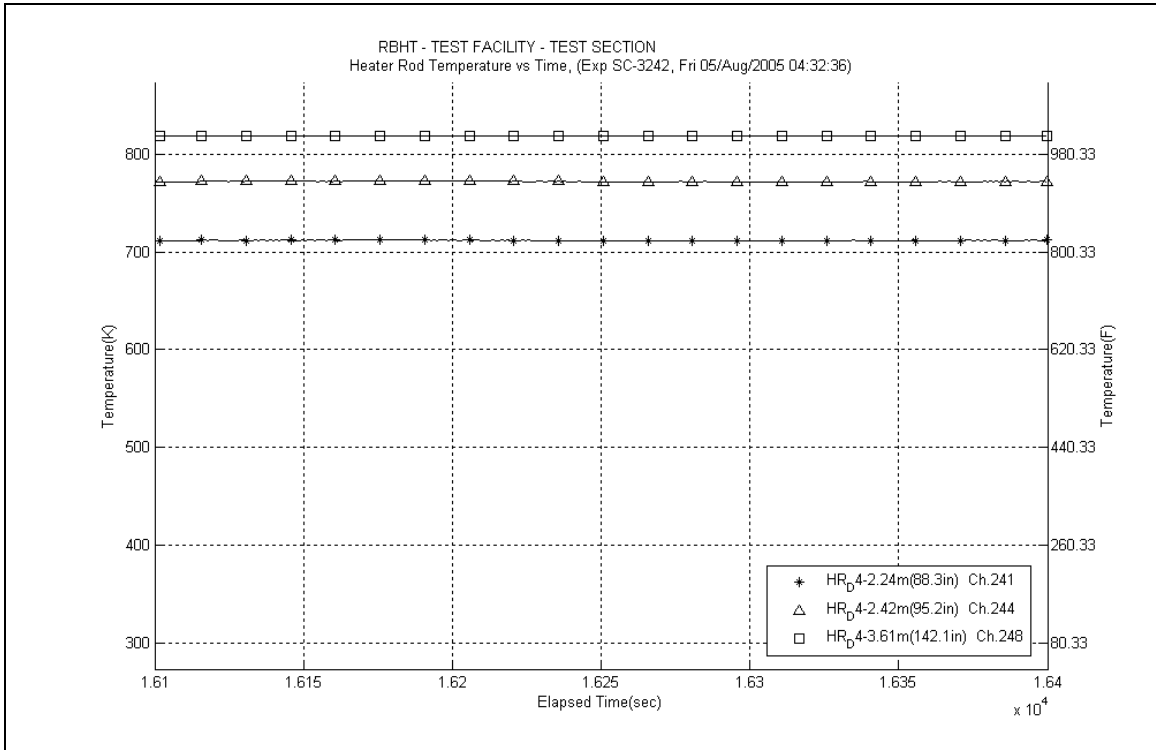
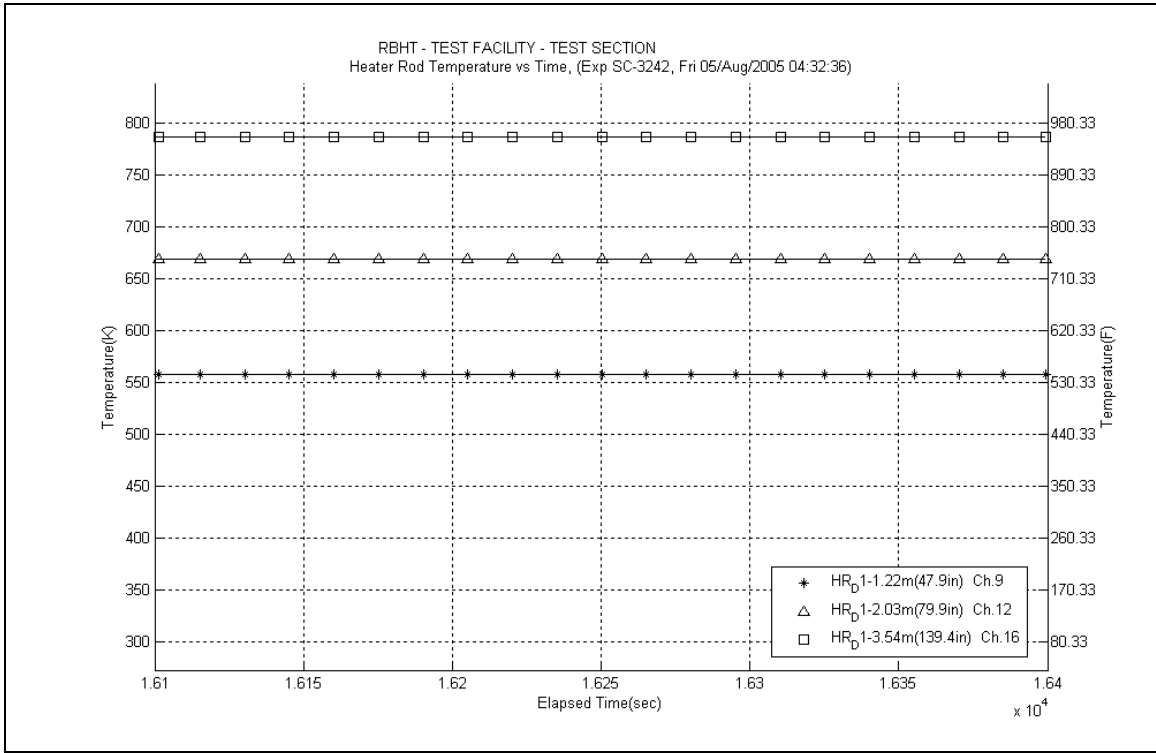
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

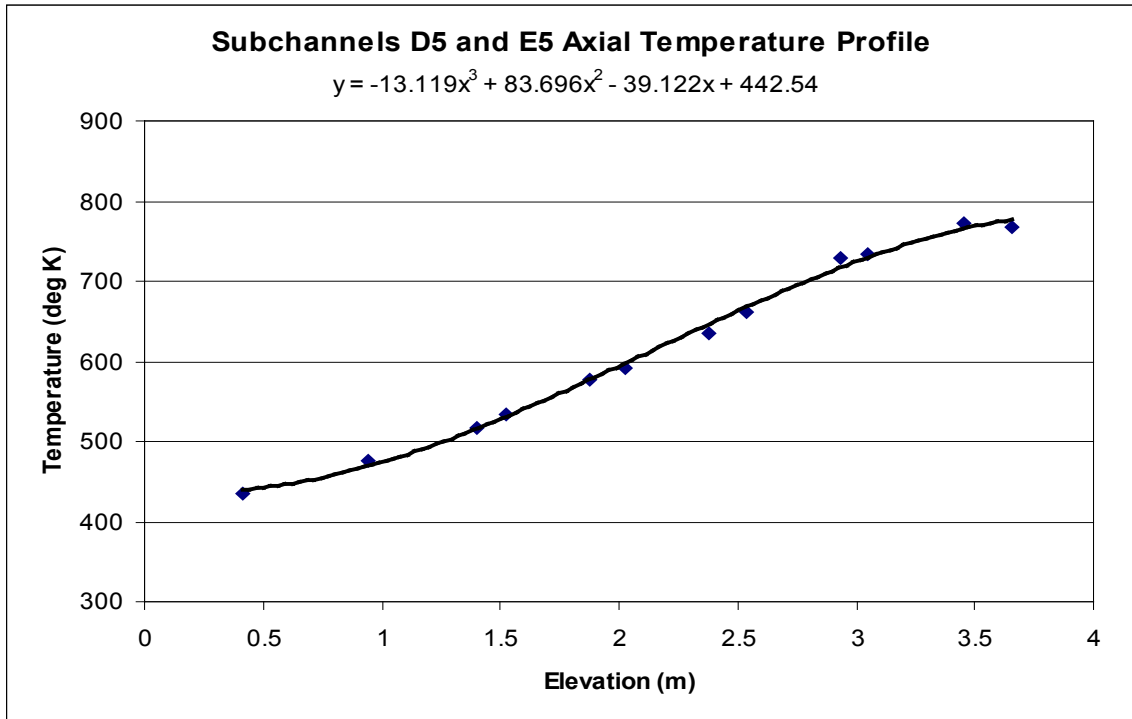
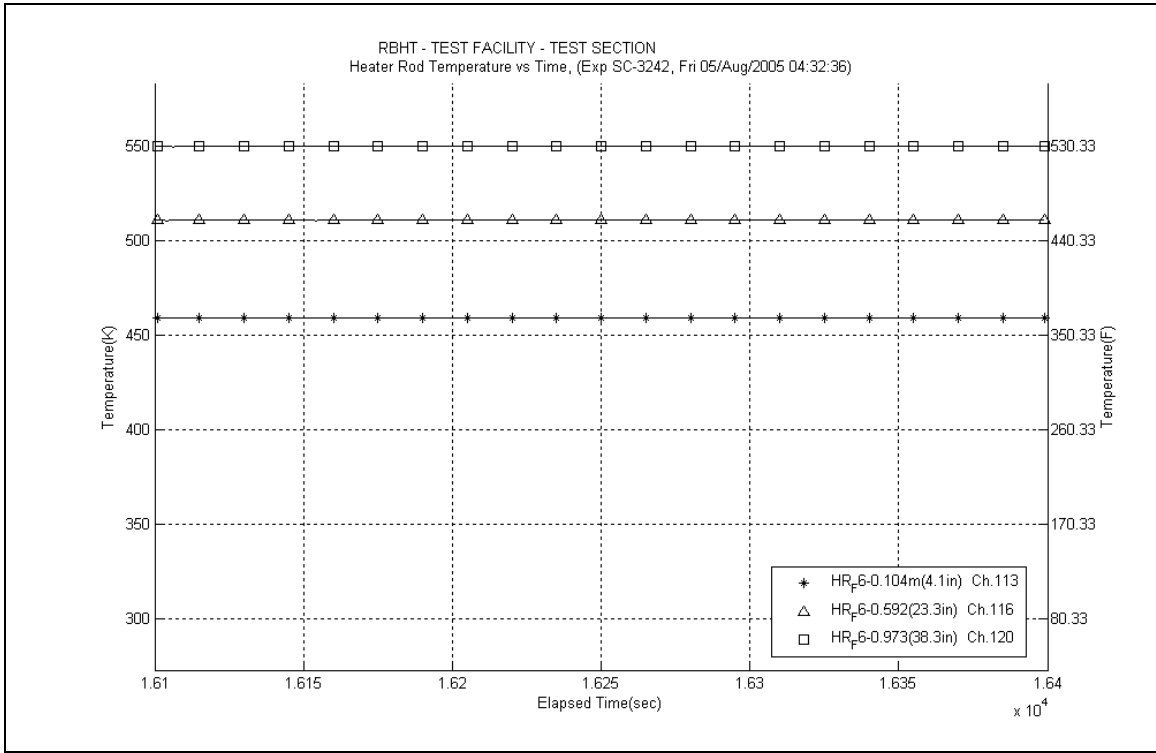
$$T_{cl} = -8.1355x^3 + 57.708x^2 - 7.379x + 431.3$$

where x is the elevation (m) and T_{cl} is in (K)









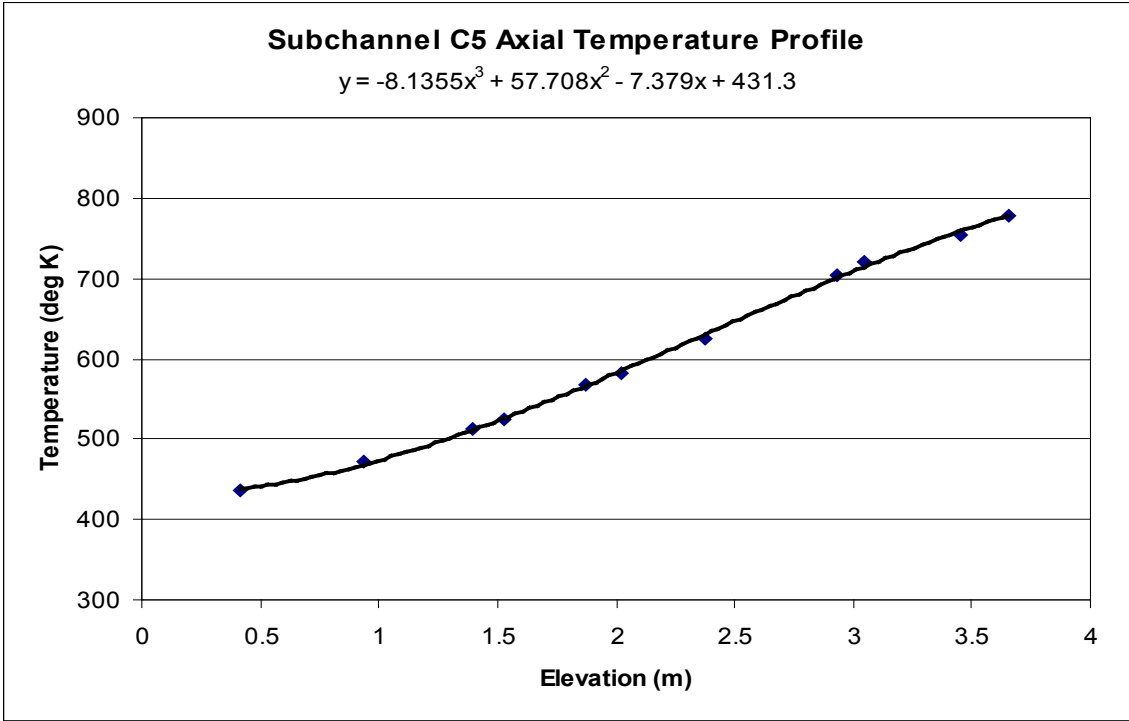


Table SC-3242-C.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	698.7	25438.6	627.8	1.20	639.6	12682	430.41	19.54	5.19%	99.22
RodD3_91.3	186	2.319	0.071	741.3	25978.2	638.3	1.20	655.5	12328	302.72	12.03	4.67%	67.38
RodD3_93.1	187	2.365	0.117	759.5	26300.3	644.6	1.20	663.7	12151	274.52	10.61	4.53%	60.01
RodD3_95.3	188	2.421	0.173	775.3	26697.5	652.2	1.20	672.7	11966	260.23	9.74	4.42%	55.80
RodD3_100.1	189	2.543	0.295	794.8	27562.3	668.5	1.20	689.6	11632	261.84	9.22	4.26%	54.18
RodD3_106.1	190	2.695	0.447	811.2	28645.2	688.2	1.20	708.7	11275	279.52	9.62	4.14%	55.60
RodD3_110	191	2.794	0.546	793.9	28288.5	700.5	1.20	716.0	11145	363.43	13.96	4.35%	71.22
RodD3_142.1	192	3.609	0.218	812.1	9865.5	774.8	1.20	781.0	10114	317.22	22.57	7.14%	54.81
RodC4_88.4	233	2.245	-0.003	703.2	25729.4	628.2	1.20	640.7	12658	411.18	18.11	5.08%	94.57
RodC4_91.1	234	2.314	0.066	742.6	26225.3	637.6	1.20	655.1	12336	299.87	11.88	4.64%	66.80
RodC4_93.4	235	2.372	0.124	760.2	26647.8	645.6	1.20	664.7	12131	279.15	10.62	4.50%	60.90
RodC4_95.3	236	2.421	0.173	772.7	26998.4	652.2	1.20	672.3	11975	268.89	9.89	4.41%	57.71
RodC4_100.1	237	2.543	0.295	789.9	27880.7	668.5	1.20	688.7	11647	275.50	9.66	4.27%	57.10
RodC4_106.1	238	2.695	0.447	805.1	28985.9	688.2	1.20	707.7	11294	297.43	10.33	4.16%	59.28
RodC4_110	239	2.794	0.546	784.6	28052.0	700.5	1.20	714.5	11172	400.27	15.89	4.48%	78.68
RodC4_142.2	240	3.612	0.221	821.0	10698.2	775.0	1.20	782.6	10091	278.57	15.17	5.89%	47.99
RodD4_88.3	241	2.243	-0.005	710.4	25637.0	627.8	1.20	641.6	12637	372.23	16.24	4.98%	85.44
RodD4_91.3	242	2.319	0.071	745.2	26181.5	638.3	1.20	656.1	12314	294.02	11.53	4.62%	65.35
RodD4_93.2	243	2.367	0.119	760.1	26527.8	644.9	1.20	664.1	12143	276.49	10.54	4.51%	60.39
RodD4_95.2	244	2.418	0.170	770.6	26892.4	651.8	1.20	671.6	11987	271.70	10.10	4.43%	58.40
RodD4_142.1	248	3.609	0.218	818.4	10339.6	774.8	1.20	782.1	10099	284.70	16.95	6.23%	49.10
RodE4_88.4	201	2.245	-0.003	704.8	25249.2	628.2	1.20	640.9	12652	395.18	17.54	5.09%	90.83
RodE4_91.2	202	2.316	0.069	742.0	25736.1	638.0	1.20	655.3	12331	296.78	11.82	4.67%	66.08
RodE4_95.3	204	2.421	0.173	768.6	26450.8	652.2	1.20	671.6	11988	272.54	10.08	4.46%	58.58
RodE4_100.9	205	2.563	0.315	785.6	27427.8	671.2	1.20	690.2	11619	287.73	9.92	4.29%	59.45
RodE4_142.3	208	3.614	0.224	815.0	10446.1	775.1	1.20	781.7	10104	314.31	20.29	6.65%	54.24
RodE3_63.4	193	1.610	0.417	639.7	20909.0	541.8	1.20	558.1	14880	256.23	12.38	5.99%	71.56
RodE3_113.6	194	2.885	0.022	798.6	25770.6	711.3	1.20	725.9	10974	354.23	13.94	4.44%	68.06
RodE3_115.5	195	2.934	0.070	814.5	24813.4	716.9	1.20	733.1	10852	305.09	11.55	4.31%	57.78
RodE3_118.5	196	3.010	0.146	825.1	23301.3	725.3	1.20	741.9	10708	280.26	10.36	4.28%	52.17
RodE3_122.7	197	3.117	0.253	822.8	21181.9	736.4	1.20	750.8	10567	294.44	10.94	4.39%	53.87
RodE3_126.5	198	3.213	0.349	820.2	19267.5	745.7	1.20	758.1	10453	310.61	12.25	4.60%	56.03
RodE3_131.7	199	3.345	-0.046	795.0	16649.1	757.2	1.20	763.5	10372	528.54	37.01	7.03%	94.39
RodE3_135.6	200	3.444	0.053	810.3	14680.9	764.6	1.20	772.3	10241	385.99	22.84	6.09%	67.80

Table SC-3242-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{h,c} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	639.2	20504.8	542.8	1.20	558.8	14857	255.22	12.38	6.06%	71.15
RodC5_113.6	226	2.885	0.022	801.0	25135.0	711.3	1.20	726.3	10968	336.45	13.36	4.44%	64.59
RodC5_115.7	227	2.939	0.075	820.3	24129.1	717.4	1.20	734.6	10829	281.61	10.45	4.28%	53.18
RodC5_122.7	229	3.117	0.253	828.5	20774.7	736.4	1.20	751.8	10552	270.63	9.95	4.34%	49.42
RodC5_126.7	230	3.218	0.354	829.1	18859.6	746.2	1.20	760.0	10424	272.87	10.61	4.48%	49.05
RodC5_131.6	231	3.343	-0.048	805.2	16513.8	757.0	1.20	765.0	10349	411.01	23.17	5.87%	73.19
RodC5_135.7	232	3.447	0.056	822.1	14550.4	764.8	1.20	774.4	10210	305.00	15.34	5.30%	53.36
RodE5_63.6	209	1.615	0.422	635.0	21015.9	542.5	1.20	557.9	14888	272.57	13.02	6.00%	76.17
RodE5_113.6	210	2.885	0.022	798.5	25934.6	711.3	1.20	725.9	10975	356.81	14.02	4.44%	68.55
RodE5_115.4	211	2.931	0.067	807.8	25040.3	716.6	1.20	731.8	10875	329.31	12.65	4.38%	62.53
RodE5_118.7	212	3.015	0.151	815.0	23402.3	725.8	1.20	740.7	10728	315.01	12.38	4.41%	58.77
RodE5_122.6	213	3.114	0.250	816.3	21465.1	736.2	1.20	749.5	10587	321.37	12.56	4.51%	58.94
RodE5_126.6	214	3.216	0.352	813.2	19479.5	746.0	1.20	757.2	10468	347.58	14.05	4.74%	62.82
RodE5_131.6	215	3.343	-0.048	789.8	16997.8	757.0	1.20	762.4	10388	621.98	52.28	8.06%	111.29
RodE5_135.6	216	3.444	0.053	809.8	15012.5	764.6	1.20	772.2	10242	399.10	24.63	6.21%	70.11
RodC3_79.8	177	2.027	0.227	693.6	23784.1	597.9	1.20	613.8	13304	298.12	11.83	5.10%	72.88
RodC3_85.6	178	2.174	0.374	686.6	24822.1	618.3	1.20	629.7	12914	435.81	19.75	5.31%	102.74
RodC3_88.5	179	2.248	0.000	695.4	25336.5	628.5	1.20	639.7	12681	454.21	21.14	5.29%	104.70
RodC3_92.4	180	2.347	0.099	740.7	26032.3	642.1	1.20	658.6	12261	317.06	12.38	4.66%	70.10
RodC3_94.4	181	2.398	0.150	753.0	26386.5	649.1	1.20	666.4	12096	304.80	11.49	4.55%	66.25
RodC3_97.2	182	2.469	0.221	768.1	26885.2	658.7	1.20	676.9	11880	294.86	10.60	4.42%	62.66
RodC3_108.8	183	2.764	0.516	798.6	28345.1	696.7	1.20	713.7	11186	333.88	12.13	4.25%	65.73
RodD5_50	217	1.270	0.076	594.7	18564.8	501.0	1.20	516.6	16315	237.60	13.59	7.07%	73.63
RodD5_54.1	218	1.374	0.180	615.4	19295.6	512.8	1.20	529.9	15827	225.54	11.90	6.66%	67.58
RodD5_56.9	219	1.445	0.251	622.4	19794.9	521.2	1.20	538.1	15541	234.72	11.75	6.43%	68.90
RodD5_60	220	1.524	0.330	629.8	20348.0	530.9	1.20	547.4	15228	246.80	12.12	6.21%	70.78
RodD5_66.1	221	1.679	0.485	649.6	21436.4	550.7	1.20	567.2	14599	260.08	12.34	5.82%	71.04
RodD5_69.9	222	1.775	-0.025	627.9	22114.4	563.5	1.20	574.2	14387	411.75	20.86	6.02%	110.55
RodD5_72.9	223	1.852	0.051	667.8	22647.9	573.8	1.20	589.4	13951	289.15	13.19	5.48%	74.85
RodD5_74.9	224	1.902	0.102	684.3	23004.0	580.7	1.20	598.0	13718	266.53	11.55	5.31%	67.61

Table SC-3242-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	566.6	16879.1	477.0	1.20	492.0	17299	225.98	13.98	8.03%	74.58
RodB5_52.9	154	1.344	0.150	604.9	19023.9	505.8	1.20	522.3	16100	230.47	11.98	6.78%	70.39
RodB5_55	155	1.397	0.203	611.1	19402.4	511.4	1.20	528.0	15894	233.72	11.71	6.59%	70.36
RodB5_57.8	156	1.468	0.274	617.4	19907.8	519.1	1.20	535.5	15630	243.08	11.71	6.37%	71.82
RodB5_64	157	1.626	0.432	637.2	21025.5	536.9	1.20	553.6	15025	251.47	11.71	5.93%	71.02
RodB5_73.9	158	1.877	0.077	673.2	22809.5	567.0	1.20	584.7	14085	257.61	11.20	5.34%	67.45
RodB5_75.9	159	1.928	0.128	684.5	23170.3	573.3	1.20	591.8	13885	249.91	10.46	5.21%	64.33
RodB5_76.9	160	1.953	0.153	689.3	23350.3	576.4	1.20	595.2	13791	248.27	10.20	5.15%	63.39
RodF5_41	105	1.041	0.343	562.8	16769.7	477.0	1.20	491.3	17326	234.72	14.69	8.10%	77.60
RodF5_53.1	106	1.349	0.155	599.9	18950.9	506.4	1.20	522.0	16115	243.01	12.85	6.82%	74.29
RodF5_55	107	1.397	0.203	606.4	19293.6	511.4	1.20	527.3	15921	243.72	12.54	6.65%	73.51
RodF5_57.8	108	1.468	0.274	614.3	19798.6	519.1	1.20	535.0	15648	249.67	12.47	6.42%	73.86
RodF5_64	109	1.626	0.432	632.3	20917.0	536.9	1.20	552.8	15051	263.13	12.60	5.99%	74.46
RodF5_73.8	110	1.875	0.074	662.5	22682.8	566.7	1.20	582.6	14143	284.16	12.68	5.43%	74.76
RodF5_75.8	111	1.925	0.125	674.7	23042.0	572.9	1.20	589.9	13938	271.79	11.59	5.28%	70.28
RodF5_76.8	112	1.951	0.150	677.9	23223.0	576.1	1.20	593.1	13851	273.91	11.42	5.22%	70.29
RodC2_41	57	1.041	0.343	560.6	16848.3	477.0	1.20	491.0	17341	241.76	15.16	8.08%	80.00
RodC2_53.1	58	1.349	0.155	601.1	19029.4	506.4	1.20	522.2	16108	241.02	12.80	6.80%	73.65
RodC2_55	59	1.397	0.203	605.5	19372.2	511.4	1.20	527.1	15927	247.26	12.75	6.64%	74.61
RodC2_57.8	60	1.468	0.274	608.7	19877.5	519.1	1.20	534.0	15681	266.17	12.87	6.42%	78.92
RodC2_63.9	61	1.623	0.429	625.9	20977.2	536.6	1.20	551.5	15094	281.73	13.33	6.01%	79.99
RodC2_73.8	62	1.875	0.074	659.7	22761.0	566.7	1.20	582.2	14156	293.48	13.06	5.44%	77.30
RodC2_75.8	63	1.925	0.125	669.8	23121.0	572.9	1.20	589.1	13961	286.51	12.31	5.30%	74.23
RodC2_76.8	64	1.951	0.150	673.3	23300.1	576.1	1.20	592.3	13872	287.79	12.07	5.25%	73.99
RodC6_40.9	137	1.039	0.340	563.2	16769.0	476.8	1.20	491.2	17331	232.92	14.53	8.10%	77.03
RodC6_52.8	138	1.341	0.147	603.4	19006.1	505.6	1.20	521.9	16118	233.19	12.28	6.80%	71.30
RodC6_54.8	139	1.392	0.198	610.5	19382.3	510.9	1.20	527.5	15913	233.62	11.96	6.61%	70.43
RodC6_57.8	140	1.468	0.274	619.6	19947.2	519.1	1.20	535.8	15618	238.31	11.70	6.36%	70.34
RodC6_63.8	141	1.621	0.427	639.1	21075.3	536.3	1.20	553.4	15030	245.99	11.54	5.92%	69.50
RodC6_73.7	142	1.872	0.072	673.7	22937.0	566.3	1.20	584.2	14097	256.46	11.18	5.33%	67.21
RodC6_75.8	143	1.925	0.125	681.7	23331.5	572.9	1.20	591.1	13906	257.53	10.96	5.22%	66.41
RodC6_76.8	144	1.951	0.150	688.3	23518.9	576.1	1.20	594.8	13803	251.53	10.50	5.15%	64.28

Table SC-3242-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{h,c} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	696.1	25235.4	613.6	1.20	627.3	12970	366.89	15.38	4.97%	86.95
RodB4_91.3	162	2.319	0.071	735.7	25739.0	623.1	1.20	641.8	12631	274.32	10.46	4.60%	62.92
RodB4_93.3	163	2.370	0.122	749.6	26088.8	629.6	1.20	649.6	12456	260.95	9.58	4.49%	58.83
RodB4_95.1	164	2.416	0.168	758.6	26402.8	635.5	1.20	656.0	12315	257.37	9.21	4.42%	57.21
RodB4_100	165	2.540	0.292	775.0	27256.5	651.6	1.20	672.1	11977	265.06	9.01	4.27%	56.91
RodB4_106	166	2.692	0.445	794.8	28302.9	671.0	1.20	691.6	11592	274.19	9.32	4.14%	56.49
RodB4_109.9	167	2.791	0.544	774.6	27400.1	683.4	1.20	698.6	11460	360.79	13.78	4.39%	73.26
RodB4_142.3	168	3.614	0.224	815.4	10627.5	774.4	1.20	781.2	10111	310.83	13.25	5.62%	53.69
RodF4_85.6	98	2.174	0.374	695.9	24894.6	604.4	1.20	619.7	13157	326.52	13.81	4.97%	78.75
RodF4_88.4	99	2.245	-0.003	700.9	25395.0	613.6	1.20	628.1	12951	348.85	14.90	4.92%	82.53
RodF4_92.4	100	2.347	0.099	743.7	26108.4	626.7	1.20	646.2	12533	267.80	10.25	4.54%	60.84
RodF4_94.3	101	2.395	0.147	755.9	26444.9	632.9	1.20	653.4	12373	258.11	9.58	4.45%	57.71
RodF4_97.2	102	2.469	0.221	769.0	26963.4	642.4	1.20	663.5	12156	255.60	9.16	4.34%	55.90
RodF4_108.8	103	2.764	0.516	803.0	28473.9	679.9	1.20	700.4	11426	277.55	9.66	4.11%	56.14
RodF4_111	104	2.819	-0.044	770.5	27316.2	686.9	1.20	700.8	11419	392.07	15.16	4.46%	79.25
RodD2_103.2	65	2.621	0.373	774.7	28178.8	661.9	1.20	680.7	11804	299.83	10.54	4.25%	63.20
RodD2_106	66	2.692	0.445	782.8	28682.3	671.0	1.20	689.6	11631	307.92	10.77	4.20%	63.71
RodD2_112.6	67	2.860	-0.004	771.3	26313.6	691.9	1.20	705.1	11340	397.82	16.38	4.58%	79.70
RodD2_114.9	68	2.918	0.055	792.6	25094.2	699.1	1.20	714.7	11169	321.81	12.28	4.35%	63.24
RodD2_117.4	69	2.982	0.118	802.8	23763.3	706.7	1.20	722.7	11028	296.67	11.04	4.31%	57.35
RodD2_120.8	70	3.068	0.204	807.2	21955.1	716.9	1.20	732.0	10871	291.80	10.35	4.32%	55.38
RodD2_124.8	71	3.170	0.306	806.9	19829.6	728.6	1.20	741.7	10712	304.12	11.24	4.49%	56.63
RodD2_128.6	72	3.266	0.403	805.6	17810.7	739.4	1.20	750.4	10573	322.86	12.92	4.76%	59.11
RodD6_103.1	129	2.619	0.371	776.5	28223.4	661.6	1.20	680.8	11803	294.73	10.04	4.22%	62.12
RodD6_106	130	2.692	0.445	785.3	28742.4	671.0	1.20	690.0	11623	301.74	10.24	4.17%	62.37
RodD6_112.9	131	2.868	0.004	779.0	26226.2	692.9	1.20	707.2	11302	365.15	14.14	4.44%	72.85
RodD6_114.9	132	2.918	0.055	799.6	25151.8	699.1	1.20	715.8	11149	300.30	11.09	4.27%	58.87
RodD6_116.8	133	2.967	0.103	808.8	24130.9	704.9	1.20	722.2	11037	278.57	9.91	4.22%	53.91
RodD6_120.9	134	3.071	0.207	810.9	21928.7	717.2	1.20	732.9	10857	280.99	9.76	4.28%	53.24
RodD6_124.8	135	3.170	0.306	811.9	19833.4	728.6	1.20	742.5	10699	286.05	10.37	4.41%	53.18
RodD6_128.7	136	3.269	0.405	811.9	17739.9	739.7	1.20	751.7	10553	294.78	11.35	4.61%	53.84

Table SC-3242-C.1: Summary of Steam Cooling Data (cont.)

H.R.	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	587.2	18623.2	498.6	1.20	513.4	16438	252.10	13.93	7.07%	78.77
RodE2_54	74	1.372	0.178	604.5	19333.7	508.8	1.20	524.7	16014	242.28	12.46	6.67%	73.56
RodE2_56.9	75	1.445	0.251	614.1	19862.0	516.6	1.20	532.9	15722	244.57	11.94	6.42%	72.74
RodE2_59.9	76	1.521	0.328	620.2	20408.9	525.0	1.20	540.9	15445	257.30	12.33	6.21%	75.00
RodE2_66	77	1.676	0.483	637.9	21520.7	542.8	1.20	558.6	14864	271.43	12.60	5.82%	75.70
RodE2_69.8	78	1.773	-0.027	618.5	22214.4	554.3	1.20	565.0	14666	415.12	20.65	6.00%	113.99
RodE2_72.9	79	1.852	0.051	657.0	22776.7	563.9	1.20	579.4	14237	293.46	13.30	5.46%	77.82
RodE2_74.9	80	1.902	0.102	671.1	23141.4	570.1	1.20	586.9	14021	275.02	12.14	5.32%	71.61
RodB3_50.2	169	1.275	0.081	583.2	18517.7	498.9	1.20	512.9	16455	263.43	14.67	7.12%	82.41
RodB3_54.1	170	1.374	0.180	597.3	19220.6	509.0	1.20	523.7	16049	261.15	13.68	6.74%	79.48
RodB3_56.9	171	1.445	0.251	605.1	19724.6	516.6	1.20	531.4	15775	267.62	13.36	6.51%	79.89
RodB3_60.1	172	1.527	0.333	612.2	20301.8	525.6	1.20	540.0	15475	281.40	13.86	6.29%	82.20
RodB3_66.1	173	1.679	0.485	630.2	21384.0	543.1	1.20	557.6	14896	294.52	13.94	5.90%	82.35
RodB3_69.9	174	1.775	-0.025	614.2	22070.3	554.6	1.20	564.5	14681	444.50	22.74	6.13%	122.20
RodB3_73	175	1.854	0.054	653.8	22627.8	564.2	1.20	579.1	14244	302.80	13.70	5.50%	80.35
RodB3_75	176	1.905	0.105	669.0	22987.7	570.4	1.20	586.9	14023	279.78	12.18	5.34%	72.87
RodF3_50.1	89	1.273	0.079	591.1	18518.8	498.6	1.20	514.0	16413	240.16	13.32	7.07%	74.92
RodF3_54	90	1.372	0.178	606.7	19237.3	508.8	1.20	525.1	16001	235.72	12.23	6.69%	71.50
RodF3_57	91	1.448	0.254	613.8	19789.6	516.9	1.20	533.0	15716	245.03	12.10	6.44%	72.84
RodF3_60	92	1.524	0.330	621.8	20342.3	525.3	1.20	541.4	15428	252.81	12.25	6.22%	73.60
RodF3_66.1	93	1.679	0.485	633.7	21465.7	543.1	1.20	558.2	14878	284.24	13.41	5.86%	79.37
RodF3_70	94	1.778	-0.022	621.9	22184.8	554.9	1.20	566.1	14633	397.19	19.47	5.93%	108.78
RodF3_73	95	1.854	0.054	662.8	22735.2	564.2	1.20	580.6	14201	276.47	12.44	5.43%	73.09
RodF3_75	96	1.905	0.105	681.7	23103.5	570.4	1.20	589.0	13964	249.07	10.79	5.26%	64.54
RodE6_50.2	121	1.275	0.081	588.1	18509.4	498.9	1.20	513.7	16424	248.94	13.95	7.10%	77.72
RodE6_54.1	122	1.374	0.180	603.3	19204.6	509.0	1.20	524.7	16013	244.33	12.67	6.71%	74.17
RodE6_57	123	1.448	0.254	609.3	19721.5	516.9	1.20	532.3	15742	256.08	12.53	6.47%	76.27
RodE6_60.2	124	1.529	0.335	616.6	20292.1	525.9	1.20	541.0	15442	268.48	12.83	6.25%	78.24
RodE6_66.1	125	1.679	0.485	637.2	21344.0	543.1	1.20	558.8	14859	272.02	12.62	5.85%	75.84
RodE6_70	126	1.778	-0.022	619.4	22041.6	554.9	1.20	565.6	14646	410.28	20.18	5.99%	112.48
RodE6_73.1	127	1.857	0.056	658.0	22592.6	564.5	1.20	580.1	14217	289.75	12.97	5.48%	76.70
RodE6_75	128	1.905	0.105	671.5	22931.7	570.4	1.20	587.3	14012	272.28	11.64	5.32%	70.85

RBHT Steam Cooling Test SC-3242-D

Matrix test # 9

Test date – 8/5/2005

Steady state time window: 18840 - 19020 sec

Inlet flow: 6.66 m³/min (235.1 ft³/min)

Inlet steam temperature: 421 K (298F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 140.0

Outlet steam temperature: 635 K (684 °F)

Bundle inlet Reynolds number: 24837

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution. Experiment SC-3242 was run with the traversing probes withdrawn. Centerline steam temperatures used are from experiment SC-3214-C.

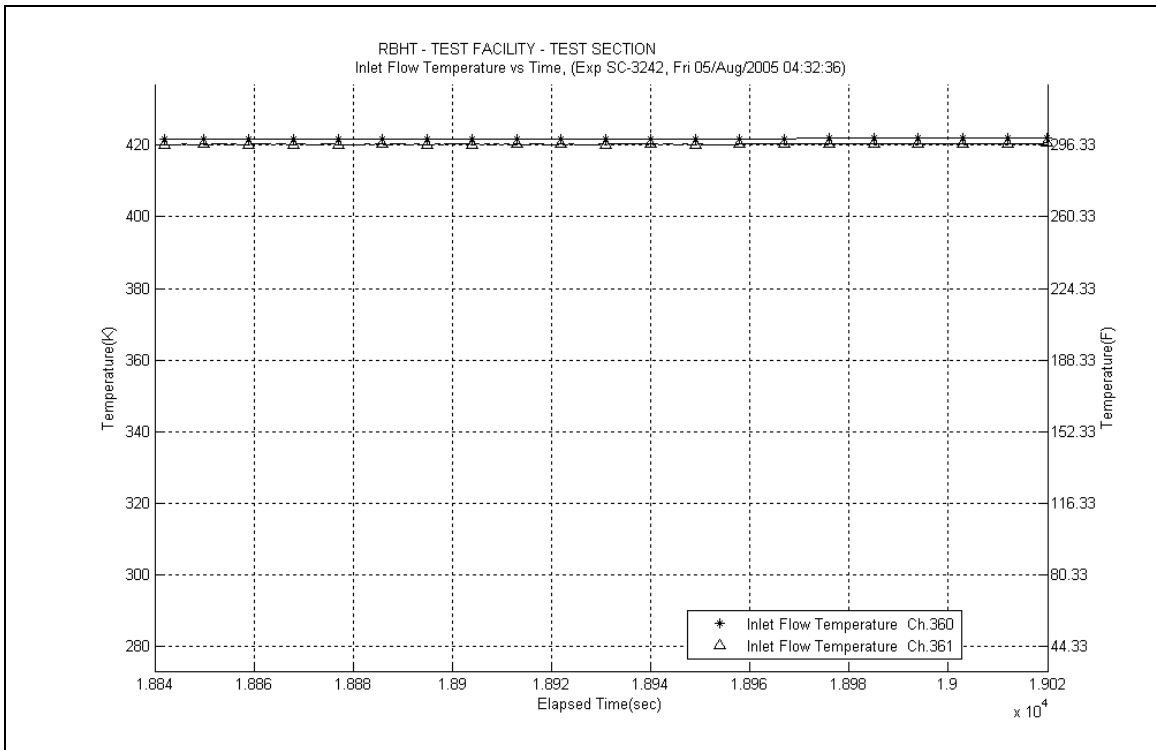
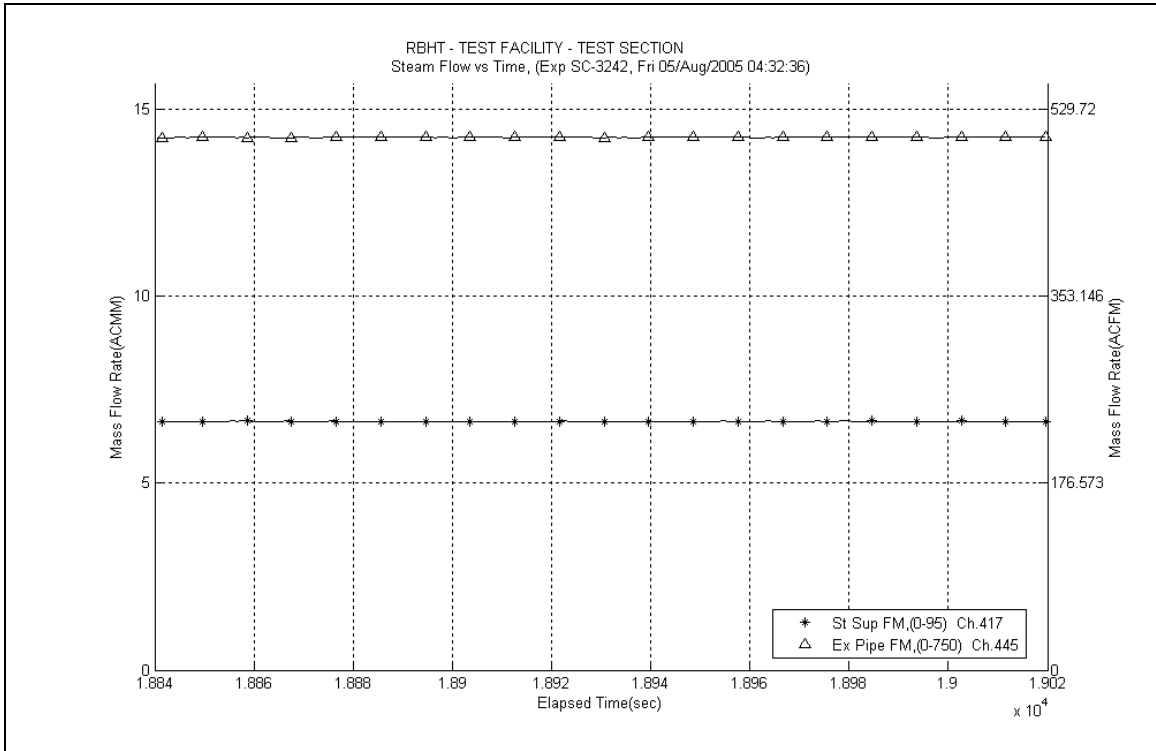
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

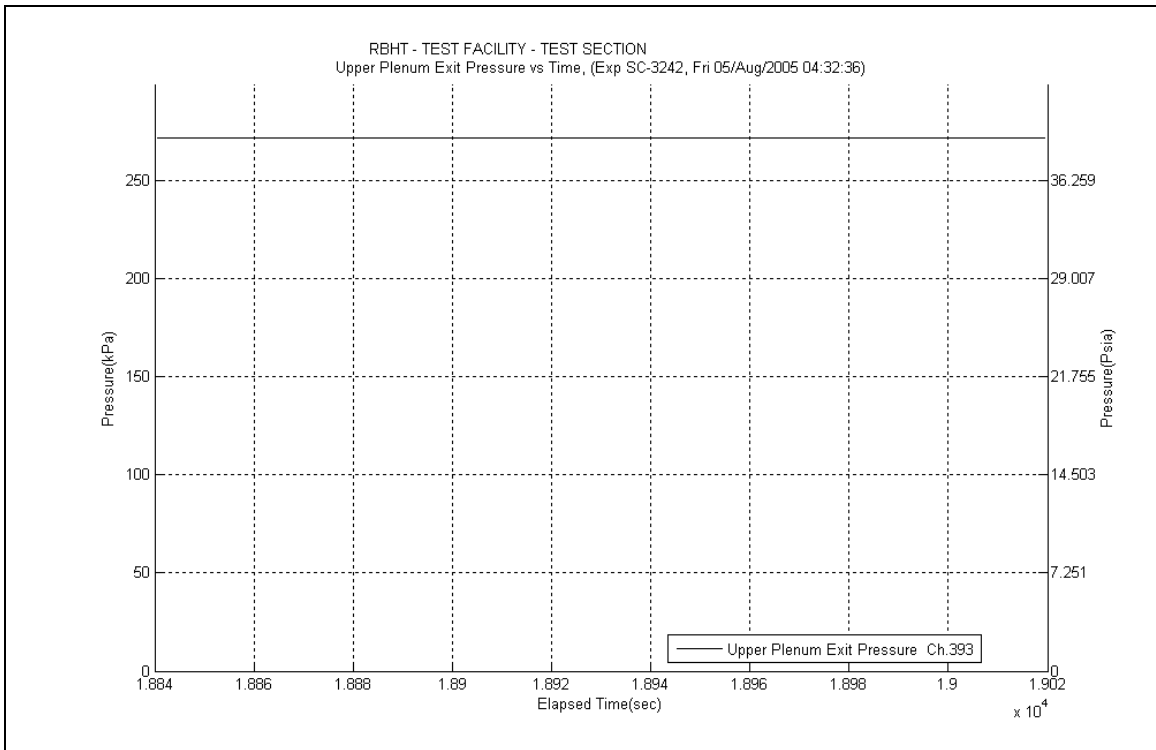
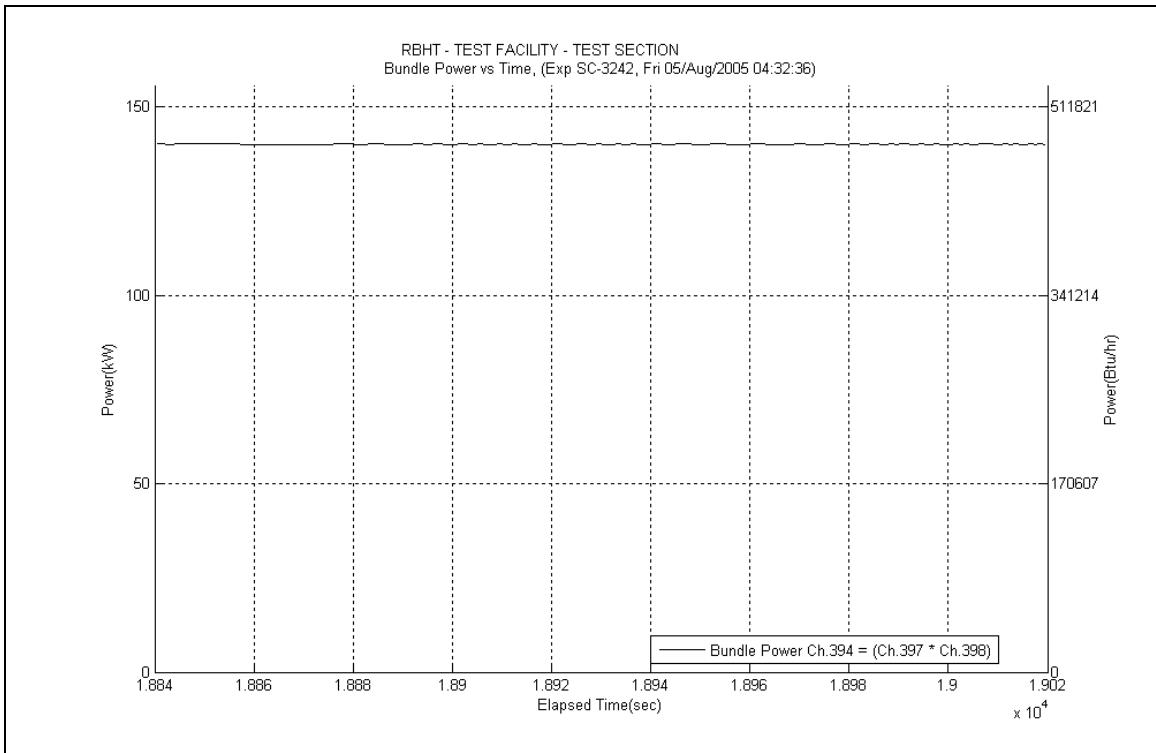
$$T_{cl} = -11.49x^3 + 75.265x^2 - 24.912x + 440.09$$

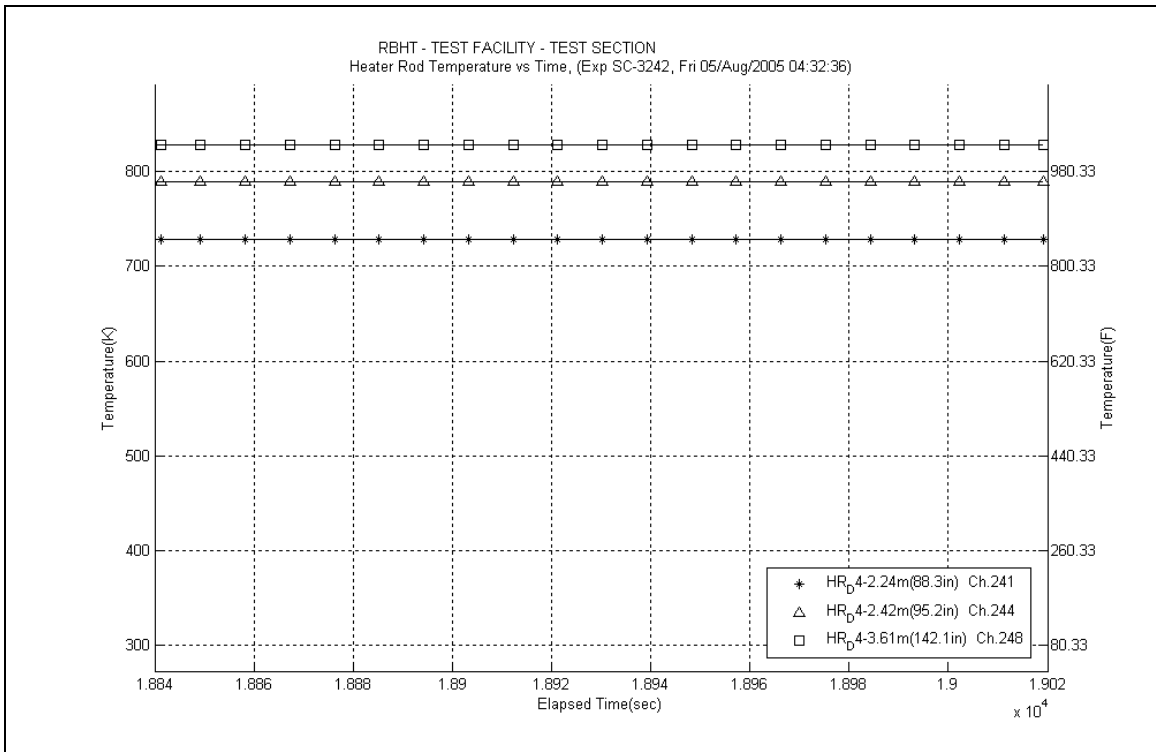
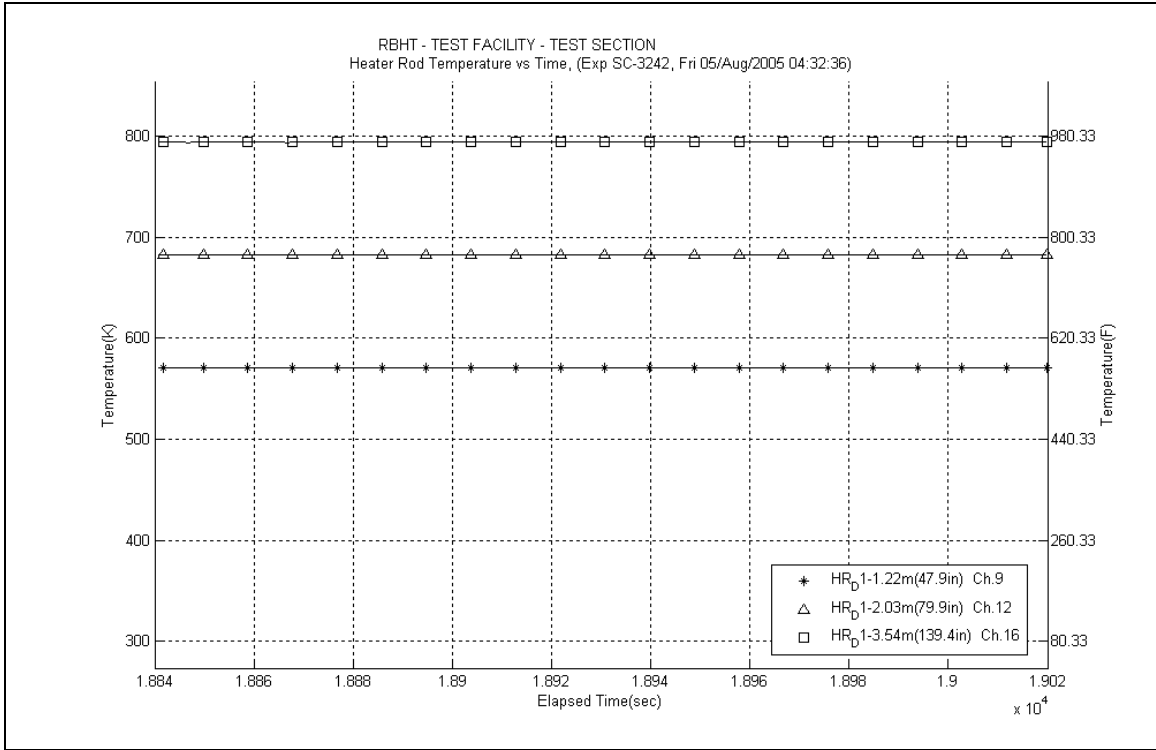
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

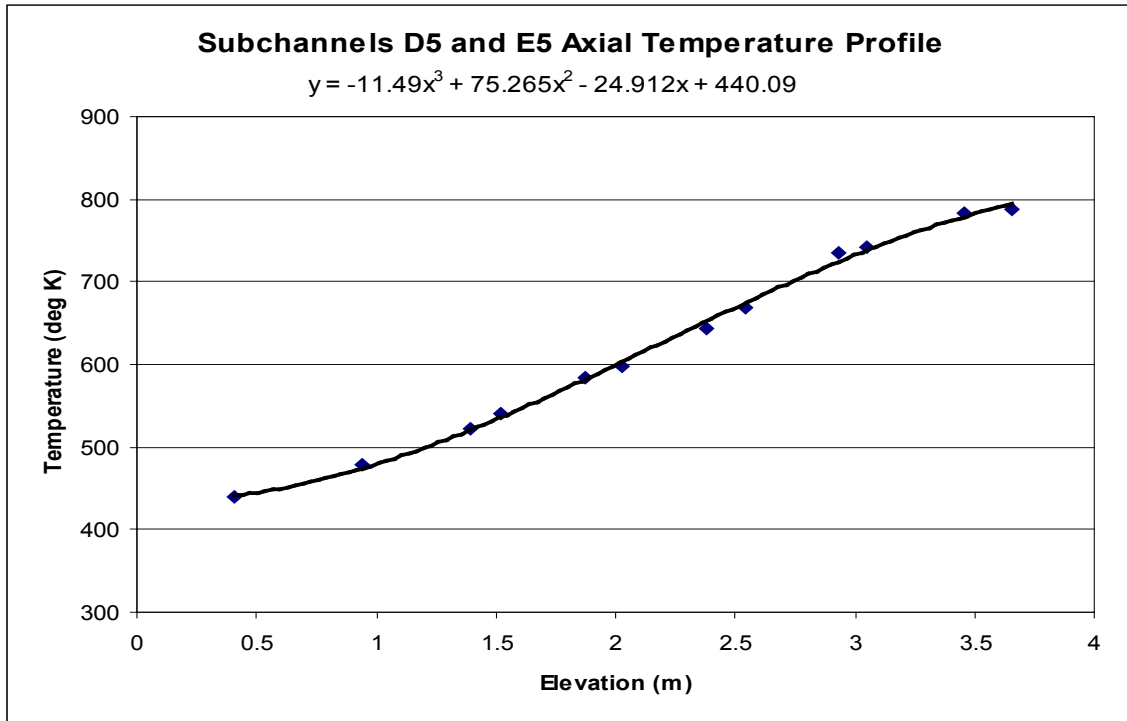
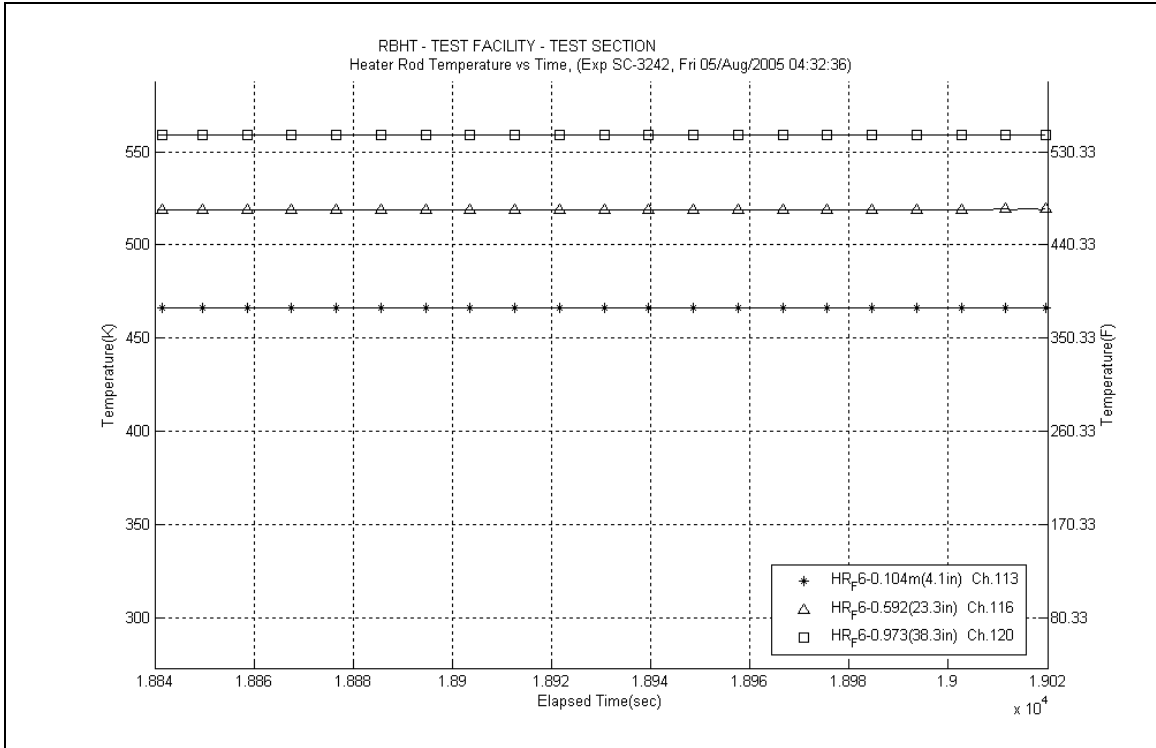
$$T_{cl} = -7.4673x^3 + 54.417x^2 - 1.5846x + 432.97$$

where x is the elevation (m) and T_{cl} is in (K)









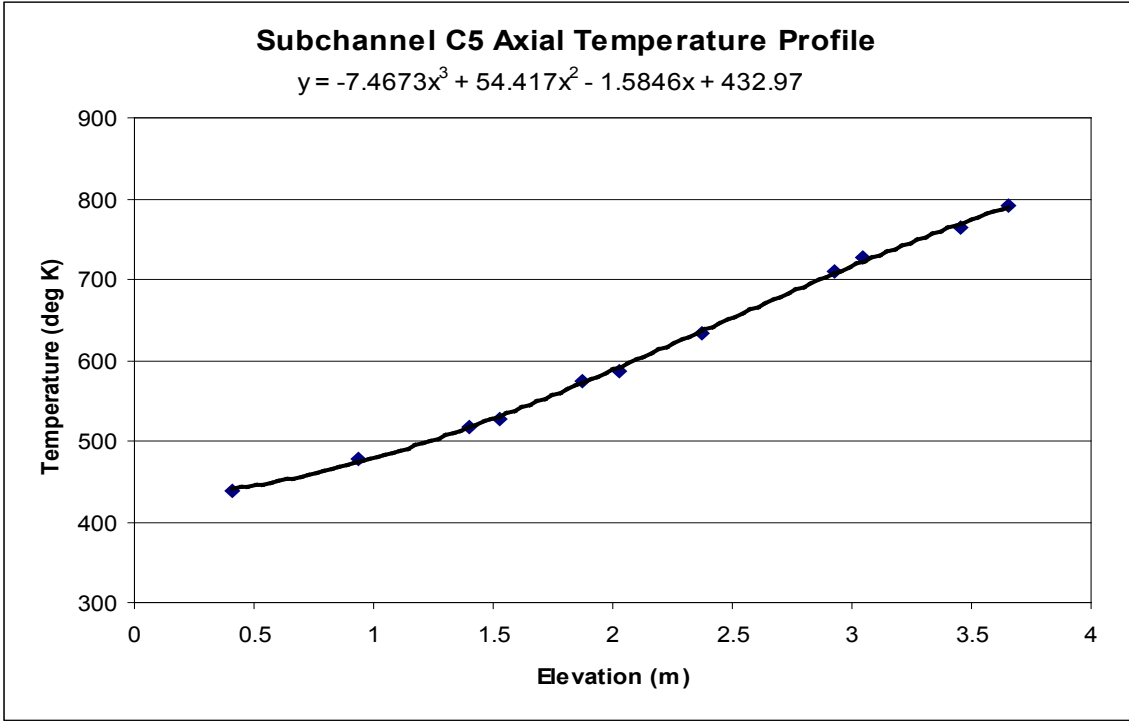


Table SC-3242-D.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±h _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	712.7	37504.6	633.2	1.20	646.4	17208	566.30	23.68	4.18%	128.58
RodD3_91.3	186	2.319	0.071	758.7	38299.4	643.8	1.20	662.9	16715	399.83	15.48	3.87%	87.56
RodD3_93.1	187	2.365	0.117	777.4	38777.0	650.1	1.20	671.3	16475	365.57	13.91	3.80%	78.62
RodD3_95.3	188	2.421	0.173	792.4	39361.0	657.8	1.20	680.3	16228	350.92	13.20	3.76%	74.05
RodD3_100.1	189	2.543	0.295	812.7	40633.5	674.5	1.20	697.5	15771	352.76	13.09	3.71%	71.80
RodD3_106.1	190	2.695	0.447	829.3	42227.2	694.7	1.20	717.1	15283	376.53	13.86	3.68%	73.62
RodD3_110	191	2.794	0.546	813.3	41702.5	707.4	1.20	725.1	15094	472.48	17.91	3.79%	90.92
RodD3_142.1	192	3.609	0.218	821.6	14544.0	790.4	1.20	795.6	13613	560.76	35.63	6.35%	94.34
RodC4_88.4	233	2.245	-0.003	717.7	37934.1	633.5	1.20	647.6	17173	541.11	22.29	4.12%	122.56
RodC4_91.1	234	2.314	0.066	759.0	38664.3	643.1	1.20	662.4	16730	400.21	15.46	3.86%	87.74
RodC4_93.4	235	2.372	0.124	776.1	39288.3	651.2	1.20	672.0	16456	377.39	14.36	3.80%	81.05
RodC4_95.3	236	2.421	0.173	788.4	39803.5	657.8	1.20	679.6	16246	365.81	13.79	3.77%	77.30
RodC4_100.1	237	2.543	0.295	805.4	41106.6	674.5	1.20	696.3	15802	376.60	14.04	3.73%	76.84
RodC4_106.1	238	2.695	0.447	822.7	42738.1	694.7	1.20	716.0	15309	400.63	14.82	3.70%	78.51
RodC4_110	239	2.794	0.546	803.0	41362.9	707.4	1.20	723.4	15134	519.50	20.08	3.87%	100.31
RodC4_142.2	240	3.612	0.221	831.4	15772.4	790.6	1.20	797.4	13579	464.20	24.75	5.33%	77.84
RodD4_88.3	241	2.243	-0.005	726.3	37795.2	633.2	1.20	648.7	17138	487.22	19.66	4.03%	110.07
RodD4_91.3	242	2.319	0.071	761.4	38598.6	643.8	1.20	663.4	16702	393.94	15.19	3.86%	86.19
RodD4_93.2	243	2.367	0.119	776.5	39108.7	650.5	1.20	671.5	16471	372.24	14.16	3.80%	80.03
RodD4_95.2	244	2.418	0.170	786.8	39644.9	657.5	1.20	679.0	16261	367.79	13.88	3.77%	77.81
RodD4_142.1	248	3.609	0.218	827.6	15242.7	790.4	1.20	796.6	13593	491.43	27.71	5.64%	82.52
RodE4_88.4	201	2.245	-0.003	720.1	37226.4	633.5	1.20	648.0	17161	516.33	21.18	4.10%	116.84
RodE4_91.2	202	2.316	0.069	758.4	37944.1	643.4	1.20	662.6	16725	396.03	15.35	3.88%	86.79
RodE4_95.3	204	2.421	0.173	785.2	38998.0	657.8	1.20	679.0	16261	367.54	13.92	3.79%	77.75
RodE4_100.9	205	2.563	0.315	800.2	40438.0	677.2	1.20	697.7	15766	394.55	14.83	3.76%	80.27
RodE4_142.3	208	3.614	0.224	824.7	15401.8	790.8	1.20	796.4	13597	544.05	32.51	5.98%	91.39
RodE3_63.4	193	1.610	0.417	652.0	30831.9	547.2	1.20	564.6	20161	353.08	15.39	4.36%	97.04
RodE3_113.6	194	2.885	0.022	815.3	37996.9	718.8	1.20	734.9	14867	472.55	18.25	3.86%	89.18
RodE3_115.5	195	2.934	0.070	831.3	36581.6	724.7	1.20	742.4	14698	411.77	15.61	3.79%	76.57
RodE3_118.5	196	3.010	0.146	838.6	34351.0	733.7	1.20	751.2	14508	392.69	14.93	3.80%	71.80
RodE3_122.7	197	3.117	0.253	834.2	31230.4	745.7	1.20	760.4	14310	423.51	16.65	3.93%	76.07
RodE3_126.5	198	3.213	0.349	832.1	28406.2	755.9	1.20	768.6	14141	447.55	18.27	4.08%	79.15
RodE3_131.7	199	3.345	-0.046	806.6	24544.8	768.9	1.20	775.2	14009	780.51	43.56	5.58%	136.35
RodE3_135.6	200	3.444	0.053	822.3	21645.9	777.7	1.20	785.1	13813	582.35	29.50	5.07%	99.87

Table SC-3242-D.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	650.5	30235.0	548.1	1.20	565.2	20137	354.61	15.58	4.39%	97.32
RodC5_113.6	226	2.885	0.022	818.6	37058.3	718.8	1.20	735.5	14855	445.61	17.12	3.84%	84.00
RodC5_115.7	227	2.939	0.075	835.8	35575.8	725.3	1.20	743.7	14670	386.16	14.58	3.77%	71.63
RodC5_122.7	229	3.117	0.253	841.9	30632.2	745.7	1.20	761.7	14284	382.10	14.77	3.87%	68.46
RodC5_126.7	230	3.218	0.354	842.9	27808.4	756.5	1.20	770.9	14096	386.11	15.27	3.95%	68.00
RodC5_131.6	231	3.343	-0.048	818.6	24349.6	768.7	1.20	777.0	13973	585.22	28.02	4.79%	101.89
RodC5_135.7	232	3.447	0.056	836.9	21455.2	777.9	1.20	787.7	13762	436.24	19.40	4.45%	74.45
RodE5_63.6	209	1.615	0.422	645.4	30982.6	547.8	1.20	564.1	20184	381.00	16.70	4.38%	104.85
RodE5_113.6	210	2.885	0.022	816.3	38229.3	718.8	1.20	735.1	14864	470.78	18.14	3.85%	88.82
RodE5_115.4	211	2.931	0.067	824.4	36911.9	724.4	1.20	741.0	14729	443.01	16.98	3.83%	82.60
RodE5_118.7	212	3.015	0.151	828.4	34496.9	734.3	1.20	749.9	14534	439.60	17.04	3.88%	80.56
RodE5_122.6	213	3.114	0.250	826.1	31641.8	745.4	1.20	758.9	14344	470.75	18.91	4.02%	84.81
RodE5_126.6	214	3.216	0.352	823.9	28714.8	756.2	1.20	767.5	14164	508.88	21.52	4.23%	90.19
RodE5_131.6	215	3.343	-0.048	801.4	25056.6	768.7	1.20	774.1	14030	917.86	56.14	6.12%	160.66
RodE5_135.6	216	3.444	0.053	822.5	22130.2	777.7	1.20	785.2	13812	592.47	29.92	5.05%	101.60
RodC3_79.8	177	2.027	0.227	703.3	35067.4	603.1	1.20	619.8	18069	420.30	17.20	4.09%	101.34
RodC3_85.6	178	2.174	0.374	701.3	36593.9	623.6	1.20	636.6	17517	565.22	23.95	4.24%	131.19
RodC3_88.5	179	2.248	0.000	709.9	37357.3	633.9	1.20	646.6	17204	589.63	24.94	4.23%	133.84
RodC3_92.4	180	2.347	0.099	754.2	38378.6	647.7	1.20	665.4	16643	432.45	16.89	3.91%	94.20
RodC3_94.4	181	2.398	0.150	764.4	38902.9	654.7	1.20	673.0	16429	425.46	16.47	3.87%	91.18
RodC3_97.2	182	2.469	0.221	777.9	39637.1	664.4	1.20	683.3	16144	419.38	16.05	3.83%	87.92
RodC3_108.8	183	2.764	0.516	814.9	41786.9	703.6	1.20	722.1	15164	450.15	16.95	3.77%	87.14
RodD5_50	217	1.270	0.076	605.0	27374.9	506.3	1.20	522.8	22096	332.71	15.83	4.76%	101.51
RodD5_54.1	218	1.374	0.180	623.8	28452.2	518.2	1.20	535.8	21458	323.35	14.84	4.59%	95.47
RodD5_56.9	219	1.445	0.251	631.4	29188.4	526.6	1.20	544.1	21068	334.17	15.08	4.51%	96.63
RodD5_60	220	1.524	0.330	640.8	30003.6	536.3	1.20	553.7	20635	344.56	15.27	4.43%	97.29
RodD5_66.1	221	1.679	0.485	662.9	31606.8	556.0	1.20	573.9	19778	354.84	15.21	4.29%	95.36
RodD5_69.9	222	1.775	-0.025	638.7	32608.9	568.8	1.20	580.5	19513	559.49	25.47	4.55%	147.97
RodD5_72.9	223	1.852	0.051	680.2	33393.7	579.1	1.20	595.9	18919	396.22	16.60	4.19%	101.00
RodD5_74.9	224	1.902	0.102	695.5	33918.6	586.0	1.20	604.2	18614	371.67	15.27	4.11%	92.91

Table SC-3242-D.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	576.2	24888.0	481.9	1.20	497.6	23439	316.79	16.32	5.15%	103.06
RodB5_52.9	154	1.344	0.150	613.2	28050.2	511.0	1.20	528.0	21834	329.21	15.31	4.65%	99.12
RodB5_55	155	1.397	0.203	619.7	28608.0	516.6	1.20	533.8	21553	333.11	15.26	4.58%	98.84
RodB5_57.8	156	1.468	0.274	627.1	29352.4	524.3	1.20	541.4	21190	342.52	15.42	4.50%	99.70
RodB5_64	157	1.626	0.432	649.3	30999.5	542.1	1.20	560.0	20359	347.00	15.03	4.33%	96.46
RodB5_73.9	158	1.877	0.077	685.5	33629.7	572.3	1.20	591.2	19097	356.75	14.65	4.11%	91.96
RodB5_75.9	159	1.928	0.128	695.2	34161.0	578.7	1.20	598.1	18839	351.89	14.29	4.06%	89.24
RodB5_76.9	160	1.953	0.153	699.1	34425.9	581.8	1.20	601.4	18718	352.17	14.23	4.04%	88.62
RodF5_41	105	1.041	0.343	571.9	24728.9	481.9	1.20	496.9	23479	329.63	17.13	5.20%	107.43
RodF5_53.1	106	1.349	0.155	608.8	27943.7	511.5	1.20	527.7	21849	344.78	16.14	4.68%	103.88
RodF5_55	107	1.397	0.203	615.3	28448.4	516.6	1.20	533.0	21588	345.91	15.96	4.61%	102.83
RodF5_57.8	108	1.468	0.274	623.7	29193.0	524.3	1.20	540.9	21216	352.34	15.95	4.53%	102.70
RodF5_64	109	1.626	0.432	643.9	30839.8	542.1	1.20	559.1	20399	363.75	15.85	4.36%	101.35
RodF5_73.8	110	1.875	0.074	674.8	33445.9	572.0	1.20	589.2	19175	390.47	16.27	4.17%	101.14
RodF5_75.8	111	1.925	0.125	685.1	33976.8	578.3	1.20	596.1	18911	382.02	15.71	4.11%	97.33
RodF5_76.8	112	1.951	0.150	687.3	34242.6	581.5	1.20	599.1	18800	388.59	15.94	4.10%	98.30
RodC2_41	57	1.041	0.343	571.3	24845.6	481.9	1.20	496.8	23484	333.32	17.29	5.19%	108.66
RodC2_53.1	58	1.349	0.155	611.5	28061.4	511.5	1.20	528.2	21826	336.82	15.69	4.66%	101.37
RodC2_55	59	1.397	0.203	615.0	28566.0	516.6	1.20	533.0	21590	348.34	16.05	4.61%	103.57
RodC2_57.8	60	1.468	0.274	616.7	29309.5	524.3	1.20	539.7	21272	380.84	17.40	4.57%	111.34
RodC2_63.9	61	1.623	0.429	636.0	30930.5	541.8	1.20	557.5	20466	393.94	17.35	4.40%	110.18
RodC2_73.8	62	1.875	0.074	670.5	33562.8	572.0	1.20	588.4	19202	409.10	17.15	4.19%	106.15
RodC2_75.8	63	1.925	0.125	679.6	34094.8	578.3	1.20	595.2	18945	403.90	16.73	4.14%	103.13
RodC2_76.8	64	1.951	0.150	681.4	34360.0	581.5	1.20	598.2	18836	413.01	17.08	4.14%	104.72
RodC6_40.9	137	1.039	0.340	572.5	24725.3	481.7	1.20	496.8	23484	326.74	16.97	5.19%	106.51
RodC6_52.8	138	1.341	0.147	613.9	28024.2	510.7	1.20	527.9	21839	325.96	15.15	4.65%	98.16
RodC6_54.8	139	1.392	0.198	620.7	28578.5	516.1	1.20	533.5	21566	327.67	15.00	4.58%	97.30
RodC6_57.8	140	1.468	0.274	630.2	29410.3	524.3	1.20	542.0	21166	333.29	14.94	4.48%	96.89
RodC6_63.8	141	1.621	0.427	651.4	31072.6	541.5	1.20	559.8	20366	339.38	14.66	4.32%	94.38
RodC6_73.7	142	1.872	0.072	686.6	33816.8	571.7	1.20	590.9	19110	353.27	14.47	4.10%	91.14
RodC6_75.8	143	1.925	0.125	692.4	34398.4	578.3	1.20	597.3	18866	362.02	14.72	4.07%	91.97
RodC6_76.8	144	1.951	0.150	697.5	34675.3	581.5	1.20	600.9	18737	358.74	14.50	4.04%	90.39

Table SC-3242-D.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	709.6	37204.3	619.2	1.20	634.3	17590	494.25	20.10	4.07%	115.31
RodB4_91.3	162	2.319	0.071	750.0	37946.9	628.8	1.20	649.0	17129	375.81	14.46	3.85%	84.85
RodB4_93.3	163	2.370	0.122	763.1	38463.2	635.4	1.20	656.7	16897	361.44	13.75	3.80%	80.23
RodB4_95.1	164	2.416	0.168	771.3	38925.2	641.4	1.20	663.1	16711	359.51	13.59	3.78%	78.71
RodB4_100	165	2.540	0.292	787.2	40185.0	657.7	1.20	679.3	16255	372.11	13.92	3.74%	78.69
RodB4_106	166	2.692	0.445	809.3	41727.1	677.4	1.20	699.4	15722	379.61	14.02	3.69%	76.96
RodB4_109.9	167	2.791	0.544	791.2	40395.2	690.2	1.20	707.0	15531	479.47	18.36	3.83%	95.70
RodB4_142.3	168	3.614	0.224	824.1	15665.7	785.6	1.20	792.0	13681	488.10	26.92	5.52%	82.66
RodF4_85.6	98	2.174	0.374	711.1	36712.6	610.0	1.20	626.9	17832	435.73	17.47	4.01%	103.38
RodF4_88.4	99	2.245	-0.003	716.1	37449.1	619.2	1.20	635.4	17555	464.02	18.60	4.01%	107.99
RodF4_92.4	100	2.347	0.099	758.5	38497.3	632.5	1.20	653.5	16994	366.59	13.99	3.82%	81.96
RodF4_94.3	101	2.395	0.147	769.9	38996.9	638.8	1.20	660.6	16782	356.78	13.49	3.78%	78.53
RodF4_97.2	102	2.469	0.221	782.3	39756.6	648.4	1.20	670.7	16493	356.23	13.35	3.75%	76.72
RodF4_108.8	103	2.764	0.516	821.8	41984.9	686.6	1.20	709.1	15478	372.64	13.67	3.67%	74.05
RodF4_111	104	2.819	-0.044	785.5	40277.1	693.7	1.20	709.0	15481	526.32	20.52	3.90%	104.61
RodD2_103.2	65	2.621	0.373	790.5	41549.3	668.2	1.20	688.6	16003	407.72	15.26	3.74%	84.53
RodD2_106	66	2.692	0.445	799.8	42292.5	677.4	1.20	697.8	15763	414.80	15.45	3.72%	84.37
RodD2_112.6	67	2.860	-0.004	788.6	38797.3	698.9	1.20	713.8	15363	518.60	20.33	3.92%	102.08
RodD2_114.9	68	2.918	0.055	809.1	36996.2	706.2	1.20	723.4	15134	431.70	16.47	3.82%	83.36
RodD2_117.4	69	2.982	0.118	818.0	35037.0	714.1	1.20	731.4	14947	404.88	15.42	3.81%	76.93
RodD2_120.8	70	3.068	0.204	819.7	32372.5	724.7	1.20	740.5	14740	409.19	15.85	3.87%	76.37
RodD2_124.8	71	3.170	0.306	819.2	29239.1	736.9	1.20	750.6	14519	426.54	17.07	4.00%	78.07
RodD2_128.6	72	3.266	0.403	818.5	26264.0	748.2	1.20	759.9	14322	447.90	18.74	4.18%	80.53
RodD6_103.1	129	2.619	0.371	789.2	41610.5	667.9	1.20	688.1	16016	411.61	15.42	3.75%	85.43
RodD6_106	130	2.692	0.445	799.4	42372.5	677.4	1.20	697.8	15764	416.80	15.53	3.72%	84.78
RodD6_112.9	131	2.868	0.004	795.0	38662.0	699.8	1.20	715.7	15317	487.40	18.87	3.87%	95.57
RodD6_114.9	132	2.918	0.055	815.5	37076.9	706.2	1.20	724.4	15109	407.17	15.38	3.78%	78.45
RodD6_116.8	133	2.967	0.103	821.3	35570.5	712.2	1.20	730.4	14970	391.39	14.78	3.78%	74.52
RodD6_120.9	134	3.071	0.207	820.6	32324.0	725.0	1.20	741.0	14731	405.85	15.70	3.87%	75.69
RodD6_124.8	135	3.170	0.306	822.7	29237.7	736.9	1.20	751.2	14507	409.14	16.21	3.96%	74.80
RodD6_128.7	136	3.269	0.405	824.3	26149.2	748.4	1.20	761.1	14297	413.74	16.92	4.09%	74.22

Table SC-3242-D.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	597.1	27462.5	503.7	1.20	519.3	22274	352.67	16.87	4.78%	108.56
RodE2_54	74	1.372	0.178	613.7	28509.8	513.9	1.20	530.5	21710	342.79	15.83	4.62%	102.55
RodE2_56.9	75	1.445	0.251	621.6	29289.0	521.8	1.20	538.4	21331	352.10	15.96	4.53%	103.26
RodE2_59.9	76	1.521	0.328	630.2	30095.2	530.2	1.20	546.9	20939	361.28	16.09	4.45%	103.74
RodE2_66	77	1.676	0.483	650.0	31734.0	548.1	1.20	565.1	20143	373.39	16.09	4.31%	102.51
RodE2_69.8	78	1.773	-0.027	628.8	32757.3	559.6	1.20	571.1	19890	568.05	25.92	4.56%	153.67
RodE2_72.9	79	1.852	0.051	669.7	33586.2	569.2	1.20	586.0	19298	400.91	16.79	4.19%	104.64
RodE2_74.9	80	1.902	0.102	683.2	34123.8	575.5	1.20	593.4	19012	380.24	15.64	4.11%	97.50
RodB3_50.2	169	1.275	0.081	592.7	27305.3	503.9	1.20	518.7	22301	369.15	17.82	4.83%	113.78
RodB3_54.1	170	1.374	0.180	606.4	28341.6	514.2	1.20	529.5	21759	368.82	17.25	4.68%	110.61
RodB3_56.9	171	1.445	0.251	613.4	29085.5	521.8	1.20	537.1	21396	381.05	17.52	4.60%	112.14
RodB3_60.1	172	1.527	0.333	622.3	29936.3	530.8	1.20	546.0	20978	392.77	17.73	4.51%	113.02
RodB3_66.1	173	1.679	0.485	641.5	31531.1	548.4	1.20	563.9	20193	406.37	17.73	4.36%	111.89
RodB3_69.9	174	1.775	-0.025	624.1	32542.7	559.9	1.20	570.6	19912	608.59	28.39	4.66%	164.85
RodB3_73	175	1.854	0.054	665.8	33363.8	569.5	1.20	585.6	19313	416.03	17.56	4.22%	108.69
RodB3_75	176	1.905	0.105	681.3	33894.0	575.8	1.20	593.4	19014	385.49	15.92	4.13%	98.85
RodF3_50.1	89	1.273	0.079	601.2	27307.5	503.7	1.20	519.9	22239	336.08	16.03	4.77%	103.28
RodF3_54	90	1.372	0.178	615.6	28366.2	513.9	1.20	530.9	21694	334.69	15.45	4.62%	100.05
RodF3_57	91	1.448	0.254	622.2	29180.9	522.1	1.20	538.8	21315	349.78	15.87	4.54%	102.50
RodF3_60	92	1.524	0.330	631.5	29995.5	530.5	1.20	547.3	20918	356.26	15.85	4.45%	102.18
RodF3_66.1	93	1.679	0.485	645.3	31651.4	548.4	1.20	564.5	20166	391.62	16.96	4.33%	107.66
RodF3_70	94	1.778	-0.022	632.6	32713.5	560.2	1.20	572.3	19843	542.26	24.45	4.51%	146.28
RodF3_73	95	1.854	0.054	675.1	33523.5	569.5	1.20	587.1	19253	381.18	15.85	4.16%	99.22
RodF3_75	96	1.905	0.105	691.5	34065.9	575.8	1.20	595.1	18950	353.34	14.40	4.07%	90.25
RodE6_50.2	121	1.275	0.081	598.3	27292.4	503.9	1.20	519.7	22253	347.04	16.62	4.79%	106.72
RodE6_54.1	122	1.374	0.180	612.3	28317.4	514.2	1.20	530.5	21710	346.15	16.05	4.64%	103.56
RodE6_57	123	1.448	0.254	617.6	29079.9	522.1	1.20	538.0	21352	365.50	16.70	4.57%	107.31
RodE6_60.2	124	1.529	0.335	626.6	29920.8	531.1	1.20	547.0	20934	375.89	16.86	4.48%	107.90
RodE6_66.1	125	1.679	0.485	649.8	31472.1	548.4	1.20	565.3	20134	372.22	16.08	4.32%	102.14
RodE6_70	126	1.778	-0.022	630.4	32500.5	560.2	1.20	571.9	19858	555.61	25.28	4.55%	150.02
RodE6_73.1	127	1.857	0.056	671.3	33312.3	569.8	1.20	586.7	19268	394.03	16.50	4.19%	102.66
RodE6_75	128	1.905	0.105	684.1	33811.6	575.8	1.20	593.9	18997	374.73	15.42	4.12%	95.99

RBHT Steam Cooling Test SC-3248-A

Matrix test # 6

Test date – 8/11/2005

Steady state time window: 7700 - 8100 sec

Inlet flow: 2.26 m³/min (79.9 ft³/min)

Inlet steam temperature: 409 K (276 °F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 50.0 kW

Outlet steam temperature: 605 K (630 °F)

Bundle inlet Reynolds number: 9056

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution. Experiment SC-3248 was run with the traversing probes withdrawn. Centerline steam temperatures used are from experiment SC-3178-C.

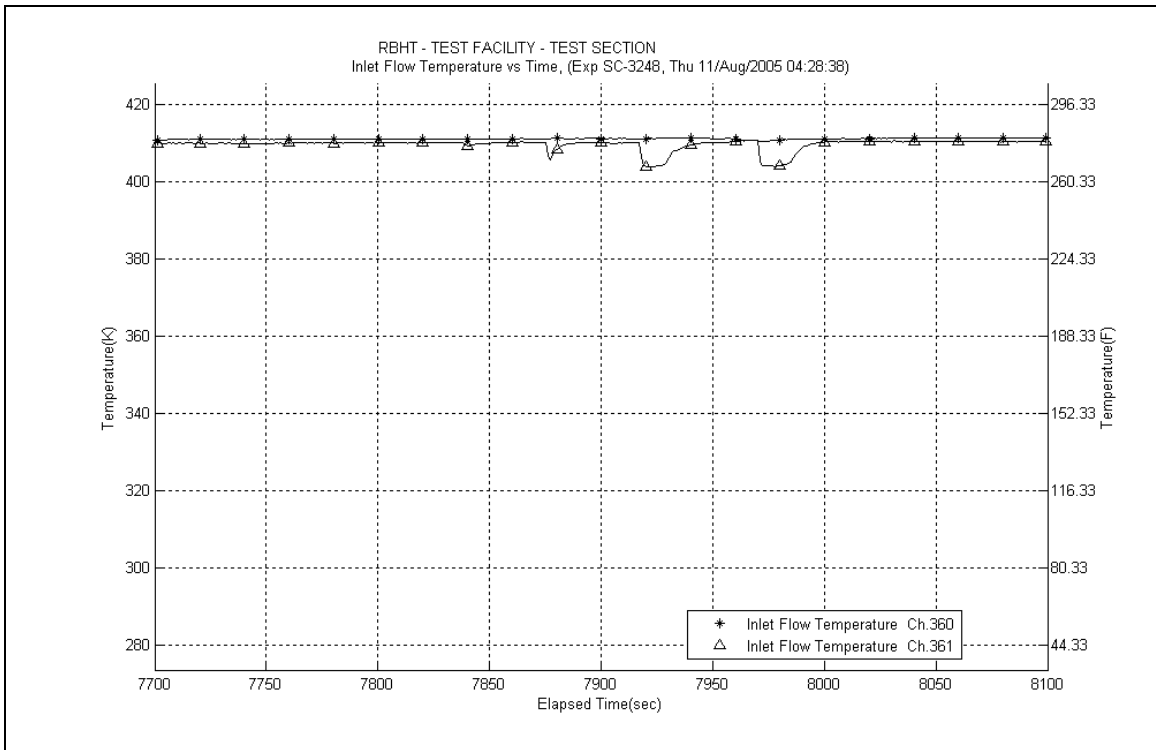
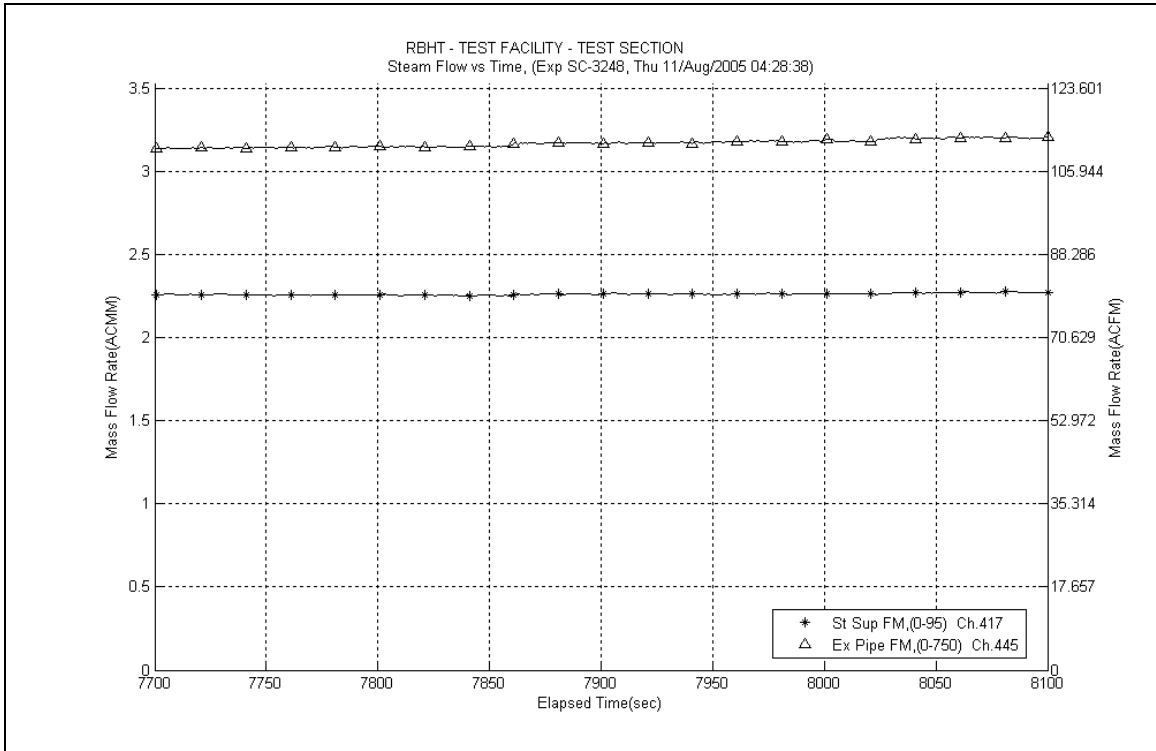
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

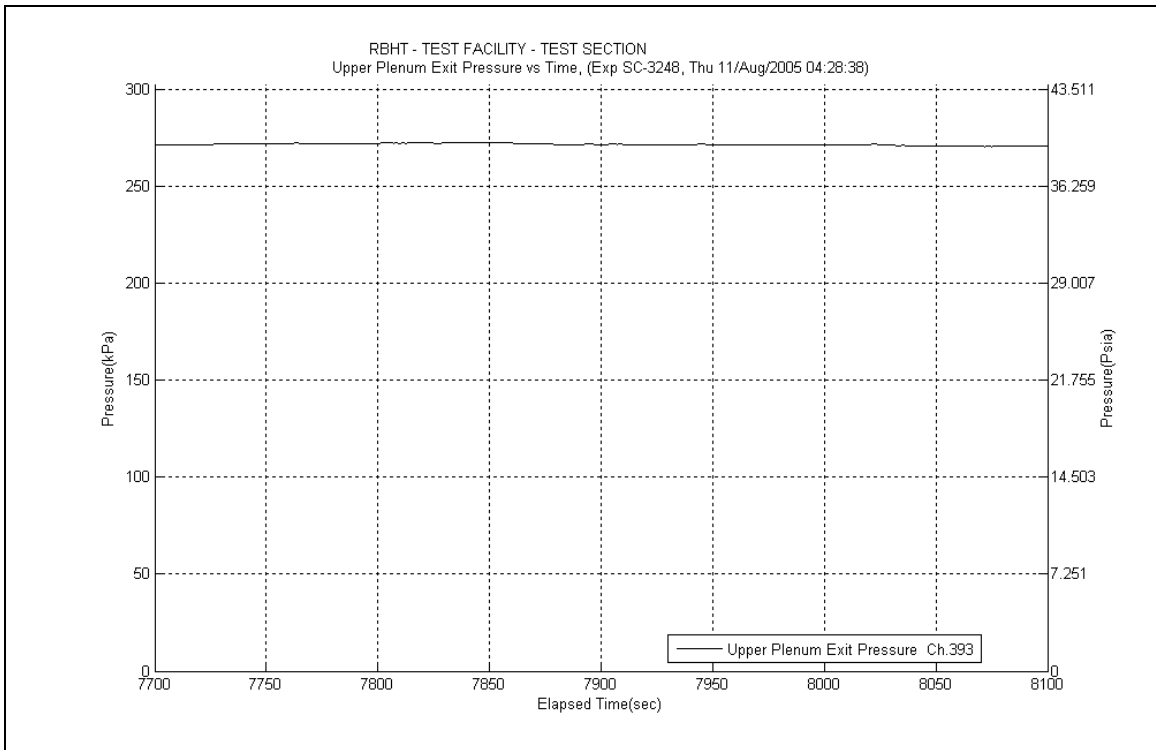
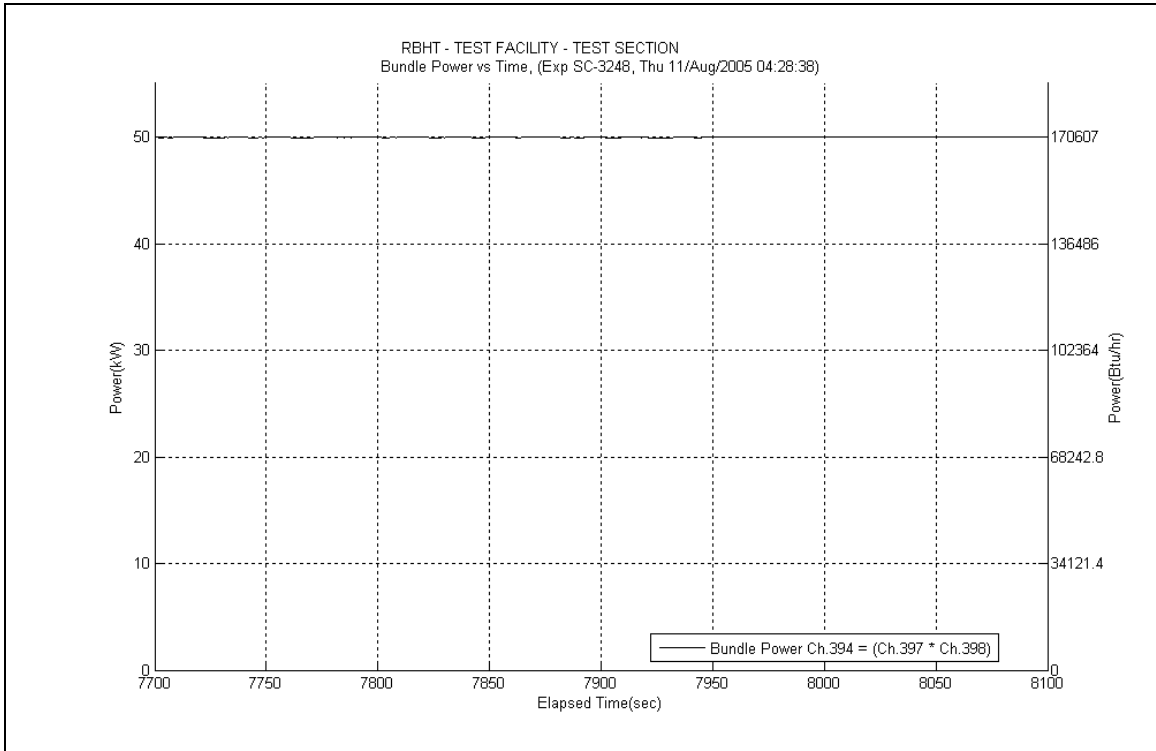
$$T_{cl} = -14.71x^3 + 93.998x^2 - 37.575x + 438.03$$

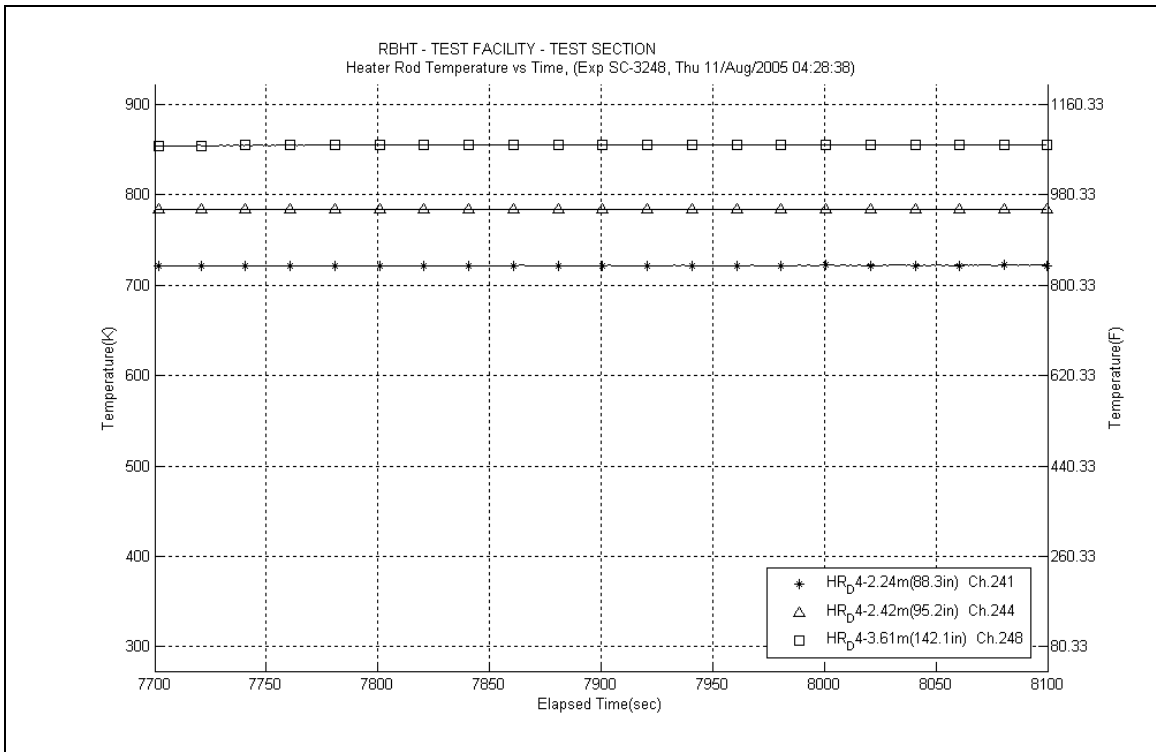
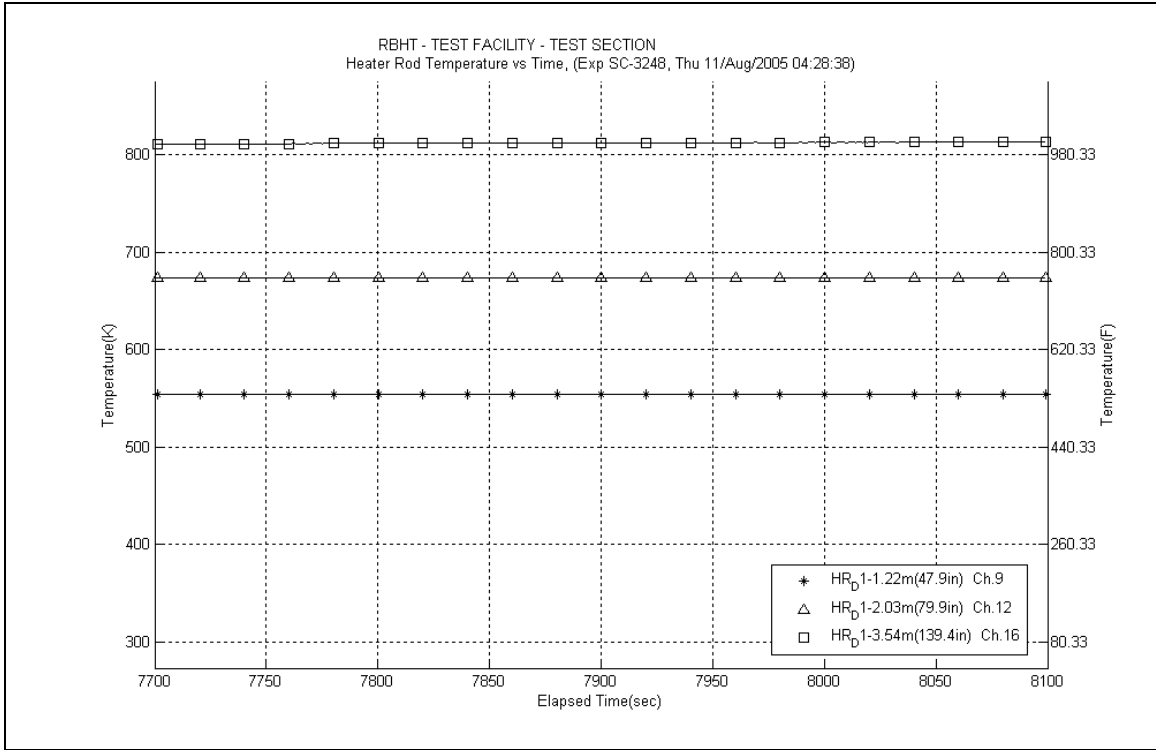
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

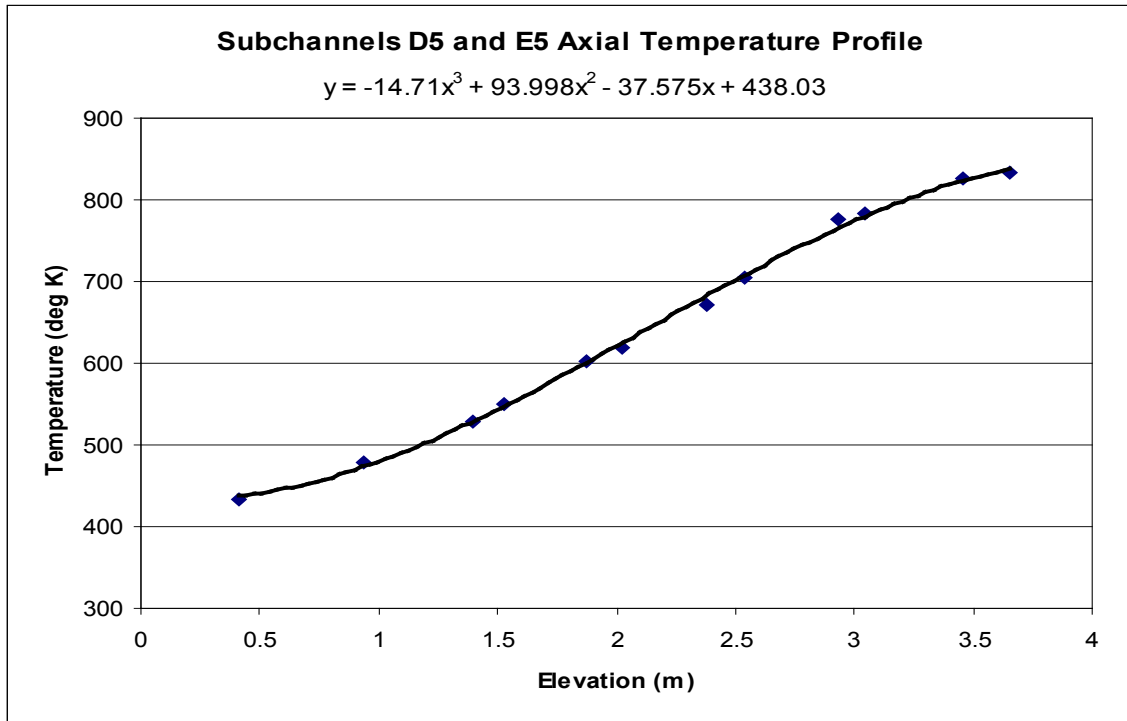
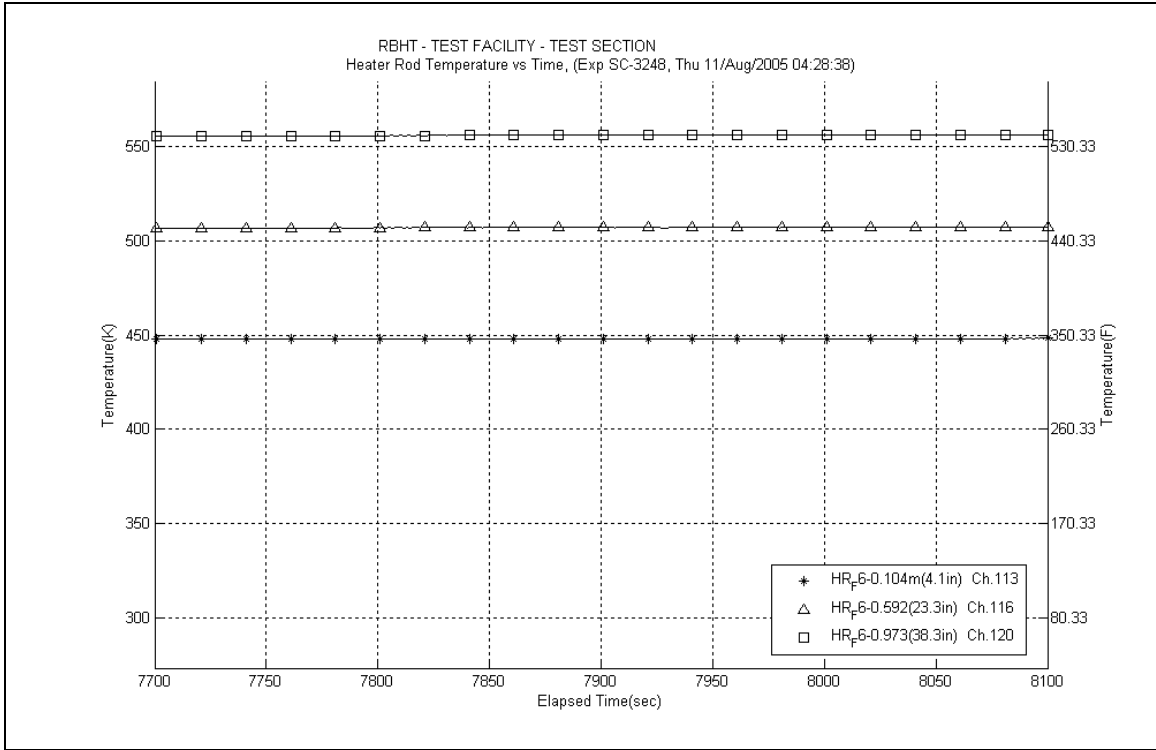
$$T_{cl} = -10.559x^3 + 70.797x^2 - 9.6599x + 429.36$$

where x is the elevation (m) and T_{cl} is in (K)









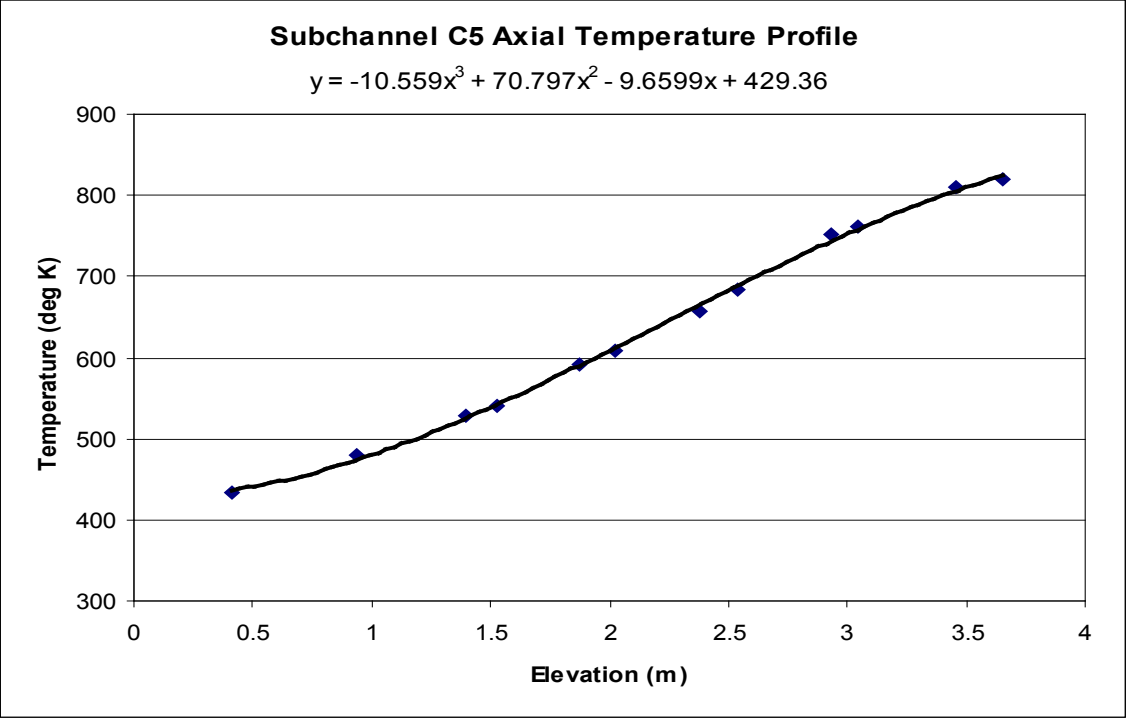


Table SC-3248-A.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{h,c} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	709.3	13360.0	660.6	1.20	668.7	5823	329.29	20.49	6.22%	71.21
RodD3_91.3	186	2.319	0.071	747.9	13642.2	672.9	1.20	685.4	5661	218.53	12.00	5.49%	45.61
RodD3_93.1	187	2.365	0.117	764.3	13812.6	680.3	1.20	694.3	5578	197.24	10.46	5.30%	40.41
RodD3_95.3	188	2.421	0.173	779.8	14020.5	689.2	1.20	704.3	5488	185.74	9.55	5.14%	37.28
RodD3_100.1	189	2.543	0.295	805.8	14476.3	708.4	1.20	724.6	5315	178.20	8.67	4.86%	34.32
RodD3_106.1	190	2.695	0.447	826.7	15044.2	731.5	1.20	747.4	5133	189.62	8.78	4.63%	34.92
RodD3_110	191	2.794	0.546	809.0	14857.0	746.0	1.20	756.5	5065	282.78	13.99	4.95%	51.17
RodD3_142.1	192	3.609	0.218	846.0	5164.3	835.3	1.27	837.6	4529	614.20	100.80	16.41%	95.92
RodC4_88.4	233	2.245	-0.003	715.7	13516.3	661.0	1.20	670.1	5809	296.95	17.80	6.00%	64.03
RodC4_91.1	234	2.314	0.066	748.9	13779.0	672.1	1.20	684.9	5666	215.40	11.75	5.45%	45.00
RodC4_93.4	235	2.372	0.124	765.7	14000.6	681.5	1.20	695.5	5567	199.64	10.50	5.26%	40.80
RodC4_95.3	236	2.421	0.173	779.1	14187.1	689.2	1.20	704.2	5490	189.44	9.69	5.12%	38.03
RodC4_100.1	237	2.543	0.295	802.1	14646.2	708.4	1.20	724.0	5320	187.48	9.12	4.87%	36.15
RodC4_106.1	238	2.695	0.447	823.7	15225.9	731.5	1.20	746.9	5137	198.33	9.19	4.63%	36.56
RodC4_110	239	2.794	0.546	804.9	14737.6	746.0	1.20	755.8	5070	300.44	15.20	5.06%	54.44
RodC4_142.2	240	3.612	0.221	856.4	5611.6	835.4	1.27	839.9	4515	341.59	32.68	9.57%	53.13
RodD4_88.3	241	2.243	-0.005	720.7	13469.1	660.6	1.20	670.6	5804	269.13	15.81	5.87%	57.97
RodD4_91.3	242	2.319	0.071	755.2	13758.0	672.9	1.20	686.6	5649	200.79	10.83	5.40%	41.80
RodD4_93.2	243	2.367	0.119	770.5	13942.4	680.7	1.20	695.7	5566	186.29	9.75	5.23%	38.06
RodD4_95.2	244	2.418	0.170	782.9	14134.8	688.8	1.20	704.5	5487	180.18	9.19	5.10%	36.15
RodD4_142.1	248	3.609	0.218	854.3	5426.7	835.3	1.27	839.4	4518	363.29	37.26	10.26%	56.56
RodE4_88.4	201	2.245	-0.003	716.4	13268.3	661.0	1.20	670.3	5808	287.67	17.33	6.02%	62.01
RodE4_91.2	202	2.316	0.069	749.4	13526.1	672.5	1.20	685.4	5662	211.07	11.60	5.50%	44.06
RodE4_95.3	204	2.421	0.173	781.1	13899.9	689.2	1.20	704.5	5487	181.45	9.34	5.15%	36.40
RodE4_100.9	205	2.563	0.315	808.1	14414.5	711.5	1.20	727.6	5290	179.07	8.69	4.85%	34.28
RodE4_142.3	208	3.614	0.224	850.0	5474.7	835.6	1.27	838.7	4522	484.96	61.70	12.72%	75.59
RodE3_63.4	193	1.610	0.417	647.9	10986.2	559.8	1.20	574.5	6950	149.79	11.31	7.55%	40.19
RodE3_113.6	194	2.885	0.022	813.0	13534.8	758.8	1.27	770.4	4963	317.96	19.69	6.19%	56.04
RodE3_115.5	195	2.934	0.070	826.7	13029.0	765.4	1.27	778.5	4906	270.37	16.28	6.02%	46.94
RodE3_118.5	196	3.010	0.146	839.1	12228.9	775.4	1.27	789.0	4834	244.23	14.59	5.97%	41.58
RodE3_122.7	197	3.117	0.253	846.2	11119.7	788.6	1.27	801.0	4755	245.89	14.98	6.09%	40.97
RodE3_126.5	198	3.213	0.349	847.7	10109.9	799.8	1.27	810.0	4697	268.54	17.13	6.38%	44.02
RodE3_131.7	199	3.345	-0.046	827.8	8731.0	813.5	1.27	816.6	4655	779.69	99.69	12.79%	126.32
RodE3_135.6	200	3.444	0.053	840.2	7700.7	822.7	1.27	826.4	4595	559.82	60.78	10.86%	89.14

Table SC-3248-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hfc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	651.0	10772.7	561.0	1.20	576.0	6929	143.68	10.98	7.64%	38.41
RodC5_113.6	226	2.885	0.022	815.3	13209.5	758.8	1.27	770.9	4959	297.54	18.32	6.16%	52.39
RodC5_115.7	227	2.939	0.075	834.0	12683.0	766.1	1.27	780.6	4891	237.54	14.10	5.94%	41.08
RodC5_122.7	229	3.117	0.253	856.5	10922.8	788.6	1.27	803.2	4740	204.71	12.12	5.92%	33.97
RodC5_126.7	230	3.218	0.354	858.7	9919.4	800.3	1.27	812.8	4679	216.42	13.17	6.08%	35.30
RodC5_131.6	231	3.343	-0.048	839.8	8685.7	813.3	1.27	819.0	4640	416.51	34.25	8.22%	67.19
RodC5_135.7	232	3.447	0.056	850.4	7644.8	822.9	1.27	828.8	4581	353.66	28.45	8.05%	56.08
RodE5_63.6	209	1.615	0.422	647.5	11064.7	560.6	1.20	575.1	6942	152.90	11.48	7.51%	40.97
RodE5_113.6	210	2.885	0.022	811.1	13634.7	758.8	1.27	770.0	4966	332.18	20.73	6.24%	58.59
RodE5_115.4	211	2.931	0.067	820.8	13166.6	765.0	1.27	777.0	4917	300.33	18.43	6.14%	52.29
RodE5_118.7	212	3.015	0.151	830.7	12304.9	776.0	1.27	787.8	4842	286.24	17.63	6.16%	48.85
RodE5_122.6	213	3.114	0.250	840.7	11289.9	788.3	1.27	799.5	4764	274.49	17.07	6.22%	45.85
RodE5_126.6	214	3.216	0.352	846.1	10248.1	800.0	1.27	809.9	4697	283.28	18.25	6.44%	46.44
RodE5_131.6	215	3.343	-0.048	825.7	8931.8	813.3	1.27	816.0	4659	914.07	131.03	14.33%	148.25
RodE5_135.6	216	3.444	0.053	838.5	7880.5	822.7	1.27	826.1	4597	631.92	73.95	11.70%	100.68
RodC3_79.8	177	2.027	0.227	712.5	12494.8	625.6	1.20	640.0	6125	172.36	10.57	6.13%	39.70
RodC3_85.6	178	2.174	0.374	703.4	13038.8	649.5	1.20	658.5	5927	290.49	18.07	6.22%	64.24
RodC3_88.5	179	2.248	0.000	706.7	13311.8	661.5	1.20	669.0	5820	352.87	22.48	6.37%	76.27
RodC3_92.4	180	2.347	0.099	751.6	13674.2	677.4	1.20	689.8	5620	221.35	12.08	5.46%	45.78
RodC3_94.4	181	2.398	0.150	765.2	13861.9	685.6	1.20	698.8	5537	208.81	11.05	5.29%	42.38
RodC3_97.2	182	2.469	0.221	781.5	14122.5	696.8	1.20	711.0	5430	200.23	10.22	5.10%	39.64
RodC3_108.8	183	2.764	0.516	816.2	14887.3	741.6	1.20	754.0	5083	239.48	11.43	4.77%	43.54
RodD5_50	217	1.270	0.076	595.3	9764.6	511.8	1.20	525.7	7723	140.35	12.88	9.18%	42.50
RodD5_54.1	218	1.374	0.180	620.4	10154.4	525.7	1.20	541.5	7455	128.75	11.05	8.58%	37.47
RodD5_56.9	219	1.445	0.251	633.2	10417.9	535.7	1.20	551.9	7288	128.11	10.53	8.22%	36.33
RodD5_60	220	1.524	0.330	643.6	10707.5	547.0	1.20	563.1	7117	133.01	10.46	7.86%	36.69
RodD5_66.1	221	1.679	0.485	659.0	11279.6	570.3	1.20	585.1	6802	152.55	11.08	7.26%	39.90
RodD5_69.9	222	1.775	-0.025	637.1	11632.3	585.3	1.20	593.9	6683	269.49	19.81	7.35%	69.02
RodD5_72.9	223	1.852	0.051	673.8	11912.4	597.3	1.20	610.1	6476	186.99	12.59	6.73%	46.11
RodD5_74.9	224	1.902	0.102	692.1	12103.3	605.5	1.20	619.9	6357	167.67	10.88	6.49%	40.42

Table SC-3248-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hfc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	568.9	8867.4	484.2	1.20	498.3	8234	125.61	13.35	10.63%	40.79
RodB5_52.9	154	1.344	0.150	611.0	9994.3	518.6	1.20	534.0	7580	129.72	11.38	8.78%	38.47
RodB5_55	155	1.397	0.203	620.5	10195.0	525.2	1.20	541.1	7461	128.38	10.90	8.49%	37.40
RodB5_57.8	156	1.468	0.274	633.2	10457.5	534.4	1.20	550.8	7305	127.01	10.33	8.13%	36.11
RodB5_64	157	1.626	0.432	650.4	11048.2	555.4	1.20	571.2	6997	139.59	10.41	7.46%	37.75
RodB5_73.9	158	1.877	0.077	679.5	11984.7	590.8	1.20	605.6	6532	162.28	10.66	6.57%	40.43
RodB5_75.9	159	1.928	0.128	693.8	12171.9	598.2	1.20	614.1	6426	152.78	9.72	6.36%	37.32
RodB5_76.9	160	1.953	0.153	700.1	12270.1	601.9	1.20	618.3	6376	149.93	9.40	6.27%	36.28
RodF5_41	105	1.041	0.343	566.4	8810.6	484.2	1.20	497.9	8242	128.62	13.76	10.70%	41.81
RodF5_53.1	106	1.349	0.155	606.3	9956.0	519.2	1.20	533.7	7585	137.22	12.09	8.81%	40.72
RodF5_55	107	1.397	0.203	615.4	10133.7	525.2	1.20	540.3	7475	134.85	11.53	8.55%	39.37
RodF5_57.8	108	1.468	0.274	626.5	10393.8	534.4	1.20	549.7	7323	135.33	11.10	8.20%	38.58
RodF5_64	109	1.626	0.432	641.8	10989.5	555.4	1.20	569.8	7018	152.58	11.48	7.52%	41.41
RodF5_73.8	110	1.875	0.074	667.5	11919.1	590.5	1.20	603.3	6562	185.73	12.41	6.68%	46.53
RodF5_75.8	111	1.925	0.125	683.4	12107.1	597.8	1.20	612.1	6451	169.78	10.95	6.45%	41.67
RodF5_76.8	112	1.951	0.150	689.9	12200.5	601.5	1.20	616.3	6401	165.73	10.53	6.35%	40.29
RodC2_41	57	1.041	0.343	551.1	8855.1	484.2	1.20	495.3	8293	158.67	17.05	10.74%	51.92
RodC2_53.1	58	1.349	0.155	565.9	10000.1	519.2	1.20	527.0	7700	257.02	23.80	9.26%	77.58
RodC2_55	59	1.397	0.203	611.0	10177.1	525.2	1.20	539.5	7487	142.40	12.17	8.54%	41.65
RodC2_57.8	60	1.468	0.274	618.1	10441.3	534.4	1.20	548.3	7345	149.60	12.28	8.21%	42.80
RodC2_63.9	61	1.623	0.429	629.1	11019.6	555.0	1.20	567.4	7053	178.52	13.56	7.60%	48.73
RodC2_73.8	62	1.875	0.074	639.1	11958.0	590.5	1.20	598.6	6622	294.97	21.06	7.14%	74.72
RodC2_75.8	63	1.925	0.125	678.2	12144.3	597.8	1.20	611.2	6462	181.45	11.75	6.48%	44.62
RodC2_76.8	64	1.951	0.150	683.7	12245.0	601.5	1.20	615.2	6413	178.93	11.42	6.38%	43.60
RodC6_40.9	137	1.039	0.340	568.8	8818.4	483.9	1.20	498.0	8239	124.62	13.32	10.69%	40.49
RodC6_52.8	138	1.341	0.147	610.9	9994.5	518.3	1.20	533.7	7585	129.44	11.37	8.78%	38.41
RodC6_54.8	139	1.392	0.198	620.6	10189.8	524.6	1.20	540.6	7470	127.40	10.84	8.51%	37.16
RodC6_57.8	140	1.468	0.274	633.8	10484.7	534.4	1.20	550.9	7304	126.49	10.27	8.12%	35.96
RodC6_63.8	141	1.621	0.427	651.0	11077.0	554.7	1.20	570.7	7004	137.98	10.28	7.45%	37.36
RodC6_73.7	142	1.872	0.072	678.9	12058.6	590.1	1.20	604.9	6541	162.96	10.67	6.55%	40.67
RodC6_75.8	143	1.925	0.125	688.5	12267.2	597.8	1.20	612.9	6441	162.42	10.34	6.36%	39.78
RodC6_76.8	144	1.951	0.150	695.9	12362.5	601.5	1.20	617.3	6388	157.16	9.85	6.27%	38.11

Table SC-3248-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hfc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	710.8	13253.8	645.1	1.20	656.0	5953	242.06	14.06	5.81%	53.81
RodB4_91.3	162	2.319	0.071	746.1	13518.6	656.0	1.20	671.0	5800	180.01	9.68	5.38%	38.74
RodB4_93.3	163	2.370	0.122	761.7	13703.5	663.5	1.20	679.9	5714	167.54	8.74	5.22%	35.38
RodB4_95.1	164	2.416	0.168	773.2	13861.7	670.3	1.20	687.4	5642	161.62	8.24	5.10%	33.59
RodB4_100	165	2.540	0.292	798.6	14313.5	688.5	1.20	706.9	5466	156.11	7.53	4.83%	31.17
RodB4_106	166	2.692	0.445	814.4	14861.5	710.5	1.20	727.8	5289	171.64	7.90	4.60%	32.85
RodB4_109.9	167	2.791	0.544	794.2	14385.7	724.4	1.20	736.0	5222	247.07	12.02	4.86%	46.52
RodB4_142.3	168	3.614	0.224	851.5	5570.3	820.7	1.27	827.3	4590	230.52	17.54	7.61%	36.65
RodF4_85.6	98	2.174	0.374	705.9	13080.8	634.5	1.20	646.4	6055	219.78	12.91	5.87%	49.90
RodF4_88.4	99	2.245	-0.003	708.8	13334.8	645.1	1.20	655.7	5956	251.22	14.64	5.83%	55.89
RodF4_92.4	100	2.347	0.099	750.1	13712.2	660.1	1.20	675.1	5760	182.91	9.70	5.30%	39.02
RodF4_94.3	101	2.395	0.147	763.9	13891.9	667.3	1.20	683.4	5680	172.58	8.90	5.16%	36.17
RodF4_97.2	102	2.469	0.221	779.7	14169.5	678.1	1.20	695.1	5571	167.42	8.34	4.98%	34.25
RodF4_108.8	103	2.764	0.516	814.4	14959.9	720.5	1.20	736.1	5221	191.08	8.74	4.57%	35.97
RodF4_111	104	2.819	-0.044	789.7	14348.5	728.2	1.20	738.5	5203	280.26	14.03	5.01%	52.52
RodD2_103.2	65	2.621	0.373	792.6	14797.5	700.3	1.20	715.7	5390	192.46	9.17	4.76%	37.74
RodD2_106	66	2.692	0.445	798.3	15061.4	710.5	1.20	725.1	5311	205.67	9.64	4.69%	39.57
RodD2_112.6	67	2.860	-0.004	782.7	13816.4	733.8	1.20	742.0	5176	338.96	18.36	5.42%	63.09
RodD2_114.9	68	2.918	0.055	803.2	13171.7	741.7	1.20	751.9	5099	256.90	12.88	5.01%	46.90
RodD2_117.4	69	2.982	0.118	815.0	12470.7	750.1	1.20	760.9	5032	230.61	11.39	4.94%	41.38
RodD2_120.8	70	3.068	0.204	829.5	11517.7	761.2	1.27	775.8	4925	214.69	12.68	5.91%	37.46
RodD2_124.8	71	3.170	0.306	834.2	10396.1	773.8	1.27	786.7	4849	218.81	13.22	6.04%	37.41
RodD2_128.6	72	3.266	0.403	833.5	9335.7	785.2	1.27	795.5	4790	245.61	15.68	6.38%	41.33
RodD6_103.1	129	2.619	0.371	801.8	14827.6	699.9	1.20	716.9	5379	174.73	8.21	4.70%	34.18
RodD6_106	130	2.692	0.445	808.1	15097.6	710.5	1.20	726.7	5297	185.49	8.55	4.61%	35.58
RodD6_112.9	131	2.868	0.004	795.1	13786.9	734.8	1.20	744.9	5153	274.61	13.83	5.04%	50.82
RodD6_114.9	132	2.918	0.055	813.4	13215.6	741.7	1.20	753.6	5086	221.14	10.64	4.81%	40.24
RodD6_116.8	133	2.967	0.103	826.2	12678.4	748.1	1.20	761.1	5030	194.85	9.21	4.73%	34.95
RodD6_120.9	134	3.071	0.207	836.9	11521.5	761.5	1.27	777.7	4912	194.53	11.31	5.81%	33.82
RodD6_124.8	135	3.170	0.306	843.8	10421.9	773.8	1.27	788.8	4835	189.44	11.14	5.88%	32.27
RodD6_128.7	136	3.269	0.405	843.5	9326.6	785.5	1.27	797.9	4775	204.47	12.46	6.09%	34.26

Table SC-3248-A.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	588.1	9783.2	510.0	1.20	523.0	7771	150.30	13.81	9.19%	45.83
RodE2_54	74	1.372	0.178	611.0	10154.3	522.1	1.20	536.9	7531	136.95	11.79	8.61%	40.32
RodE2_56.9	75	1.445	0.251	624.4	10431.7	531.4	1.20	546.9	7368	134.66	11.08	8.23%	38.67
RodE2_59.9	76	1.521	0.328	634.8	10719.2	541.4	1.20	556.9	7210	137.73	10.84	7.87%	38.58
RodE2_66	77	1.676	0.483	646.3	11302.8	562.4	1.20	576.4	6924	161.56	11.75	7.27%	43.15
RodE2_69.8	78	1.773	-0.027	625.5	11668.1	575.9	1.20	584.2	6815	282.71	20.94	7.41%	74.11
RodE2_72.9	79	1.852	0.051	658.2	11961.9	587.2	1.20	599.0	6617	202.13	13.68	6.77%	51.15
RodE2_74.9	80	1.902	0.102	669.9	12154.0	594.5	1.20	607.1	6514	193.46	12.69	6.56%	48.04
RodB3_50.2	169	1.275	0.081	586.6	9728.0	510.3	1.20	523.0	7771	152.92	14.12	9.23%	46.63
RodB3_54.1	170	1.374	0.180	604.9	10095.5	522.4	1.20	536.1	7544	146.84	12.74	8.67%	43.32
RodB3_56.9	171	1.445	0.251	617.1	10360.6	531.4	1.20	545.7	7387	145.16	12.06	8.31%	41.81
RodB3_60.1	172	1.527	0.333	625.8	10661.9	542.0	1.20	556.0	7225	152.80	12.13	7.94%	42.90
RodB3_66.1	173	1.679	0.485	640.5	11230.8	562.7	1.20	575.7	6933	173.22	12.72	7.34%	46.34
RodB3_69.9	174	1.775	-0.025	623.8	11593.6	576.3	1.20	584.2	6814	293.09	21.96	7.49%	76.82
RodB3_73	175	1.854	0.054	660.8	11887.8	587.5	1.20	599.8	6607	194.66	13.17	6.77%	49.17
RodB3_75	176	1.905	0.105	677.2	12070.7	594.9	1.20	608.6	6495	175.96	11.48	6.52%	43.54
RodF3_50.1	89	1.273	0.079	592.9	9725.7	510.0	1.20	523.8	7757	140.74	12.96	9.21%	42.83
RodF3_54	90	1.372	0.178	613.7	10100.5	522.1	1.20	537.3	7524	132.25	11.42	8.63%	38.89
RodF3_57	91	1.448	0.254	625.5	10389.7	531.7	1.20	547.4	7360	133.01	10.97	8.24%	38.15
RodF3_60	92	1.524	0.330	634.2	10684.7	541.7	1.20	557.1	7208	138.62	10.94	7.89%	38.81
RodF3_66.1	93	1.679	0.485	641.3	11271.2	562.7	1.20	575.8	6931	172.17	12.60	7.32%	46.05
RodF3_70	94	1.778	-0.022	628.6	11647.8	576.6	1.20	585.3	6799	268.89	19.73	7.34%	70.29
RodF3_73	95	1.854	0.054	662.8	11938.2	587.5	1.20	600.1	6603	190.25	12.80	6.73%	48.02
RodF3_75	96	1.905	0.105	680.8	12129.6	594.9	1.20	609.2	6487	169.35	10.97	6.48%	41.84
RodE6_50.2	121	1.275	0.081	588.3	9723.1	510.3	1.20	523.3	7766	149.57	13.80	9.23%	45.58
RodE6_54.1	122	1.374	0.180	609.8	10090.3	522.4	1.20	536.9	7531	138.50	11.98	8.65%	40.77
RodE6_57	123	1.448	0.254	621.8	10361.3	531.7	1.20	546.7	7370	138.04	11.43	8.28%	39.65
RodE6_60.2	124	1.529	0.335	631.9	10660.1	542.4	1.20	557.3	7205	142.82	11.29	7.91%	39.97
RodE6_66.1	125	1.679	0.485	646.4	11214.9	562.7	1.20	576.7	6919	160.84	11.76	7.31%	42.93
RodE6_70	126	1.778	-0.022	628.0	11582.6	576.6	1.20	585.2	6801	270.44	19.95	7.38%	70.71
RodE6_73.1	127	1.857	0.056	661.3	11866.6	587.9	1.20	600.1	6602	193.96	13.13	6.77%	48.95
RodE6_75	128	1.905	0.105	676.8	12045.9	594.9	1.20	608.5	6496	176.57	11.54	6.54%	43.70

RBHT Steam Cooling Test SC-3248-B

Matrix test # 5

Test date – 8/11/2005

Steady state time window: 24100 - 24400 sec

Inlet flow: 1.81 m³/min (64.1 ft³/min)

Inlet steam temperature: 413 K (284 °F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 40.0 kW

Outlet steam temperature: 580 K (585 °F)

Bundle inlet Reynolds number: 7089

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution. . Experiment SC-3248 was run with the traversing probes withdrawn. Centerline steam temperatures used are from experiment SC-3163-B.

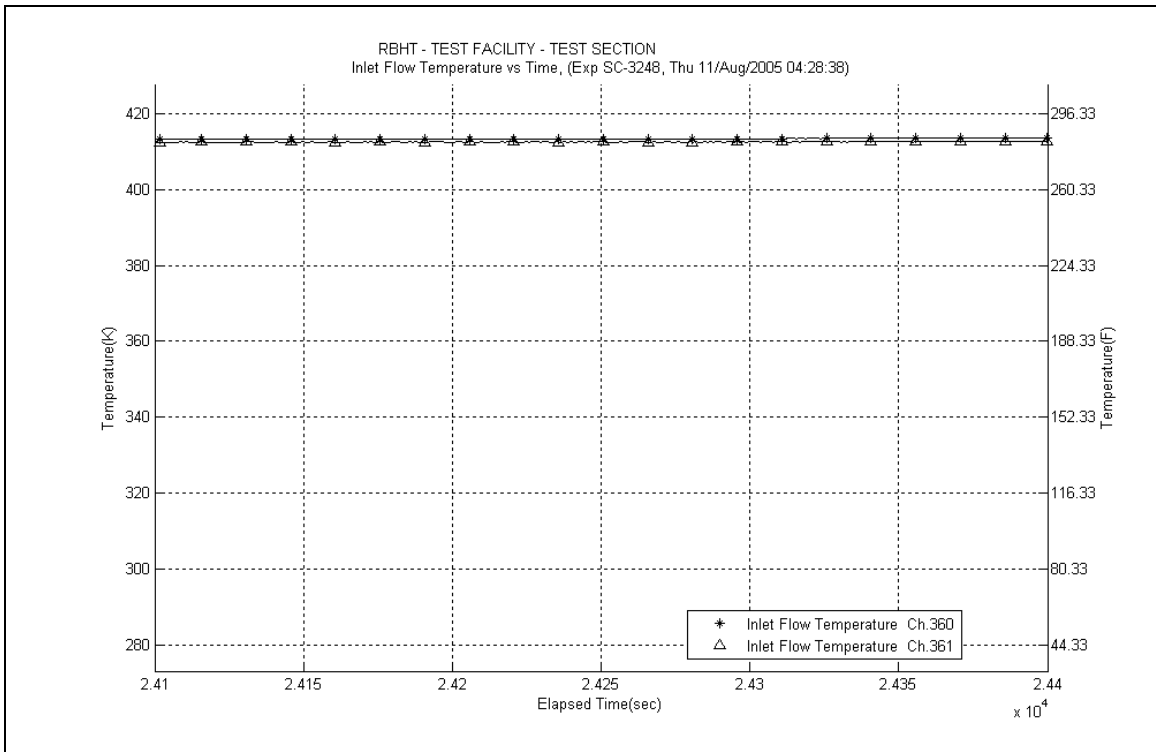
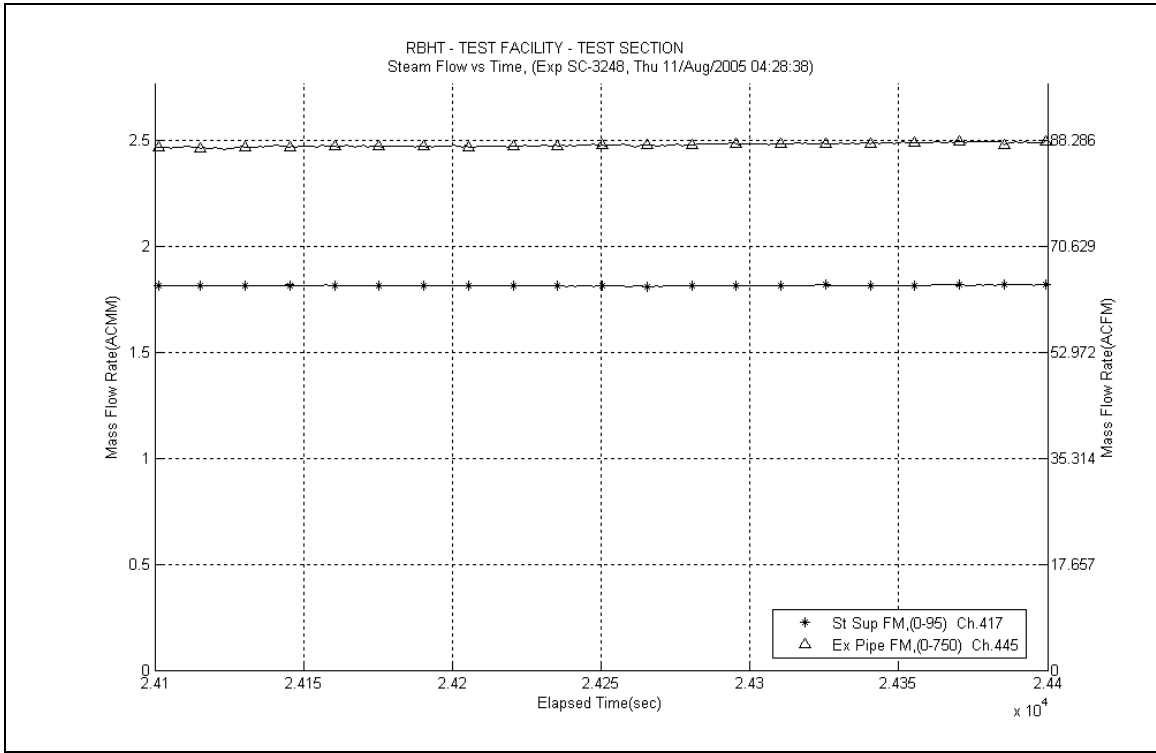
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

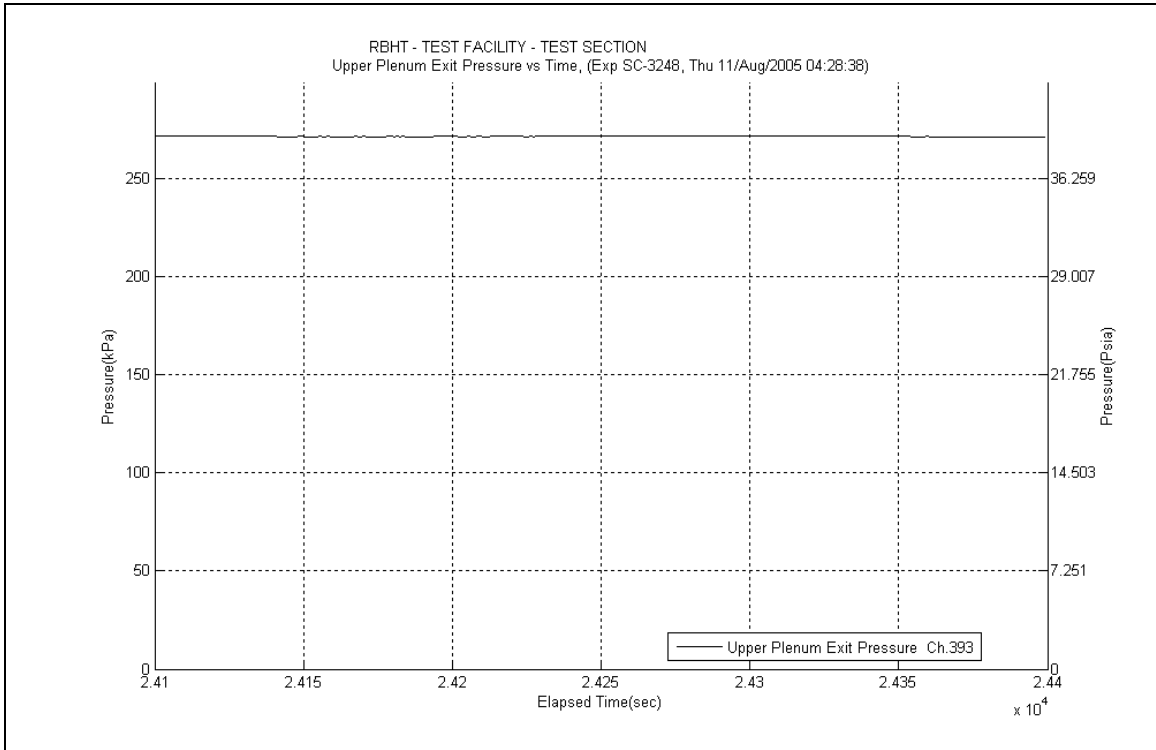
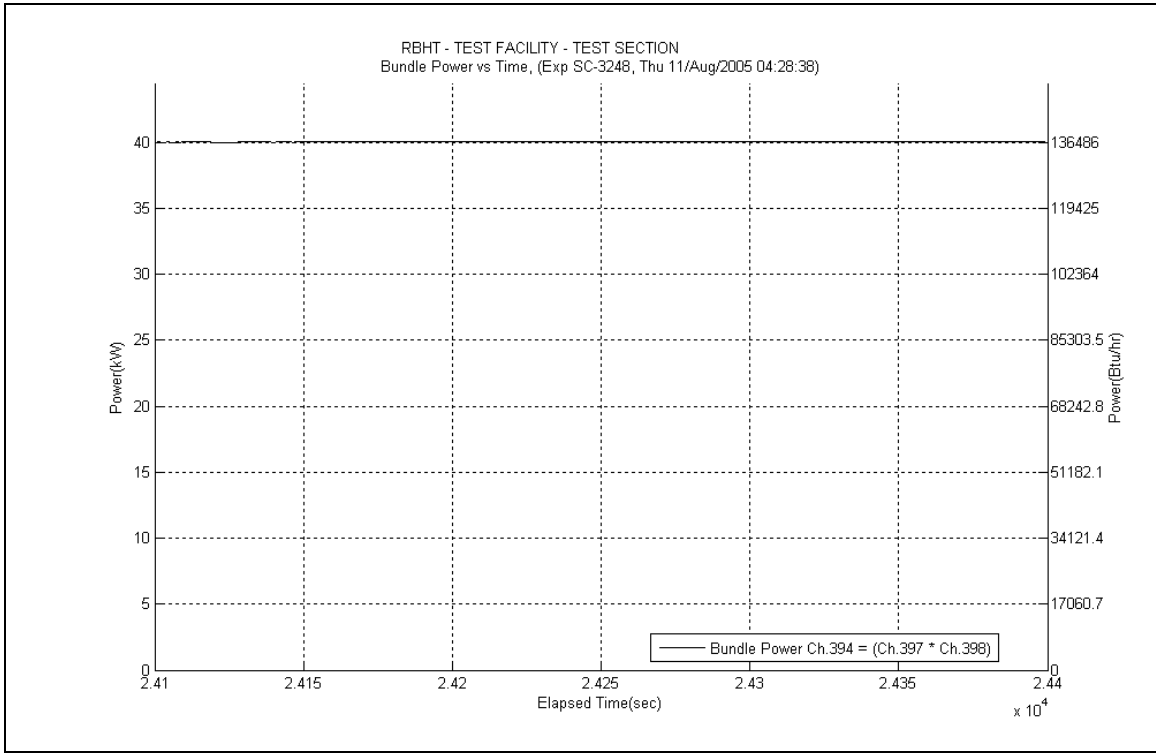
$$T_{cl} = -16.261x^3 + 100.93x^2 - 49.657x + 438.59$$

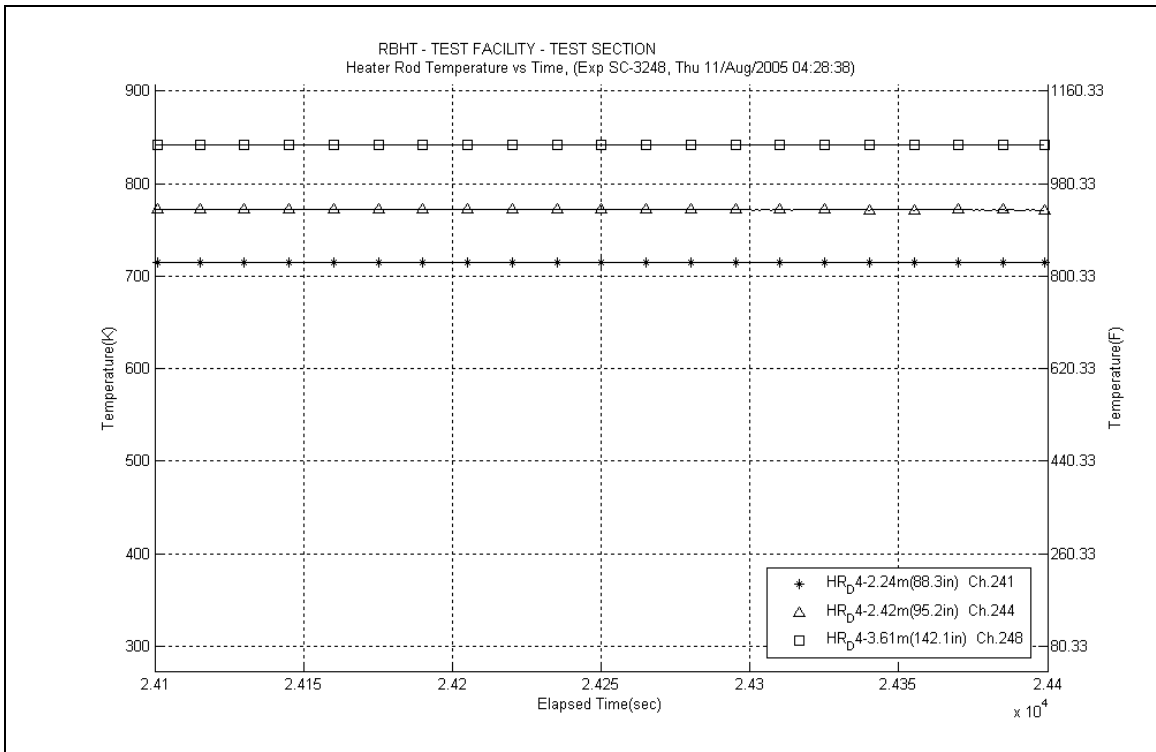
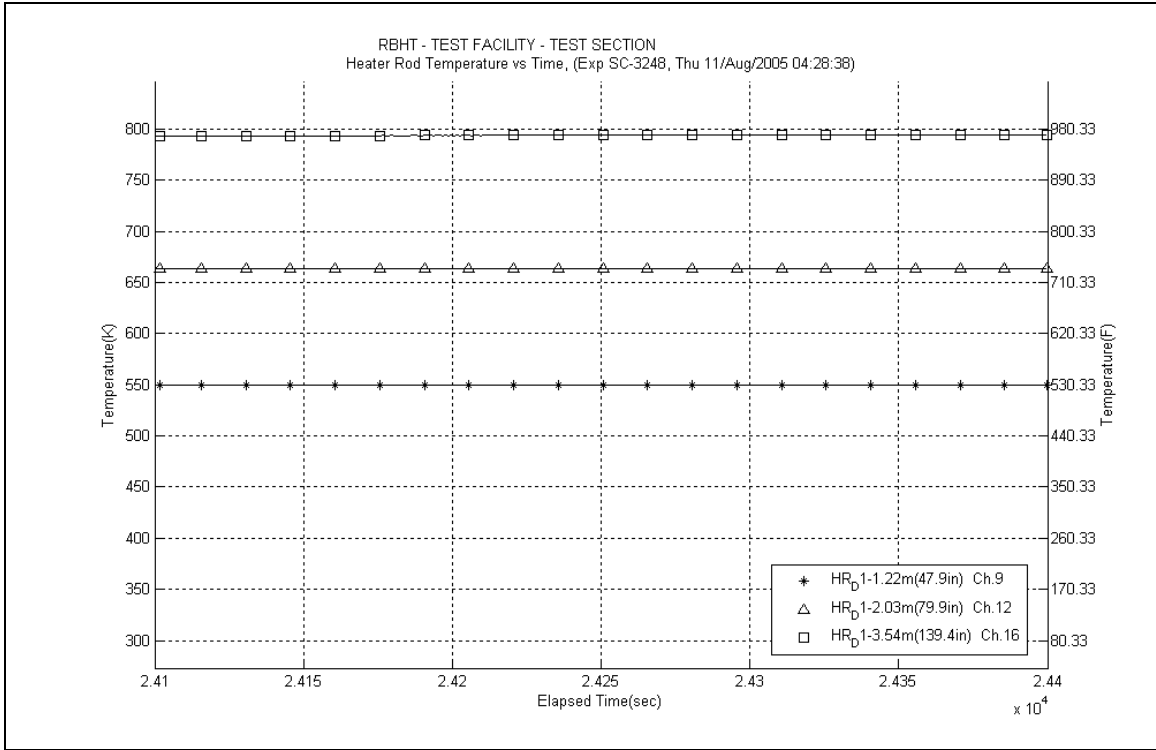
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

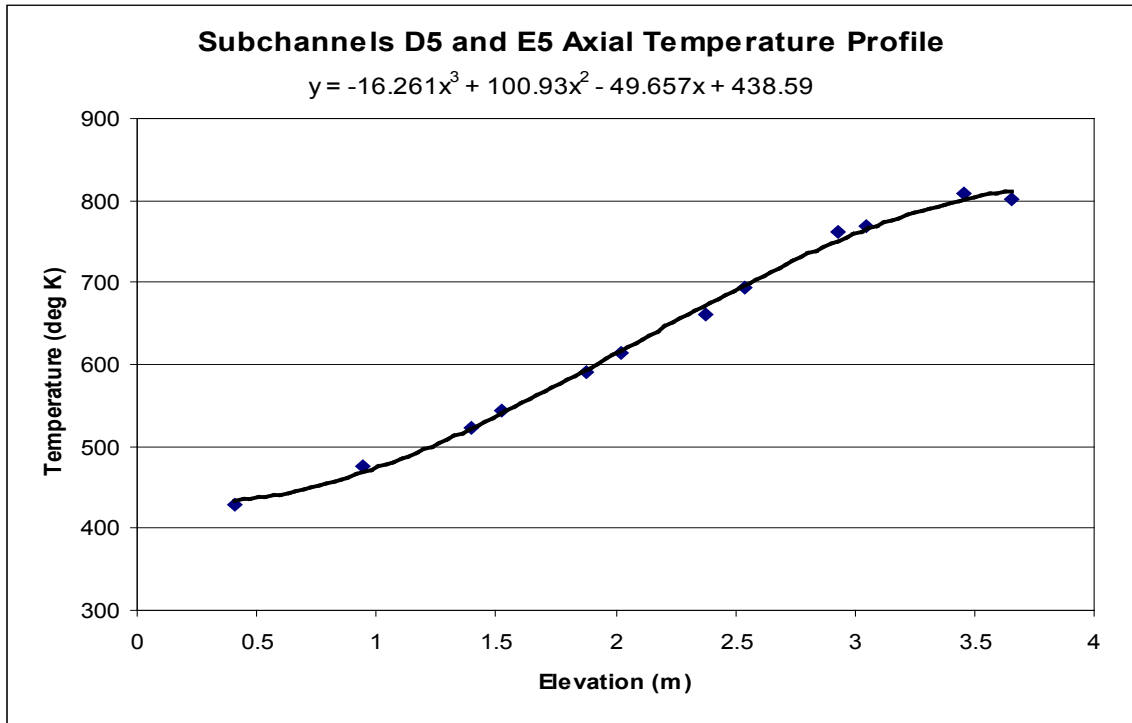
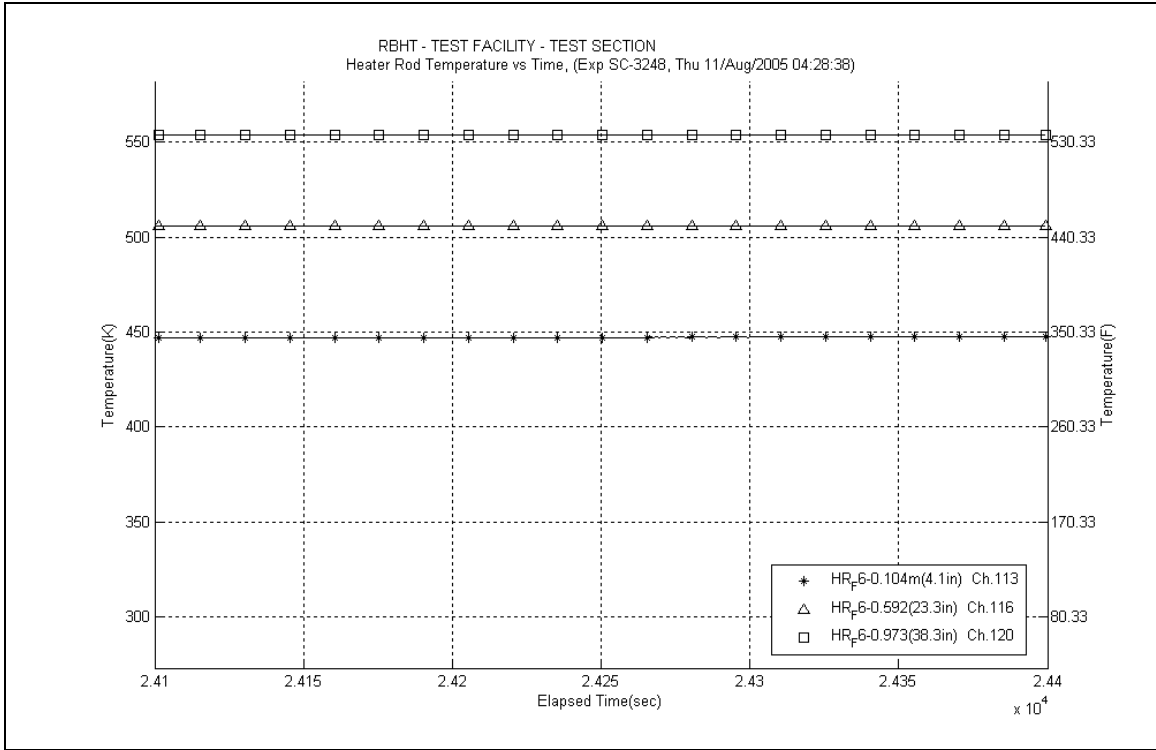
$$T_{cl} = -9.6585x^3 + 64.419x^2 - 2.3145x + 422.76$$

where x is the elevation (m) and T_{cl} is in (K)









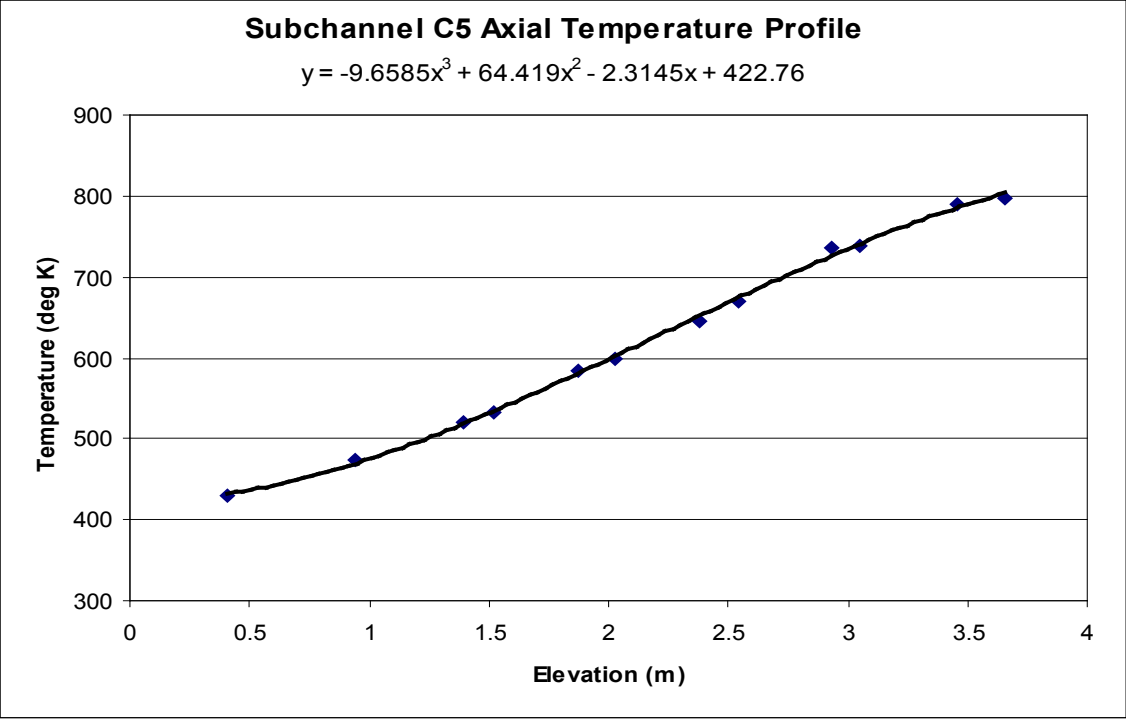


Table SC-3248-B.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	703.6	10729.1	651.5	1.27	662.6	4662	261.82	19.81	7.56%	57.37
RodD3_91.3	186	2.319	0.071	738.4	10956.4	663.4	1.27	679.5	4530	186.07	13.04	7.01%	39.33
RodD3_93.1	187	2.365	0.117	753.5	11091.1	670.6	1.27	688.3	4463	170.09	11.61	6.83%	35.29
RodD3_95.3	188	2.421	0.173	767.7	11261.5	679.2	1.27	698.1	4392	161.85	10.77	6.65%	32.90
RodD3_100.1	189	2.543	0.295	792.5	11623.7	697.5	1.27	717.9	4255	155.80	9.89	6.35%	30.42
RodD3_106.1	190	2.695	0.447	813.3	12081.4	719.5	1.27	739.6	4115	163.90	9.93	6.06%	30.64
RodD3_110	191	2.794	0.546	799.8	11933.0	733.1	1.27	747.4	4067	227.61	14.11	6.20%	41.92
RodD3_142.1	192	3.609	0.218	834.6	4157.3	809.7	1.27	815.0	3696	212.40	18.84	8.87%	34.51
RodC4_88.4	233	2.245	-0.003	707.6	10847.9	651.9	1.27	663.8	4653	247.84	18.44	7.44%	54.17
RodC4_91.1	234	2.314	0.066	736.7	11059.0	662.6	1.27	678.5	4537	190.03	13.29	7.00%	40.25
RodC4_93.4	235	2.372	0.124	752.4	11236.1	671.7	1.27	689.0	4458	177.29	12.04	6.79%	36.73
RodC4_95.3	236	2.421	0.173	764.7	11386.6	679.2	1.27	697.5	4397	169.29	11.24	6.64%	34.46
RodC4_100.1	237	2.543	0.295	787.9	11762.3	697.5	1.27	716.9	4262	165.72	10.51	6.34%	32.42
RodC4_106.1	238	2.695	0.447	810.3	12225.7	719.5	1.27	739.0	4119	171.35	10.37	6.05%	32.08
RodC4_110	239	2.794	0.546	795.8	11827.3	733.1	1.27	746.5	4072	239.99	15.07	6.28%	44.27
RodC4_142.2	240	3.612	0.221	841.4	4505.9	809.8	1.27	816.5	3688	181.37	14.05	7.74%	29.39
RodD4_88.3	241	2.243	-0.005	714.3	10810.4	651.5	1.27	664.9	4643	218.90	16.04	7.33%	47.73
RodD4_91.3	242	2.319	0.071	744.7	11046.6	663.4	1.27	680.8	4519	173.03	11.99	6.93%	36.47
RodD4_93.2	243	2.367	0.119	759.2	11191.0	670.9	1.27	689.9	4452	161.29	10.91	6.76%	33.35
RodD4_95.2	244	2.418	0.170	771.1	11346.1	678.8	1.27	698.5	4389	156.39	10.35	6.62%	31.76
RodD4_142.1	248	3.609	0.218	841.6	4362.2	809.7	1.27	816.5	3689	173.68	13.47	7.76%	28.14
RodE4_88.4	201	2.245	-0.003	710.4	10646.8	651.9	1.27	664.4	4648	231.37	17.23	7.45%	50.51
RodE4_91.2	202	2.316	0.069	739.4	10855.6	663.0	1.27	679.4	4530	180.84	12.71	7.03%	38.23
RodE4_95.3	204	2.421	0.173	769.4	11153.7	679.2	1.27	698.5	4389	157.30	10.49	6.67%	31.95
RodE4_100.9	205	2.563	0.315	794.9	11565.9	700.6	1.27	720.7	4236	156.06	9.88	6.33%	30.29
RodE4_142.3	208	3.614	0.224	837.2	4399.4	809.9	1.27	815.7	3692	205.05	17.12	8.35%	33.27
RodE3_63.4	193	1.610	0.417	646.5	8810.9	552.5	1.20	568.1	5579	112.38	10.06	8.95%	30.62
RodE3_113.6	194	2.885	0.022	806.0	10863.7	745.0	1.27	758.1	4003	226.67	14.36	6.33%	40.90
RodE3_115.5	195	2.934	0.070	818.3	10461.7	751.0	1.27	765.4	3960	197.94	12.32	6.23%	35.22
RodE3_118.5	196	3.010	0.146	829.9	9822.4	760.1	1.27	775.1	3906	179.23	11.09	6.19%	31.32
RodE3_122.7	197	3.117	0.253	837.9	8930.4	772.0	1.27	786.1	3846	172.40	10.74	6.23%	29.51
RodE3_126.5	198	3.213	0.349	839.5	8123.8	781.7	1.27	794.1	3803	178.73	11.38	6.37%	30.15
RodE3_131.7	199	3.345	-0.046	820.2	7024.3	793.2	1.27	799.0	3777	331.93	27.75	8.36%	55.50
RodE3_135.6	200	3.444	0.053	829.5	6190.3	800.5	1.27	806.7	3737	271.63	21.81	8.03%	44.79

Table SC-3248-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	647.6	8647.4	553.6	1.20	569.3	5566	110.43	10.02	9.07%	30.01
RodC5_113.6	226	2.885	0.022	803.1	10606.6	745.0	1.27	757.5	4007	232.30	14.94	6.43%	41.96
RodC5_115.7	227	2.939	0.075	818.8	10181.2	751.7	1.27	766.0	3957	192.99	12.09	6.27%	34.30
RodC5_122.7	229	3.117	0.253	839.1	8768.7	772.0	1.27	786.3	3844	166.15	10.37	6.24%	28.43
RodC5_126.7	230	3.218	0.354	841.1	7960.8	782.1	1.27	794.8	3799	171.79	10.94	6.37%	28.94
RodC5_131.6	231	3.343	-0.048	827.6	6972.2	793.0	1.27	800.4	3770	256.60	19.07	7.43%	42.79
RodC5_135.7	232	3.447	0.056	836.1	6141.7	800.7	1.27	808.3	3730	220.40	16.16	7.33%	36.24
RodE5_63.6	209	1.615	0.422	647.3	8884.3	553.2	1.20	568.9	5570	113.26	10.05	8.88%	30.81
RodE5_113.6	210	2.885	0.022	802.7	10950.2	745.0	1.27	757.4	4007	241.39	15.42	6.39%	43.61
RodE5_115.4	211	2.931	0.067	811.2	10575.6	750.7	1.27	763.7	3971	222.47	14.07	6.32%	39.71
RodE5_118.7	212	3.015	0.151	818.6	9880.2	760.7	1.27	773.1	3917	217.23	13.84	6.37%	38.09
RodE5_122.6	213	3.114	0.250	826.4	9061.9	771.7	1.27	783.4	3860	210.69	13.56	6.43%	36.25
RodE5_126.6	214	3.216	0.352	831.8	8227.5	781.9	1.27	792.6	3811	209.85	13.77	6.56%	35.50
RodE5_131.6	215	3.343	-0.048	817.9	7177.9	793.0	1.27	798.4	3780	367.41	32.05	8.72%	61.50
RodE5_135.6	216	3.444	0.053	827.8	6335.9	800.5	1.27	806.4	3739	296.02	24.48	8.27%	48.84
RodC3_79.8	177	2.027	0.227	699.4	10031.0	617.2	1.27	634.8	4899	155.35	12.21	7.86%	36.20
RodC3_85.6	178	2.174	0.374	697.4	10469.8	640.6	1.27	652.8	4743	234.51	17.99	7.67%	52.51
RodC3_88.5	179	2.248	0.000	698.7	10686.7	652.3	1.27	662.2	4665	292.90	22.67	7.74%	64.24
RodC3_92.4	180	2.347	0.099	738.2	10980.1	667.8	1.27	682.9	4504	198.35	13.88	7.00%	41.62
RodC3_94.4	181	2.398	0.150	750.9	11131.7	675.7	1.27	691.8	4438	188.19	12.84	6.82%	38.76
RodC3_97.2	182	2.469	0.221	765.5	11339.3	686.5	1.27	703.4	4355	182.75	12.11	6.62%	36.74
RodC3_108.8	183	2.764	0.516	800.6	11957.1	729.0	1.27	744.3	4086	212.45	13.10	6.17%	39.36
RodD5_50	217	1.270	0.076	590.9	7835.3	505.0	1.20	519.3	6208	109.43	12.11	11.06%	33.68
RodD5_54.1	218	1.374	0.180	616.4	8148.3	518.7	1.20	535.0	5992	100.12	10.32	10.31%	29.61
RodD5_56.9	219	1.445	0.251	630.1	8358.3	528.6	1.20	545.5	5855	98.81	9.73	9.85%	28.47
RodD5_60	220	1.524	0.330	642.4	8589.3	539.8	1.20	556.9	5713	100.48	9.43	9.38%	28.15
RodD5_66.1	221	1.679	0.485	655.4	9051.5	562.8	1.20	578.2	5465	117.24	10.05	8.57%	31.18
RodD5_69.9	222	1.775	-0.025	634.7	9332.0	577.6	1.20	587.1	5367	196.21	16.49	8.40%	51.07
RodD5_72.9	223	1.852	0.051	667.7	9560.0	589.5	1.20	602.5	5207	146.64	11.49	7.84%	36.80
RodD5_74.9	224	1.902	0.102	684.5	9710.3	597.5	1.20	612.0	5112	133.81	10.12	7.56%	32.85

Table SC-3248-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	$\pm\sigma_{htc}$ (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	564.0	7121.4	479.3	1.20	493.4	6601	100.90	13.04	12.92%	33.18
RodB5_52.9	154	1.344	0.150	602.7	8025.0	512.5	1.20	527.5	6093	106.83	11.30	10.57%	32.20
RodB5_55	155	1.397	0.203	612.0	8185.1	518.9	1.20	534.4	6000	105.54	10.78	10.21%	31.26
RodB5_57.8	156	1.468	0.274	625.2	8398.6	527.6	1.20	543.9	5875	103.36	10.08	9.75%	29.90
RodB5_64	157	1.626	0.432	644.6	8872.3	547.7	1.20	563.9	5629	109.88	9.72	8.85%	30.25
RodB5_73.9	158	1.877	0.077	668.0	9622.9	581.5	1.20	595.9	5274	133.48	10.25	7.68%	34.02
RodB5_75.9	159	1.928	0.128	682.0	9776.7	588.5	1.20	604.1	5191	125.51	9.32	7.43%	31.38
RodB5_76.9	160	1.953	0.153	688.2	9854.5	592.0	1.20	608.1	5151	123.02	8.99	7.31%	30.48
RodF5_41	105	1.041	0.343	565.4	7069.2	479.3	1.20	493.7	6597	98.51	12.81	13.00%	32.37
RodF5_53.1	106	1.349	0.155	601.2	7986.6	513.1	1.20	527.8	6089	108.78	11.54	10.61%	32.77
RodF5_55	107	1.397	0.203	610.6	8131.8	518.9	1.20	534.2	6003	106.44	10.93	10.27%	31.55
RodF5_57.8	108	1.468	0.274	622.1	8345.1	527.6	1.20	543.4	5882	105.99	10.40	9.81%	30.70
RodF5_64	109	1.626	0.432	637.8	8817.2	547.7	1.20	562.8	5643	117.49	10.48	8.92%	32.44
RodF5_73.8	110	1.875	0.074	658.9	9562.5	581.2	1.20	594.1	5293	147.62	11.49	7.78%	37.79
RodF5_75.8	111	1.925	0.125	673.6	9714.7	588.2	1.20	602.4	5208	136.47	10.25	7.51%	34.26
RodF5_76.8	112	1.951	0.150	679.7	9789.1	591.7	1.20	606.4	5168	133.42	9.86	7.39%	33.18
RodC2_41	57	1.041	0.343	547.7	7108.3	479.3	1.20	490.7	6645	124.72	16.24	13.02%	41.30
RodC2_53.1	58	1.349	0.155	561.4	8046.0	513.1	1.20	521.2	6182	199.96	21.82	10.91%	61.25
RodC2_55	59	1.397	0.203	603.4	8195.3	518.9	1.20	533.0	6019	116.40	11.91	10.23%	34.61
RodC2_57.8	60	1.468	0.274	610.8	8411.0	527.6	1.20	541.5	5906	121.37	11.88	9.79%	35.32
RodC2_63.9	61	1.623	0.429	622.3	8876.5	547.4	1.20	559.9	5677	142.23	12.74	8.96%	39.55
RodC2_73.8	62	1.875	0.074	635.6	9628.9	581.2	1.20	590.2	5334	212.41	17.04	8.02%	54.88
RodC2_75.8	63	1.925	0.125	665.1	9775.3	588.2	1.20	601.0	5222	152.48	11.49	7.53%	38.41
RodC2_76.8	64	1.951	0.150	669.9	9852.9	591.7	1.20	604.7	5184	151.18	11.22	7.42%	37.75
RodC6_40.9	137	1.039	0.340	567.2	7072.0	479.1	1.20	493.7	6595	96.24	12.51	13.00%	31.62
RodC6_52.8	138	1.341	0.147	604.7	8018.3	512.2	1.20	527.6	6092	104.02	11.01	10.58%	31.35
RodC6_54.8	139	1.392	0.198	614.5	8173.0	518.3	1.20	534.3	6001	101.90	10.43	10.23%	30.19
RodC6_57.8	140	1.468	0.274	627.8	8411.2	527.6	1.20	544.3	5870	100.82	9.81	9.73%	29.14
RodC6_63.8	141	1.621	0.427	645.0	8889.7	547.1	1.20	563.4	5635	108.90	9.63	8.84%	30.02
RodC6_73.7	142	1.872	0.072	669.1	9673.8	580.8	1.20	595.5	5278	131.45	10.06	7.65%	33.54
RodC6_75.8	143	1.925	0.125	678.6	9838.7	588.2	1.20	603.2	5199	130.48	9.67	7.41%	32.69
RodC6_76.8	144	1.951	0.150	685.5	9918.6	591.7	1.20	607.3	5158	126.89	9.25	7.29%	31.49

Table SC-3248-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	701.3	10640.6	633.0	1.27	647.6	4787	198.15	14.48	7.31%	44.87
RodB4_91.3	162	2.319	0.071	732.4	10854.6	643.4	1.27	662.4	4664	155.17	10.76	6.94%	34.02
RodB4_93.3	163	2.370	0.122	746.8	10998.9	650.5	1.27	671.1	4594	145.42	9.84	6.77%	31.29
RodB4_95.1	164	2.416	0.168	757.6	11131.3	656.9	1.27	678.5	4537	140.74	9.34	6.64%	29.81
RodB4_100	165	2.540	0.292	780.5	11490.7	674.2	1.27	697.0	4400	137.60	8.71	6.33%	28.04
RodB4_106	166	2.692	0.445	797.1	11932.6	695.0	1.27	716.9	4262	148.73	8.99	6.04%	29.10
RodB4_109.9	167	2.791	0.544	782.4	11551.9	708.2	1.27	724.1	4214	197.93	12.20	6.16%	38.16
RodB4_142.3	168	3.614	0.224	833.2	4472.0	799.9	1.27	807.0	3736	170.65	12.91	7.57%	28.12
RodF4_85.6	98	2.174	0.374	698.5	10497.4	623.0	1.27	639.2	4860	176.79	13.11	7.42%	40.80
RodF4_88.4	99	2.245	-0.003	700.7	10705.1	633.0	1.27	647.5	4788	201.34	14.68	7.29%	45.61
RodF4_92.4	100	2.347	0.099	738.8	11007.3	647.3	1.27	666.9	4628	153.15	10.46	6.83%	33.25
RodF4_94.3	101	2.395	0.147	752.1	11150.2	654.1	1.27	675.1	4564	144.80	9.67	6.68%	30.89
RodF4_97.2	102	2.469	0.221	767.7	11368.4	664.4	1.27	686.5	4477	139.97	9.07	6.48%	29.15
RodF4_108.8	103	2.764	0.516	801.7	12001.1	704.5	1.27	725.3	4206	157.13	9.37	5.96%	30.22
RodF4_111	104	2.819	-0.044	783.3	11514.5	711.8	1.27	727.2	4194	204.91	12.63	6.16%	39.27
RodD2_103.2	65	2.621	0.373	781.1	11886.9	685.4	1.27	705.9	4337	158.00	9.76	6.18%	31.61
RodD2_106	66	2.692	0.445	787.2	12097.1	695.0	1.27	714.7	4277	166.99	10.13	6.07%	32.81
RodD2_112.6	67	2.860	-0.004	772.5	11097.9	717.1	1.27	729.0	4182	254.83	16.44	6.45%	48.66
RodD2_114.9	68	2.918	0.055	792.0	10581.3	724.6	1.27	739.0	4119	199.92	12.45	6.23%	37.42
RodD2_117.4	69	2.982	0.118	802.8	10021.4	732.6	1.27	747.6	4066	181.70	11.24	6.19%	33.45
RodD2_120.8	70	3.068	0.204	816.8	9261.3	743.1	1.27	758.9	3998	159.87	9.83	6.15%	28.80
RodD2_124.8	71	3.170	0.306	821.9	8360.0	755.1	1.27	769.4	3938	159.15	9.92	6.23%	28.10
RodD2_128.6	72	3.266	0.403	821.8	7509.0	765.9	1.27	777.9	3890	170.84	11.01	6.44%	29.69
RodD6_103.1	129	2.619	0.371	788.8	11902.0	685.0	1.27	707.2	4328	145.99	8.97	6.14%	29.12
RodD6_106	130	2.692	0.445	795.9	12119.2	695.0	1.27	716.6	4264	152.91	9.20	6.02%	29.93
RodD6_112.9	131	2.868	0.004	784.9	11055.0	718.1	1.27	732.4	4160	210.61	13.12	6.23%	39.94
RodD6_114.9	132	2.918	0.055	800.2	10606.2	724.6	1.27	740.8	4108	178.49	10.93	6.12%	33.30
RodD6_116.8	133	2.967	0.103	810.5	10175.3	730.7	1.27	747.8	4065	162.11	9.86	6.08%	29.83
RodD6_120.9	134	3.071	0.207	820.4	9247.2	743.4	1.27	759.9	3992	152.93	9.34	6.11%	27.49
RodD6_124.8	135	3.170	0.306	826.4	8363.0	755.1	1.27	770.4	3932	149.25	9.22	6.17%	26.31
RodD6_128.7	136	3.269	0.405	828.1	7484.5	766.2	1.27	779.4	3882	153.93	9.72	6.32%	26.68

Table SC-3248-B.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	583.4	7849.1	504.2	1.20	517.4	6236	118.91	13.16	11.07%	36.77
RodE2_54	74	1.372	0.178	607.3	8151.2	515.9	1.20	531.1	6045	107.01	11.06	10.34%	31.97
RodE2_56.9	75	1.445	0.251	620.4	8373.2	524.8	1.20	540.7	5916	105.11	10.36	9.85%	30.65
RodE2_59.9	76	1.521	0.328	633.1	8603.6	534.3	1.20	550.8	5788	104.58	9.82	9.39%	29.74
RodE2_66	77	1.676	0.483	642.9	9072.9	554.4	1.20	569.2	5567	122.99	10.55	8.58%	33.43
RodE2_69.8	78	1.773	-0.027	623.6	9364.4	567.3	1.20	576.7	5482	199.67	16.78	8.40%	53.29
RodE2_72.9	79	1.852	0.051	651.3	9602.1	578.0	1.20	590.2	5334	157.28	12.35	7.85%	40.64
RodE2_74.9	80	1.902	0.102	662.1	9756.1	585.0	1.20	597.9	5254	151.82	11.54	7.60%	38.52
RodB3_50.2	169	1.275	0.081	580.6	7808.0	504.5	1.20	517.2	6239	123.22	13.71	11.13%	38.13
RodB3_54.1	170	1.374	0.180	600.4	8104.0	516.2	1.20	530.2	6057	115.41	12.01	10.41%	34.55
RodB3_56.9	171	1.445	0.251	613.2	8317.4	524.8	1.20	539.5	5932	112.91	11.22	9.93%	33.02
RodB3_60.1	172	1.527	0.333	624.8	8562.1	535.0	1.20	550.0	5799	114.42	10.80	9.44%	32.61
RodB3_66.1	173	1.679	0.485	636.6	9017.0	554.8	1.20	568.4	5576	132.22	11.43	8.64%	36.01
RodB3_69.9	174	1.775	-0.025	619.0	9306.0	567.7	1.20	576.2	5487	217.38	18.55	8.53%	58.08
RodB3_73	175	1.854	0.054	651.2	9542.4	578.4	1.20	590.5	5331	157.32	12.40	7.89%	40.62
RodB3_75	176	1.905	0.105	666.3	9694.6	585.4	1.20	598.8	5244	143.75	10.93	7.60%	36.39
RodF3_50.1	89	1.273	0.079	587.5	7807.5	504.2	1.20	518.1	6226	112.45	12.48	11.10%	34.72
RodF3_54	90	1.372	0.178	609.5	8110.2	515.9	1.20	531.5	6039	103.88	10.78	10.37%	31.00
RodF3_57	91	1.448	0.254	621.9	8344.3	525.1	1.20	541.3	5909	103.44	10.21	9.87%	30.12
RodF3_60	92	1.524	0.330	632.1	8578.8	534.7	1.20	550.9	5787	105.69	9.94	9.40%	30.05
RodF3_66.1	93	1.679	0.485	637.5	9050.7	554.8	1.20	568.5	5575	131.21	11.30	8.61%	35.72
RodF3_70	94	1.778	-0.022	625.0	9350.8	568.0	1.20	577.5	5473	196.86	16.51	8.39%	52.44
RodF3_73	95	1.854	0.054	654.7	9583.2	578.4	1.20	591.1	5325	150.73	11.80	7.83%	38.86
RodF3_75	96	1.905	0.105	670.9	9739.2	585.4	1.20	599.6	5236	136.69	10.32	7.55%	34.54
RodE6_50.2	121	1.275	0.081	583.3	7800.6	504.5	1.20	517.7	6232	118.77	13.21	11.12%	36.71
RodE6_54.1	122	1.374	0.180	605.0	8094.2	516.2	1.20	531.0	6046	109.39	11.38	10.40%	32.69
RodE6_57	123	1.448	0.254	617.0	8313.9	525.1	1.20	540.4	5920	108.60	10.77	9.92%	31.69
RodE6_60.2	124	1.529	0.335	629.0	8555.4	535.3	1.20	550.9	5787	109.59	10.33	9.42%	31.15
RodE6_66.1	125	1.679	0.485	641.5	8997.1	554.8	1.20	569.2	5567	124.46	10.75	8.63%	33.83
RodE6_70	126	1.778	-0.022	624.6	9290.2	568.0	1.20	577.4	5473	196.89	16.60	8.43%	52.45
RodE6_73.1	127	1.857	0.056	653.9	9524.0	578.7	1.20	591.2	5323	152.12	11.97	7.87%	39.21
RodE6_75	128	1.905	0.105	668.0	9669.5	585.4	1.20	599.1	5241	140.44	10.68	7.61%	35.53

RBHT Steam Cooling Test SC-3248-C

Matrix test # 4

Test date – 8/11/2005

Steady state time window: 27200 - 27500 sec

Inlet flow: 1.36 m³/min (48.1 ft³/min)

Inlet steam temperature: 408 K (276 °F)

Upper plenum pressure: 271.0 kPa (39.3 psia)

Bundle power: 30.0 kW

Outlet steam temperature: 590 K (603 °F)

Bundle inlet Reynolds number: 5448

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution. Experiment SC-3248 was run with the traversing probes withdrawn. Centerline steam temperatures used are from experiment SC-3163-A.

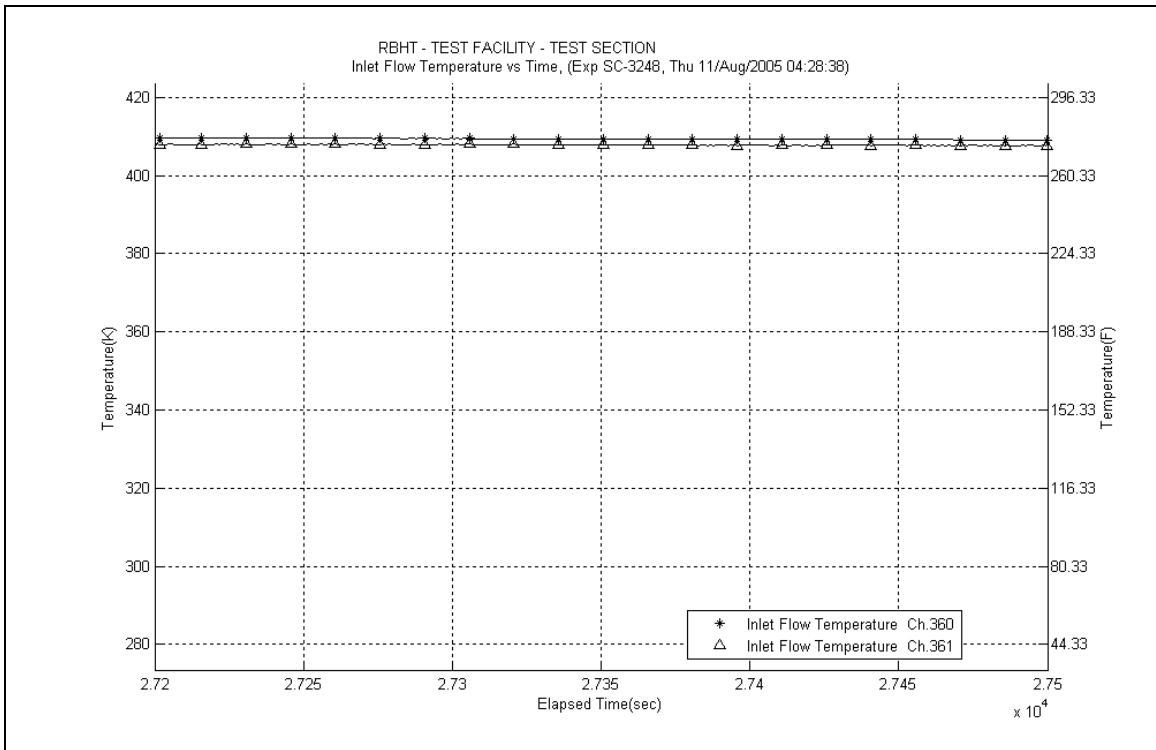
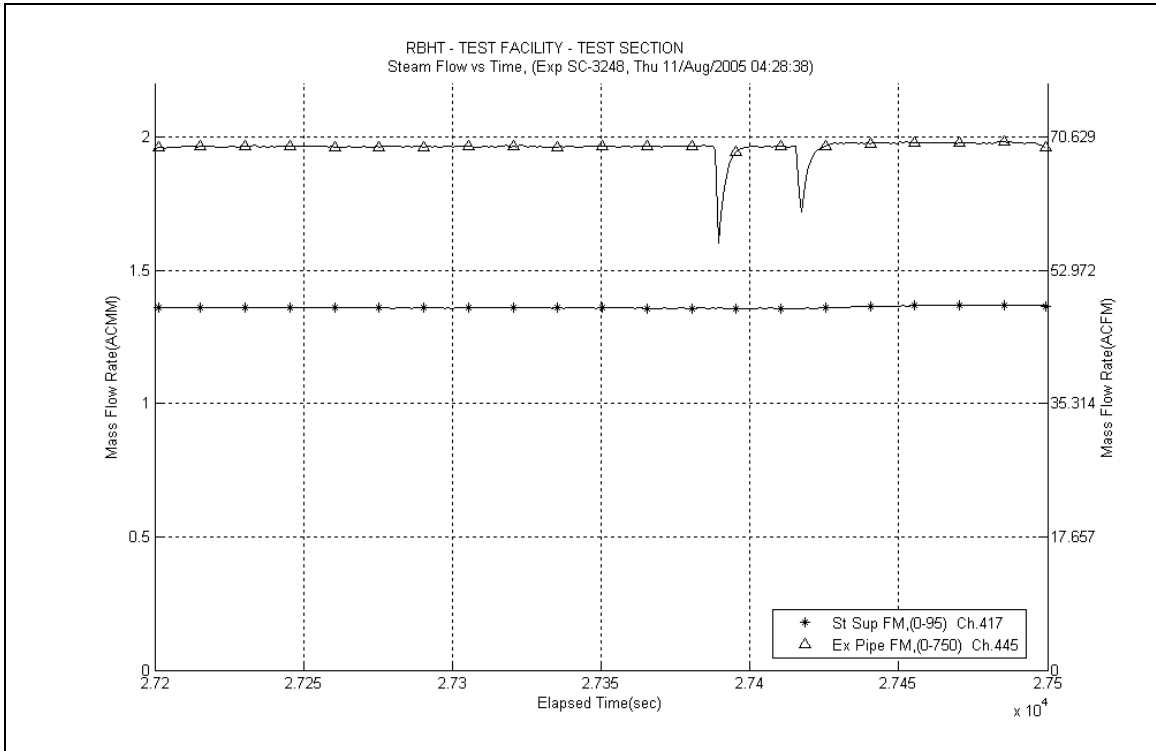
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

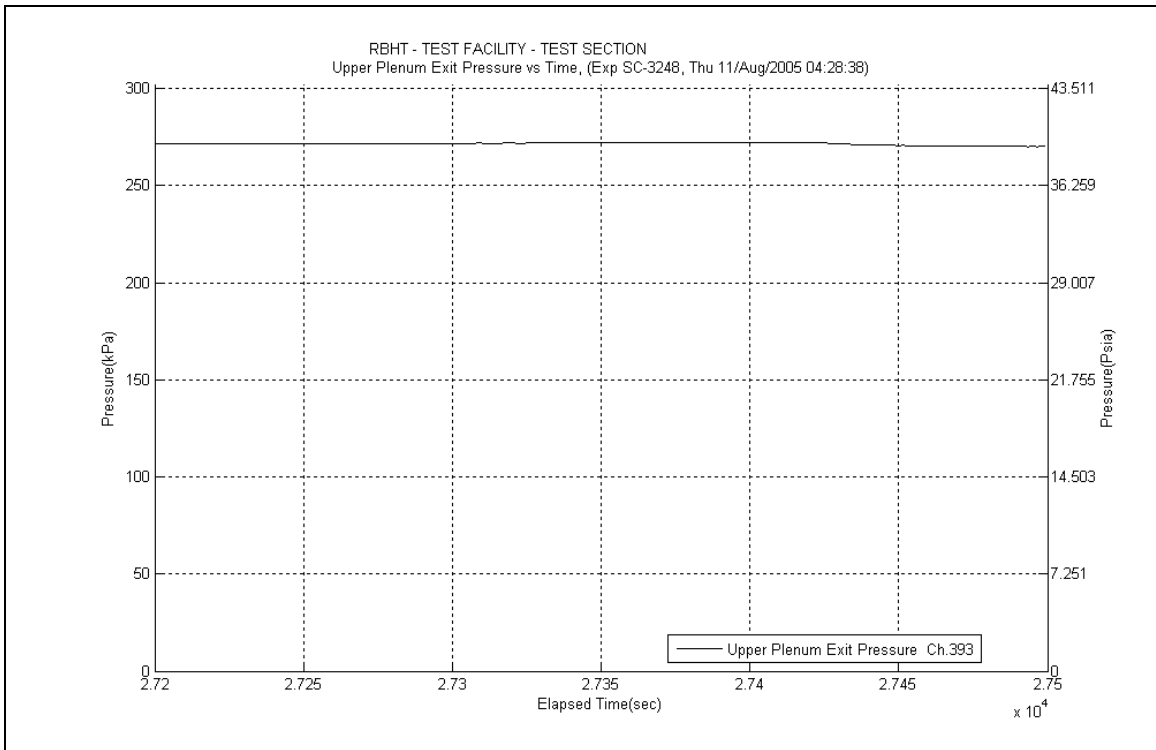
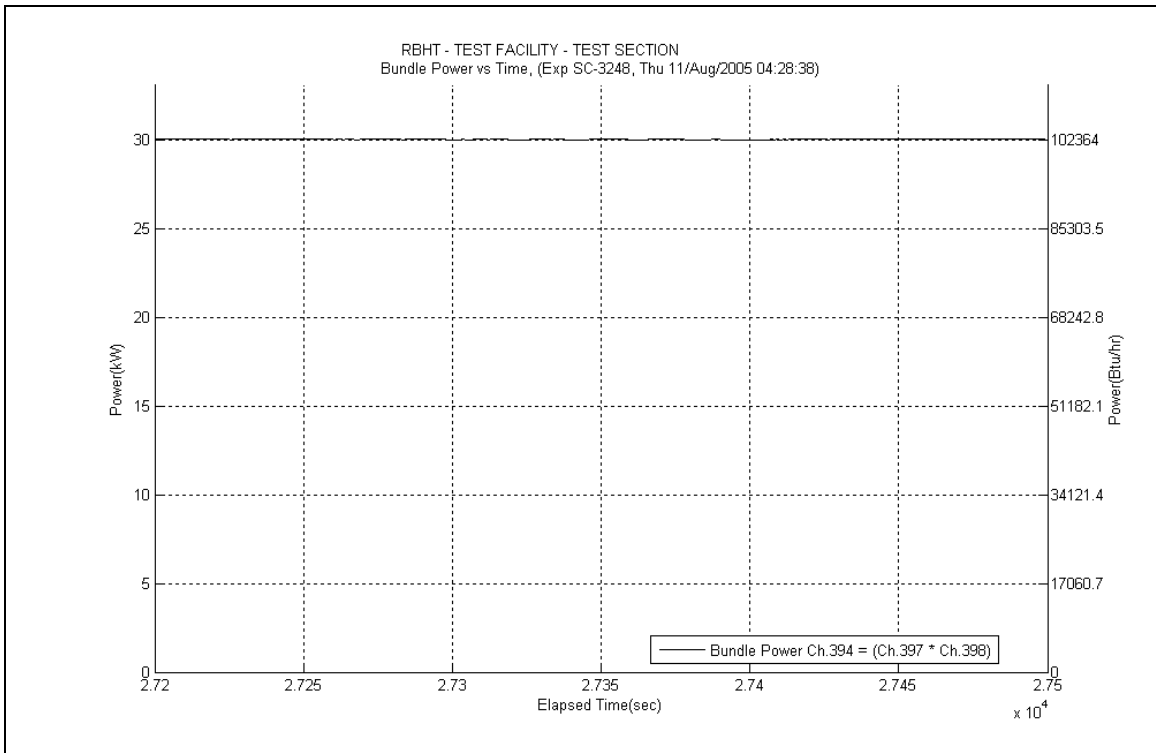
$$T_{cl} = -16.388x^3 + 100.57x^2 - 49.17x + 436.12$$

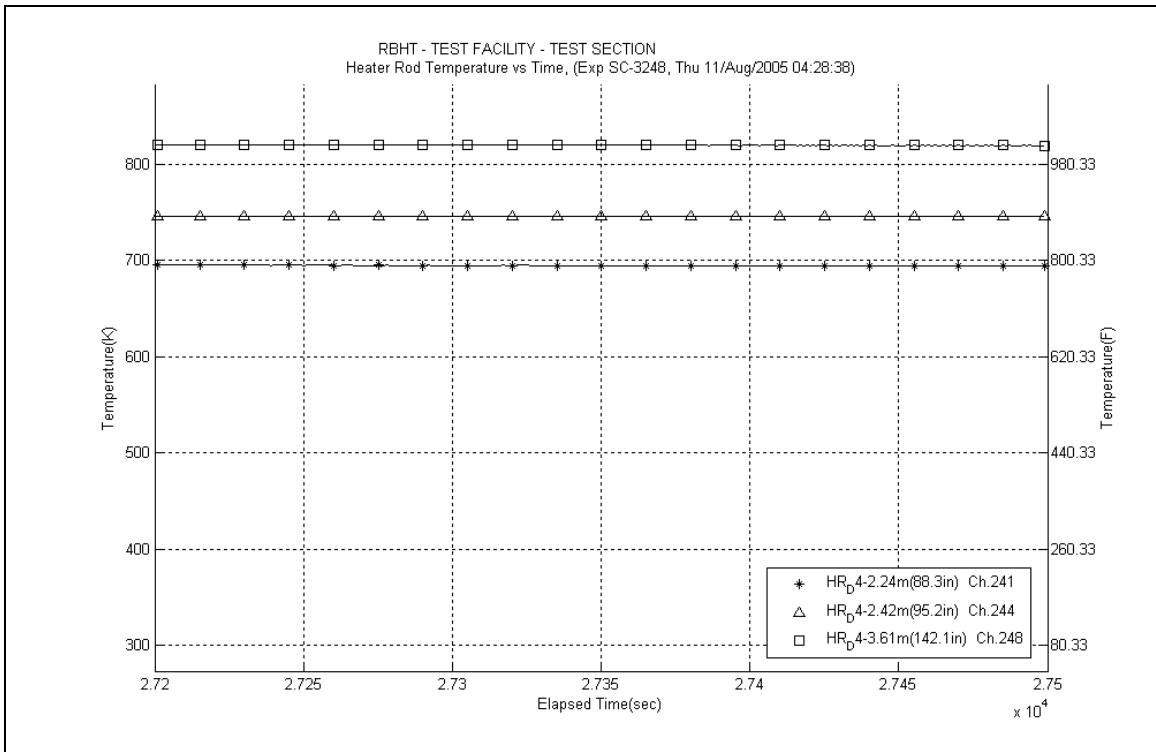
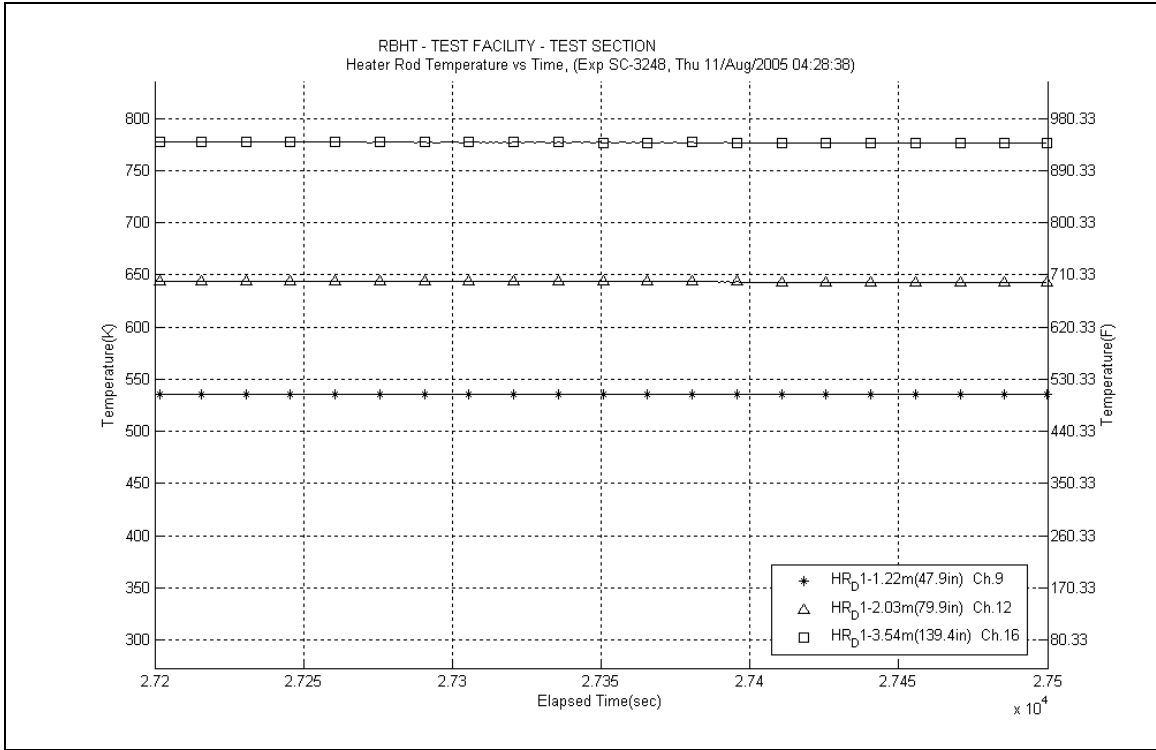
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

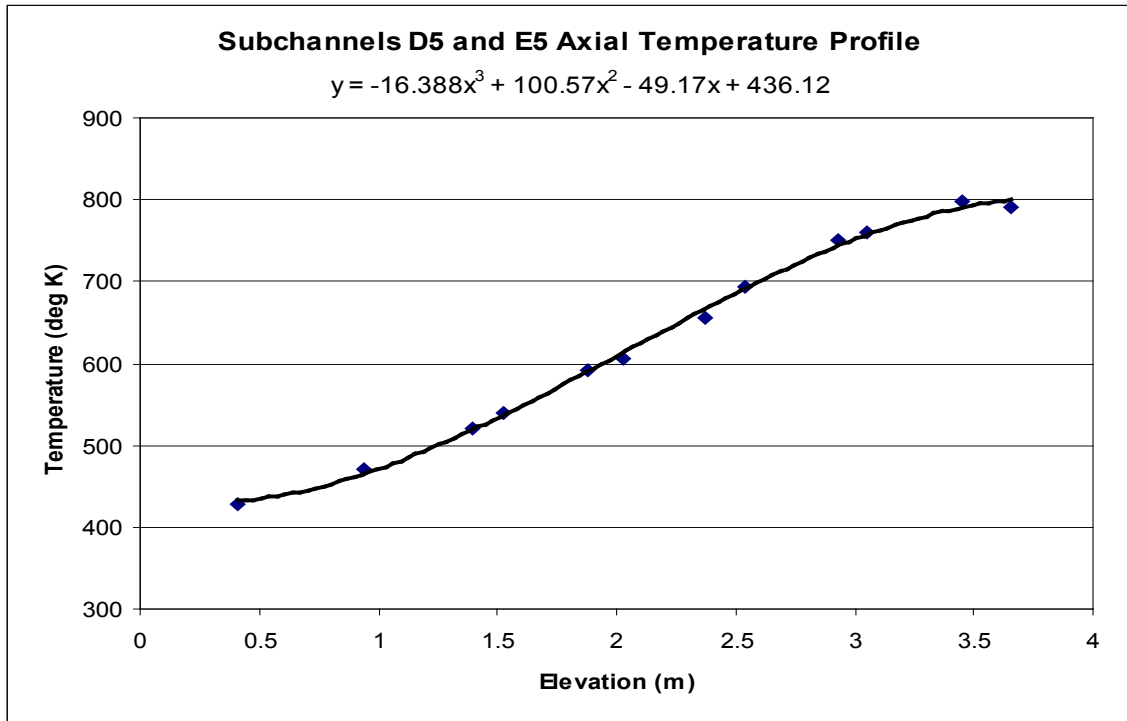
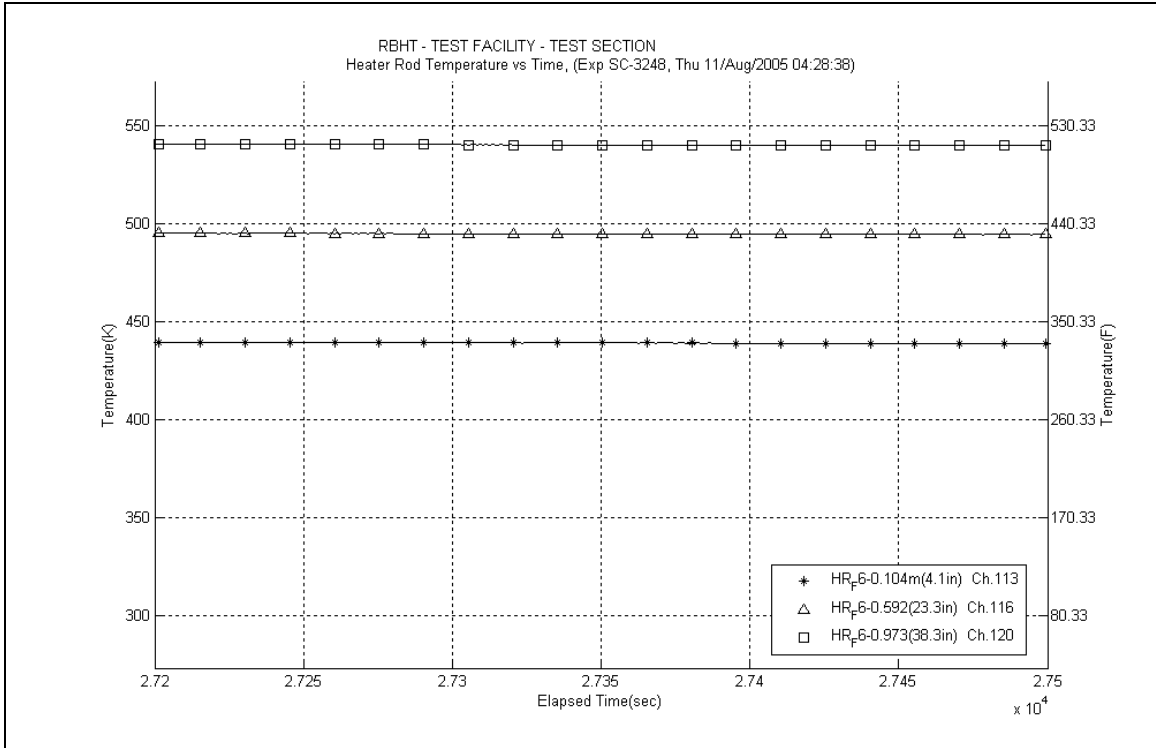
$$T_{cl} = -8.9366x^3 + 58.937x^2 + 6.0702x + 417.72$$

where x is the elevation (m) and T_{cl} is in (K)









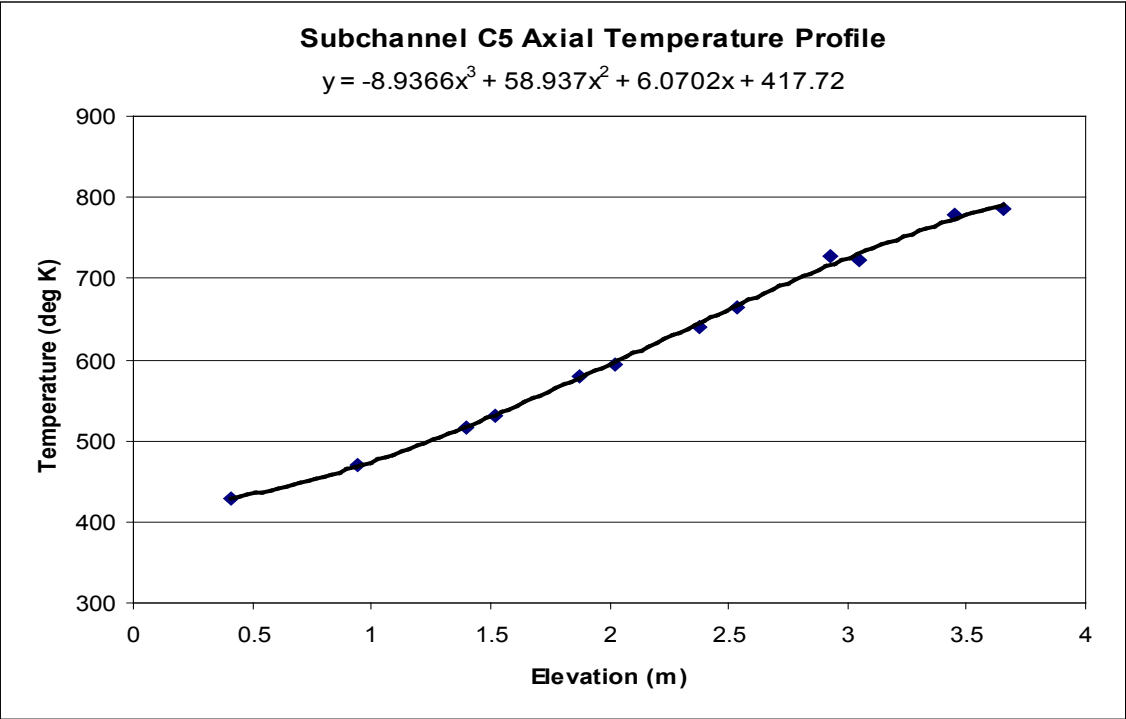


Table SC-3248-C.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	684.0	8053.6	646.8	1.27	654.7	3585	275.04	25.56	9.29%	61.32
RodD3_91.3	186	2.319	0.071	714.4	8223.0	658.6	1.27	670.4	3489	186.98	15.66	8.38%	40.29
RodD3_93.1	187	2.365	0.117	728.7	8324.9	665.5	1.27	678.9	3439	167.38	13.53	8.09%	35.42
RodD3_95.3	188	2.421	0.173	741.9	8450.5	673.9	1.27	688.4	3385	157.80	12.34	7.82%	32.73
RodD3_100.1	189	2.543	0.295	765.5	8724.9	691.9	1.27	707.5	3281	150.53	11.06	7.35%	30.01
RodD3_106.1	190	2.695	0.447	785.3	9065.0	713.2	1.27	728.6	3174	159.74	11.03	6.91%	30.53
RodD3_110	191	2.794	0.546	776.2	8954.2	726.4	1.27	737.0	3134	228.12	16.32	7.15%	42.88
RodD3_142.1	192	3.609	0.218	812.9	3138.7	798.2	1.27	801.3	2856	271.16	35.41	13.06%	45.15
RodC4_88.4	233	2.245	-0.003	687.7	8147.0	647.2	1.27	655.8	3578	255.53	23.16	9.06%	56.83
RodC4_91.1	234	2.314	0.066	713.0	8305.1	657.8	1.27	669.5	3494	190.84	15.94	8.35%	41.20
RodC4_93.4	235	2.372	0.124	727.9	8437.4	666.7	1.27	679.7	3434	175.05	14.06	8.03%	36.98
RodC4_95.3	236	2.421	0.173	739.5	8548.7	673.9	1.27	687.9	3388	165.52	12.91	7.80%	34.37
RodC4_100.1	237	2.543	0.295	762.2	8830.2	691.9	1.27	706.8	3285	159.41	11.70	7.34%	31.83
RodC4_106.1	238	2.695	0.447	783.6	9175.5	713.2	1.27	728.2	3176	165.74	11.42	6.89%	31.70
RodC4_110	239	2.794	0.546	773.7	8881.3	726.4	1.27	736.4	3136	238.52	17.32	7.26%	44.88
RodC4_142.2	240	3.612	0.221	818.3	3402.1	798.3	1.27	802.6	2851	215.88	22.52	10.43%	35.86
RodD4_88.3	241	2.243	-0.005	693.9	8119.4	646.8	1.27	656.8	3572	219.17	19.38	8.84%	48.64
RodD4_91.3	242	2.319	0.071	719.9	8291.8	658.6	1.27	671.6	3482	171.70	14.16	8.25%	36.91
RodD4_93.2	243	2.367	0.119	733.6	8399.2	665.9	1.27	680.3	3431	157.56	12.58	7.98%	33.24
RodD4_95.2	244	2.418	0.170	744.9	8516.6	673.5	1.27	688.7	3383	151.62	11.76	7.76%	31.43
RodD4_142.1	248	3.609	0.218	819.2	3289.0	798.2	1.27	802.7	2850	198.86	20.28	10.20%	33.03
RodE4_88.4	201	2.245	-0.003	690.0	7996.6	647.2	1.27	656.3	3575	237.29	21.49	9.06%	52.72
RodE4_91.2	202	2.316	0.069	715.4	8151.1	658.2	1.27	670.3	3489	180.84	15.19	8.40%	38.97
RodE4_95.3	204	2.421	0.173	743.2	8375.9	673.9	1.27	688.6	3383	153.64	12.05	7.84%	31.85
RodE4_100.9	205	2.563	0.315	767.1	8681.7	694.8	1.27	710.2	3267	152.40	11.17	7.33%	30.22
RodE4_142.3	208	3.614	0.224	814.9	3323.8	798.4	1.27	801.9	2853	256.33	30.56	11.92%	42.63
RodE3_63.4	193	1.610	0.417	628.3	6622.8	549.3	1.27	566.1	4250	106.53	12.76	11.98%	29.17
RodE3_113.6	194	2.885	0.022	780.9	8161.7	737.8	1.27	747.0	3086	240.68	17.96	7.46%	44.36
RodE3_115.5	195	2.934	0.070	792.0	7857.8	743.6	1.27	753.9	3055	206.13	14.94	7.25%	37.49
RodE3_118.5	196	3.010	0.146	803.8	7380.6	752.3	1.27	763.3	3013	182.26	13.03	7.15%	32.56
RodE3_122.7	197	3.117	0.253	812.6	6710.8	763.6	1.27	774.0	2967	173.84	12.52	7.20%	30.43
RodE3_126.5	198	3.213	0.349	815.4	6107.4	772.8	1.27	781.8	2934	182.07	13.55	7.44%	31.42
RodE3_131.7	199	3.345	-0.046	800.5	5279.8	783.6	1.27	787.1	2912	396.77	46.22	11.65%	67.79
RodE3_135.6	200	3.444	0.053	807.0	4658.1	790.2	1.27	793.8	2886	351.45	41.00	11.67%	59.32

Table SC-3248-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hfc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	629.3	6496.4	550.4	1.27	567.2	4240	104.62	12.70	12.14%	28.57
RodC5_113.6	226	2.885	0.022	777.1	7959.5	737.8	1.27	746.2	3090	257.67	19.91	7.73%	47.57
RodC5_115.7	227	2.939	0.075	791.2	7643.8	744.2	1.27	754.2	3054	206.74	15.22	7.36%	37.58
RodC5_122.7	229	3.117	0.253	811.9	6585.7	763.6	1.27	773.9	2968	173.23	12.61	7.28%	30.34
RodC5_126.7	230	3.218	0.354	815.2	5979.2	773.2	1.27	782.2	2933	180.75	13.57	7.51%	31.17
RodC5_131.6	231	3.343	-0.048	806.2	5244.6	783.4	1.27	788.2	2908	292.06	28.14	9.64%	49.80
RodC5_135.7	232	3.447	0.056	812.0	4620.7	790.3	1.27	794.9	2881	271.52	26.91	9.91%	45.73
RodE5_63.6	209	1.615	0.422	624.3	6654.3	550.0	1.27	565.8	4252	113.77	13.58	11.94%	31.18
RodE5_113.6	210	2.885	0.022	775.2	8211.9	737.8	1.27	745.8	3092	279.57	21.73	7.77%	51.65
RodE5_115.4	211	2.931	0.067	783.0	7932.2	743.3	1.27	751.8	3065	254.14	19.36	7.62%	46.41
RodE5_118.7	212	3.015	0.151	791.7	7415.2	752.9	1.27	761.1	3023	242.99	18.60	7.66%	43.59
RodE5_122.6	213	3.114	0.250	799.9	6801.8	763.4	1.27	771.1	2979	236.42	18.41	7.79%	41.62
RodE5_126.6	214	3.216	0.352	805.9	6173.4	773.0	1.27	780.0	2942	238.38	19.23	8.07%	41.27
RodE5_131.6	215	3.343	-0.048	797.4	5395.1	783.4	1.27	786.4	2916	488.06	65.14	13.35%	83.51
RodE5_135.6	216	3.444	0.053	803.9	4766.8	790.2	1.27	793.1	2888	442.76	60.24	13.61%	74.83
RodC3_79.8	177	2.027	0.227	676.0	7530.7	613.2	1.27	626.5	3773	152.09	14.60	9.60%	36.11
RodC3_85.6	178	2.174	0.374	678.9	7858.5	636.2	1.27	645.3	3646	233.46	21.80	9.34%	53.15
RodC3_88.5	179	2.248	0.000	680.0	8022.5	647.6	1.27	654.5	3587	314.38	30.27	9.63%	70.12
RodC3_92.4	180	2.347	0.099	714.6	8240.7	662.8	1.27	673.8	3469	202.13	16.94	8.38%	43.24
RodC3_94.4	181	2.398	0.150	726.7	8351.6	670.5	1.27	682.5	3418	188.58	15.27	8.10%	39.61
RodC3_97.2	182	2.469	0.221	740.7	8511.9	681.1	1.27	693.8	3355	181.53	14.14	7.79%	37.23
RodC3_108.8	183	2.764	0.516	775.0	8971.5	722.4	1.27	733.6	3150	216.49	15.43	7.13%	40.96
RodD5_50	217	1.270	0.076	572.1	5881.8	502.3	1.27	517.1	4733	107.08	15.84	14.80%	33.14
RodD5_54.1	218	1.374	0.180	595.1	6113.7	515.9	1.27	532.8	4567	98.08	13.55	13.81%	29.18
RodD5_56.9	219	1.445	0.251	607.4	6268.6	525.6	1.27	543.0	4465	97.43	12.87	13.21%	28.25
RodD5_60	220	1.524	0.330	619.0	6444.3	536.8	1.27	554.2	4358	99.52	12.52	12.58%	28.06
RodD5_66.1	221	1.679	0.485	633.6	6788.2	559.5	1.27	575.2	4170	116.34	13.39	11.51%	31.16
RodD5_69.9	222	1.775	-0.025	618.1	7005.2	574.1	1.27	583.5	4101	202.08	22.79	11.28%	53.06
RodD5_72.9	223	1.852	0.051	646.4	7173.8	585.8	1.27	598.7	3978	150.52	15.85	10.53%	38.12
RodD5_74.9	224	1.902	0.102	661.6	7285.5	593.7	1.27	608.2	3906	136.26	13.88	10.18%	33.75

Table SC-3248-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	549.9	5346.5	477.9	1.20	489.9	5050	89.04	15.06	16.92%	29.55
RodB5_52.9	154	1.344	0.150	583.4	6024.8	510.6	1.27	526.1	4637	105.15	14.88	14.15%	31.81
RodB5_55	155	1.397	0.203	591.9	6144.2	516.9	1.27	532.8	4567	104.00	14.22	13.67%	30.93
RodB5_57.8	156	1.468	0.274	604.2	6303.7	525.4	1.27	542.1	4473	101.54	13.26	13.06%	29.50
RodB5_64	157	1.626	0.432	624.7	6658.9	544.9	1.27	561.9	4287	106.01	12.58	11.86%	29.33
RodB5_73.9	158	1.877	0.077	646.6	7220.7	577.7	1.27	592.3	4029	132.96	13.72	10.32%	34.18
RodB5_75.9	159	1.928	0.128	659.2	7335.8	584.4	1.27	600.3	3966	124.56	12.45	10.00%	31.42
RodB5_76.9	160	1.953	0.153	664.7	7389.9	587.8	1.27	604.2	3936	122.10	12.02	9.85%	30.53
RodF5_41	105	1.041	0.343	552.4	5314.4	477.9	1.20	490.3	5045	85.51	14.54	17.00%	28.34
RodF5_53.1	106	1.349	0.155	583.3	6005.0	511.2	1.27	526.5	4632	105.72	14.98	14.17%	31.95
RodF5_55	107	1.397	0.203	592.5	6112.7	516.9	1.27	532.9	4566	102.59	14.09	13.73%	30.51
RodF5_57.8	108	1.468	0.274	604.0	6273.6	525.4	1.27	542.1	4474	101.41	13.30	13.12%	29.47
RodF5_64	109	1.626	0.432	621.2	6627.6	544.9	1.27	561.2	4294	110.40	13.16	11.92%	30.60
RodF5_73.8	110	1.875	0.074	638.3	7185.1	577.3	1.27	590.3	4045	149.60	15.61	10.44%	38.65
RodF5_75.8	111	1.925	0.125	651.6	7301.3	584.1	1.27	598.4	3980	137.44	13.87	10.09%	34.83
RodF5_76.8	112	1.951	0.150	657.2	7356.7	587.5	1.27	602.3	3950	133.95	13.31	9.94%	33.63
RodC2_41	57	1.041	0.343	535.9	5332.3	477.9	1.20	487.5	5079	110.29	18.79	17.04%	36.82
RodC2_53.1	58	1.349	0.155	548.9	6024.4	511.2	1.27	519.2	4710	202.74	29.60	14.60%	62.42
RodC2_55	59	1.397	0.203	587.4	6132.5	516.9	1.27	531.9	4577	110.38	15.14	13.72%	32.91
RodC2_57.8	60	1.468	0.274	594.7	6291.9	525.4	1.27	540.1	4493	115.25	15.13	13.13%	33.66
RodC2_63.9	61	1.623	0.429	605.0	6640.6	544.6	1.27	557.5	4328	139.62	16.79	12.03%	39.06
RodC2_73.8	62	1.875	0.074	620.9	7204.5	577.3	1.27	586.6	4075	209.78	22.53	10.74%	54.67
RodC2_75.8	63	1.925	0.125	642.2	7318.3	584.1	1.27	596.4	3996	160.10	16.28	10.17%	40.76
RodC2_76.8	64	1.951	0.150	646.5	7375.1	587.5	1.27	600.0	3968	158.66	15.89	10.02%	40.05
RodC6_40.9	137	1.039	0.340	554.2	5313.6	477.6	1.20	490.4	5044	83.24	14.16	17.01%	27.59
RodC6_52.8	138	1.341	0.147	586.0	6018.5	510.3	1.27	526.4	4633	101.05	14.31	14.16%	30.55
RodC6_54.8	139	1.392	0.198	595.5	6139.2	516.3	1.27	533.1	4564	98.45	13.47	13.69%	29.26
RodC6_57.8	140	1.468	0.274	607.9	6316.6	525.4	1.27	542.9	4466	97.17	12.66	13.03%	28.18
RodC6_63.8	141	1.621	0.427	626.7	6674.1	544.3	1.27	561.8	4288	102.81	12.18	11.85%	28.45
RodC6_73.7	142	1.872	0.072	648.0	7262.4	577.0	1.27	592.1	4031	129.86	13.34	10.27%	33.40
RodC6_75.8	143	1.925	0.125	657.5	7386.0	584.1	1.27	599.7	3971	127.82	12.74	9.96%	32.29
RodC6_76.8	144	1.951	0.150	663.7	7445.8	587.5	1.27	603.7	3940	124.17	12.18	9.81%	31.08

Table SC-3248-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hfc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	682.2	7985.8	627.3	1.27	639.0	3687	184.70	16.13	8.73%	42.64
RodB4_91.3	162	2.319	0.071	709.8	8146.6	637.3	1.27	652.7	3598	142.76	11.71	8.20%	31.97
RodB4_93.3	163	2.370	0.122	723.5	8253.1	644.2	1.27	661.0	3546	132.11	10.51	7.95%	29.05
RodB4_95.1	164	2.416	0.168	733.7	8356.1	650.3	1.27	668.0	3503	127.28	9.87	7.75%	27.57
RodB4_100	165	2.540	0.292	755.1	8627.1	666.9	1.27	685.7	3400	124.25	9.06	7.29%	25.92
RodB4_106	166	2.692	0.445	771.0	8955.9	686.9	1.27	704.8	3296	135.17	9.25	6.85%	27.10
RodB4_109.9	167	2.791	0.544	761.1	8671.8	699.5	1.27	712.6	3254	178.97	12.48	6.98%	35.31
RodB4_142.3	168	3.614	0.224	810.1	3377.8	787.6	1.27	792.4	2891	190.91	18.59	9.74%	32.30
RodF4_85.6	98	2.174	0.374	678.7	7878.8	617.7	1.27	630.7	3744	163.85	14.59	8.91%	38.54
RodF4_88.4	99	2.245	-0.003	680.5	8035.7	627.3	1.27	638.6	3690	192.09	16.78	8.74%	44.38
RodF4_92.4	100	2.347	0.099	714.2	8262.2	641.1	1.27	656.6	3573	143.42	11.56	8.06%	31.84
RodF4_94.3	101	2.395	0.147	726.7	8369.0	647.6	1.27	664.4	3525	134.39	10.52	7.83%	29.34
RodF4_97.2	102	2.469	0.221	742.1	8530.9	657.5	1.27	675.5	3459	127.96	9.63	7.53%	27.28
RodF4_108.8	103	2.764	0.516	774.8	9009.3	696.0	1.27	712.7	3254	145.16	9.76	6.72%	28.64
RodF4_111	104	2.819	-0.044	763.1	8645.0	703.0	1.27	715.8	3238	182.71	12.70	6.95%	35.82
RodD2_103.2	65	2.621	0.373	754.3	8915.2	677.6	1.27	693.9	3354	147.76	10.45	7.07%	30.30
RodD2_106	66	2.692	0.445	760.5	9076.9	686.9	1.27	702.5	3307	156.53	10.79	6.89%	31.53
RodD2_112.6	67	2.860	-0.004	750.2	8330.8	708.1	1.27	717.0	3232	251.54	18.89	7.51%	49.19
RodD2_114.9	68	2.918	0.055	767.7	7942.4	715.3	1.27	726.4	3185	192.43	13.73	7.14%	36.93
RodD2_117.4	69	2.982	0.118	777.8	7522.6	722.9	1.27	734.6	3145	174.24	12.33	7.08%	32.90
RodD2_120.8	70	3.068	0.204	791.3	6950.6	733.1	1.27	745.4	3094	151.56	10.61	7.00%	28.02
RodD2_124.8	71	3.170	0.306	797.5	6283.1	744.5	1.27	755.8	3046	150.67	10.73	7.12%	27.30
RodD2_128.6	72	3.266	0.403	799.0	5645.5	754.9	1.27	764.3	3009	162.80	12.08	7.42%	29.03
RodD6_103.1	129	2.619	0.371	761.4	8936.3	677.3	1.27	695.2	3347	135.01	9.47	7.01%	27.61
RodD6_106	130	2.692	0.445	768.7	9099.7	686.9	1.27	704.3	3298	141.30	9.63	6.82%	28.36
RodD6_112.9	131	2.868	0.004	761.7	8310.8	709.1	1.27	720.2	3216	200.43	14.27	7.12%	38.94
RodD6_114.9	132	2.918	0.055	775.5	7968.5	715.3	1.27	728.1	3177	167.95	11.68	6.95%	32.13
RodD6_116.8	133	2.967	0.103	785.4	7645.7	721.1	1.27	734.8	3144	150.95	10.40	6.89%	28.49
RodD6_120.9	134	3.071	0.207	794.8	6949.6	733.4	1.27	746.4	3089	143.54	9.96	6.94%	26.49
RodD6_124.8	135	3.170	0.306	801.3	6288.6	744.5	1.27	756.6	3043	140.71	9.89	7.03%	25.46
RodD6_128.7	136	3.269	0.405	803.5	5628.8	755.2	1.27	765.5	3004	147.90	10.73	7.26%	26.31

Table SC-3248-C.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	567.1	5900.5	502.5	1.27	516.2	4743	115.90	17.12	14.77%	35.96
RodE2_54	74	1.372	0.178	589.2	6125.3	513.9	1.27	529.9	4597	103.23	14.26	13.82%	30.93
RodE2_56.9	75	1.445	0.251	601.5	6292.7	522.6	1.27	539.4	4501	101.33	13.35	13.18%	29.65
RodE2_59.9	76	1.521	0.328	614.5	6465.6	531.9	1.27	549.5	4403	99.44	12.49	12.56%	28.37
RodE2_66	77	1.676	0.483	625.5	6818.1	551.4	1.27	567.2	4240	116.91	13.42	11.48%	31.93
RodE2_69.8	78	1.773	-0.027	609.0	7035.4	563.9	1.27	573.5	4185	198.20	22.24	11.22%	53.31
RodE2_72.9	79	1.852	0.051	632.0	7214.1	574.3	1.27	586.6	4075	158.68	16.70	10.52%	41.36
RodE2_74.9	80	1.902	0.102	642.0	7329.4	581.0	1.27	594.0	4015	152.62	15.56	10.20%	39.08
RodB3_50.2	169	1.275	0.081	564.2	5861.1	502.8	1.27	515.8	4747	121.10	18.01	14.87%	37.61
RodB3_54.1	170	1.374	0.180	583.4	6082.4	514.2	1.27	528.9	4607	111.54	15.53	13.92%	33.51
RodB3_56.9	171	1.445	0.251	595.6	6240.4	522.6	1.27	538.1	4513	108.57	14.44	13.30%	31.86
RodB3_60.1	172	1.527	0.333	607.8	6423.4	532.5	1.27	548.5	4411	108.35	13.69	12.64%	30.98
RodB3_66.1	173	1.679	0.485	620.2	6767.3	551.8	1.27	566.3	4248	125.48	14.52	11.57%	34.34
RodB3_69.9	174	1.775	-0.025	604.5	6984.1	564.3	1.27	572.8	4191	220.20	25.14	11.42%	59.32
RodB3_73	175	1.854	0.054	632.2	7159.3	574.6	1.27	586.9	4073	158.08	16.72	10.58%	41.17
RodB3_75	176	1.905	0.105	646.0	7275.2	581.4	1.27	595.1	4006	142.94	14.58	10.20%	36.50
RodF3_50.1	89	1.273	0.079	570.9	5869.7	502.5	1.27	517.0	4734	108.92	16.14	14.82%	33.72
RodF3_54	90	1.372	0.178	592.2	6095.4	513.9	1.27	530.5	4591	98.88	13.71	13.86%	29.58
RodF3_57	91	1.448	0.254	604.7	6271.9	522.9	1.27	540.3	4491	97.36	12.84	13.19%	28.42
RodF3_60	92	1.524	0.330	616.0	6444.4	532.2	1.27	550.0	4397	97.66	12.28	12.58%	27.82
RodF3_66.1	93	1.679	0.485	622.9	6802.1	551.8	1.27	566.9	4243	121.34	13.96	11.51%	33.17
RodF3_70	94	1.778	-0.022	611.0	7026.9	564.6	1.27	574.5	4177	192.51	21.53	11.18%	51.66
RodF3_73	95	1.854	0.054	636.1	7201.6	574.6	1.27	587.7	4066	148.76	15.60	10.48%	38.67
RodF3_75	96	1.905	0.105	650.5	7319.1	581.4	1.27	596.1	3999	134.45	13.62	10.13%	34.26
RodE6_50.2	121	1.275	0.081	566.4	5878.6	502.8	1.27	516.3	4742	117.28	17.38	14.82%	36.38
RodE6_54.1	122	1.374	0.180	586.3	6100.6	514.2	1.27	529.5	4601	107.42	14.90	13.87%	32.22
RodE6_57	123	1.448	0.254	597.3	6265.7	522.9	1.27	538.7	4507	107.06	14.17	13.24%	31.38
RodE6_60.2	124	1.529	0.335	609.2	6445.8	532.9	1.27	549.1	4406	107.26	13.50	12.59%	30.63
RodE6_66.1	125	1.679	0.485	622.6	6782.3	551.8	1.27	566.8	4243	121.64	14.03	11.54%	33.25
RodE6_70	126	1.778	-0.022	609.3	6996.1	564.6	1.27	574.1	4180	198.82	22.39	11.26%	53.40
RodE6_73.1	127	1.857	0.056	634.9	7173.1	575.0	1.27	587.7	4066	151.99	15.99	10.52%	39.51
RodE6_75	128	1.905	0.105	648.3	7282.1	581.4	1.27	595.6	4003	138.30	14.09	10.19%	35.28

RBHT Steam Cooling Test SC-3248-D

Matrix test # 3

Test date – 8/11/2005

Steady state time window: 29400 - 29700 sec

Inlet flow: 0.91 m³/min (32.0 ft³/min)

Inlet steam temperature: 409 K (277 °F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 21.0 kW

Outlet steam temperature: 580 K (585 °F)

Bundle inlet Reynolds number: 3610

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution. Experiment SC-3248 was run with the traversing probes withdrawn. Centerline steam temperatures used are from experiment SC-3166-A.

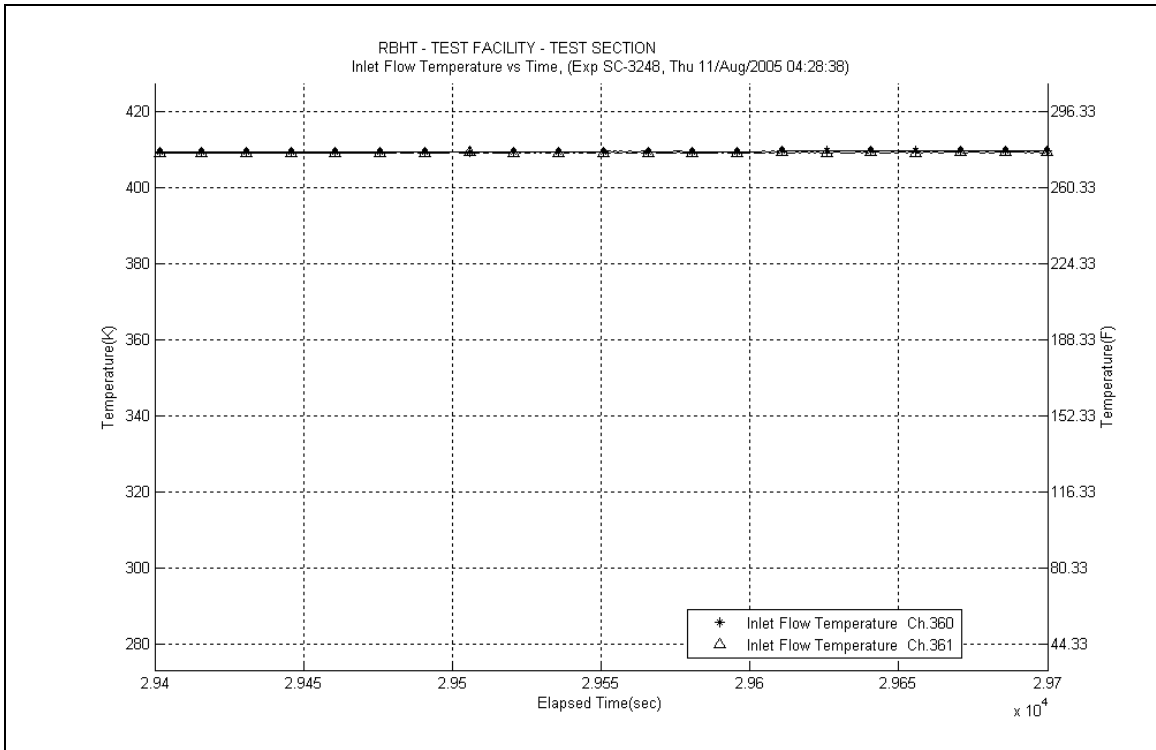
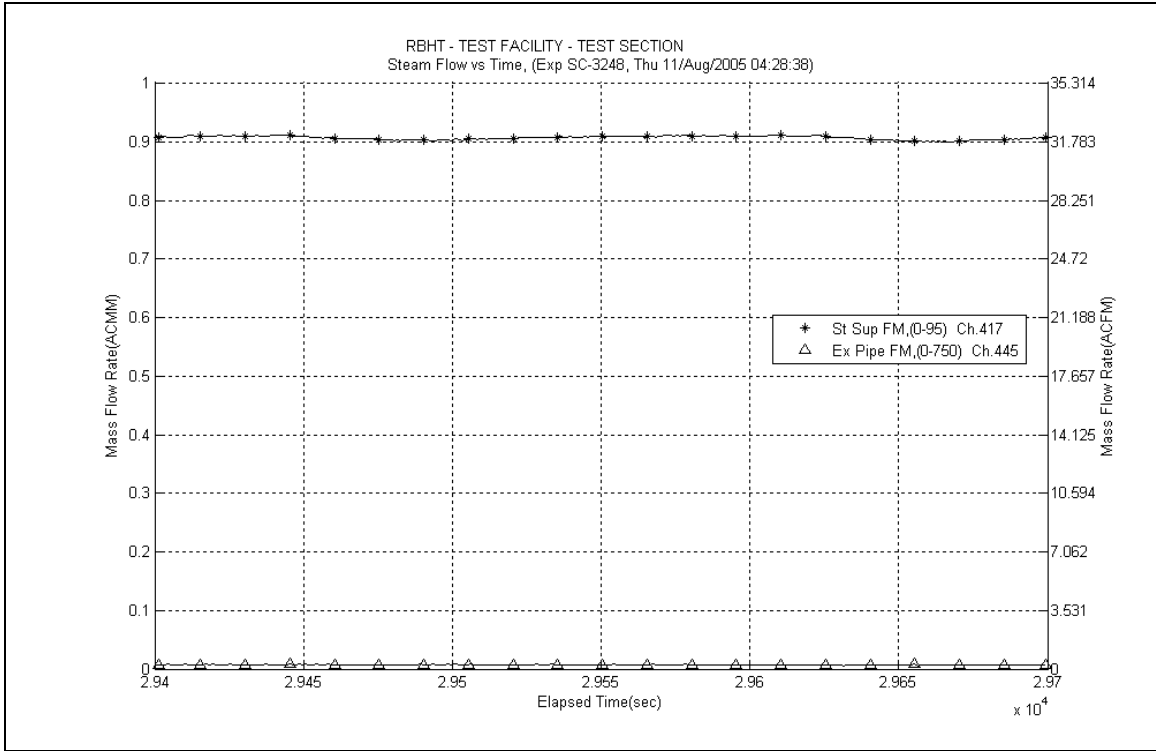
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

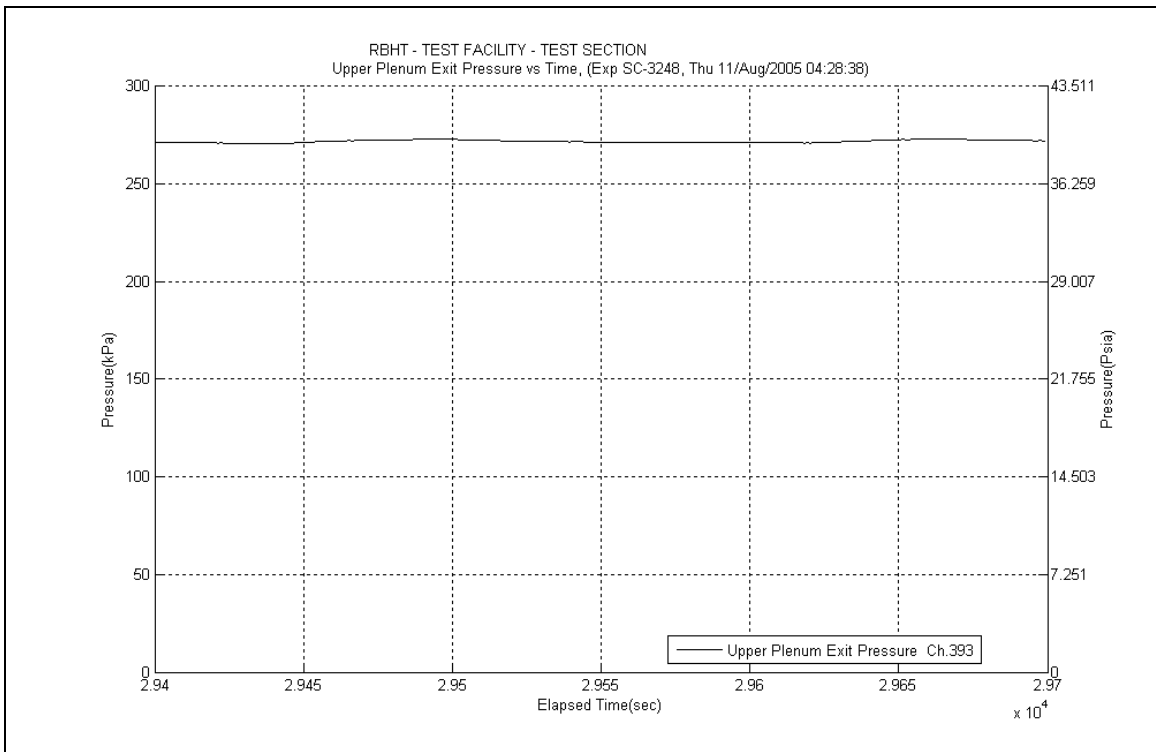
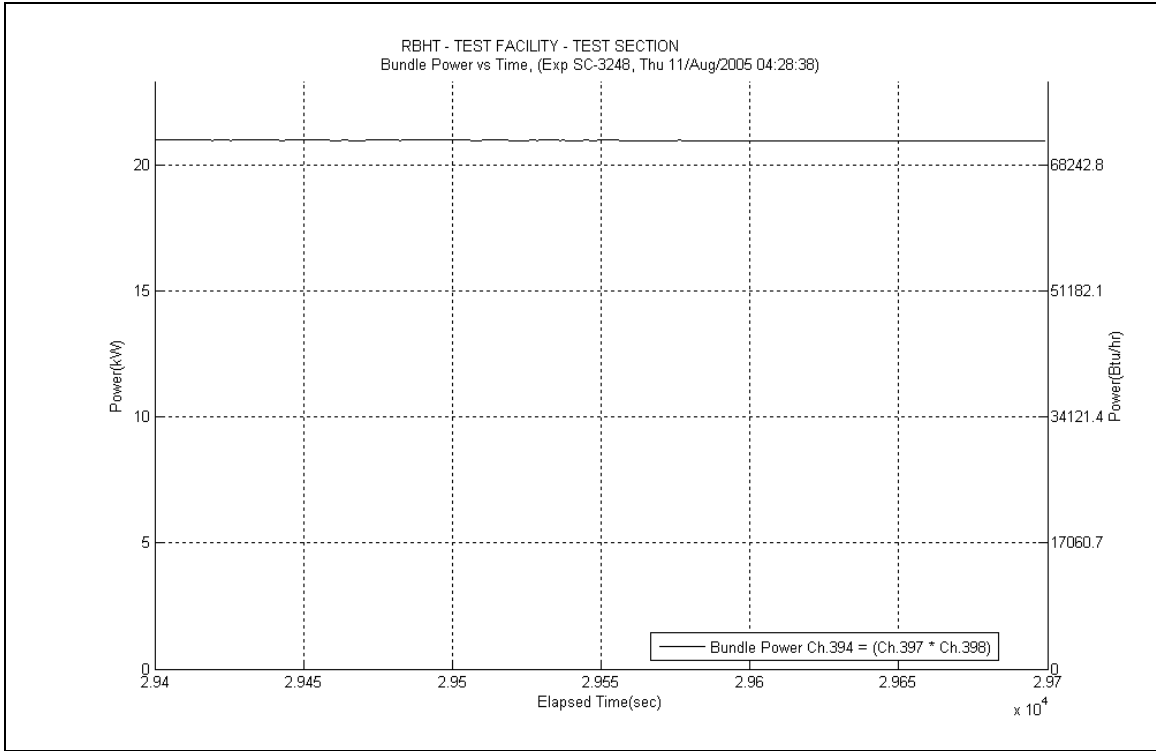
$$T_{cl} = -15.787x^3 + 96.024x^2 - 41.28x + 433.52$$

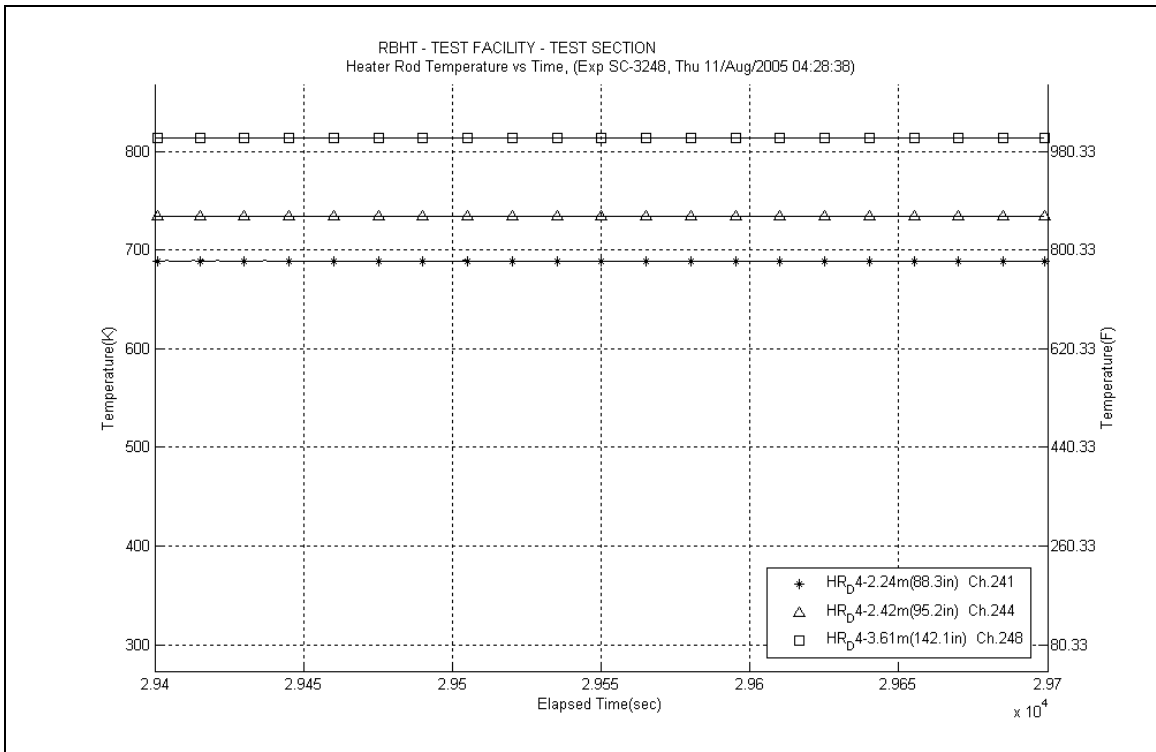
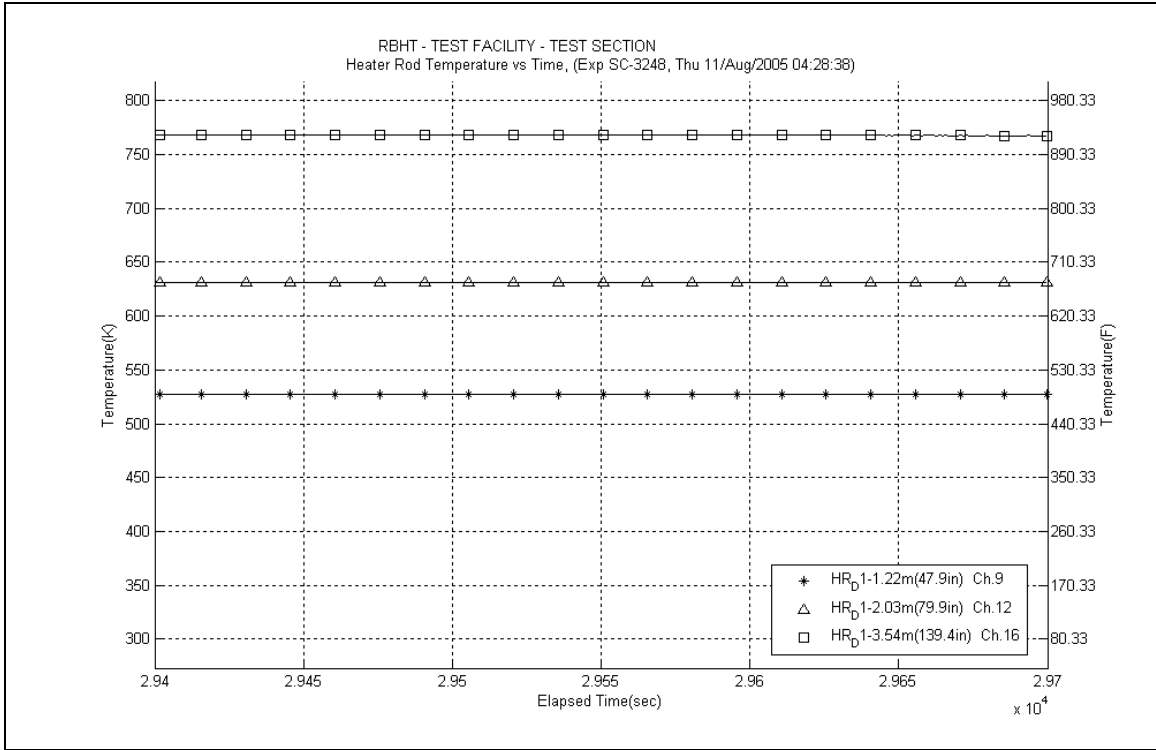
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

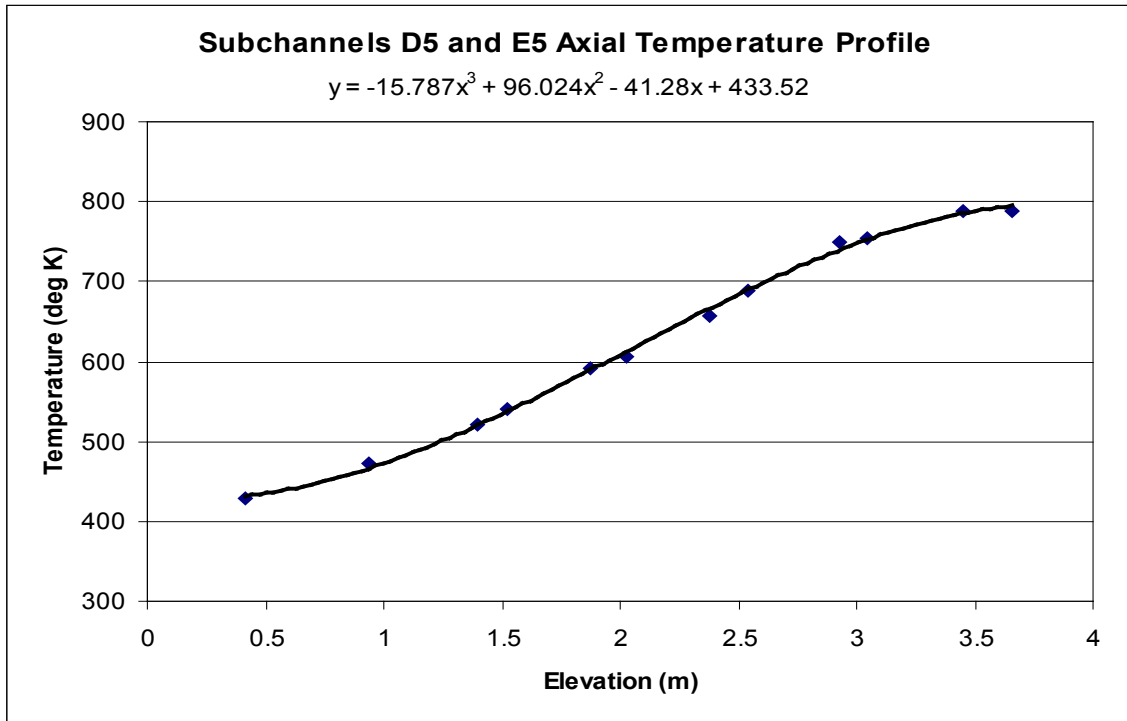
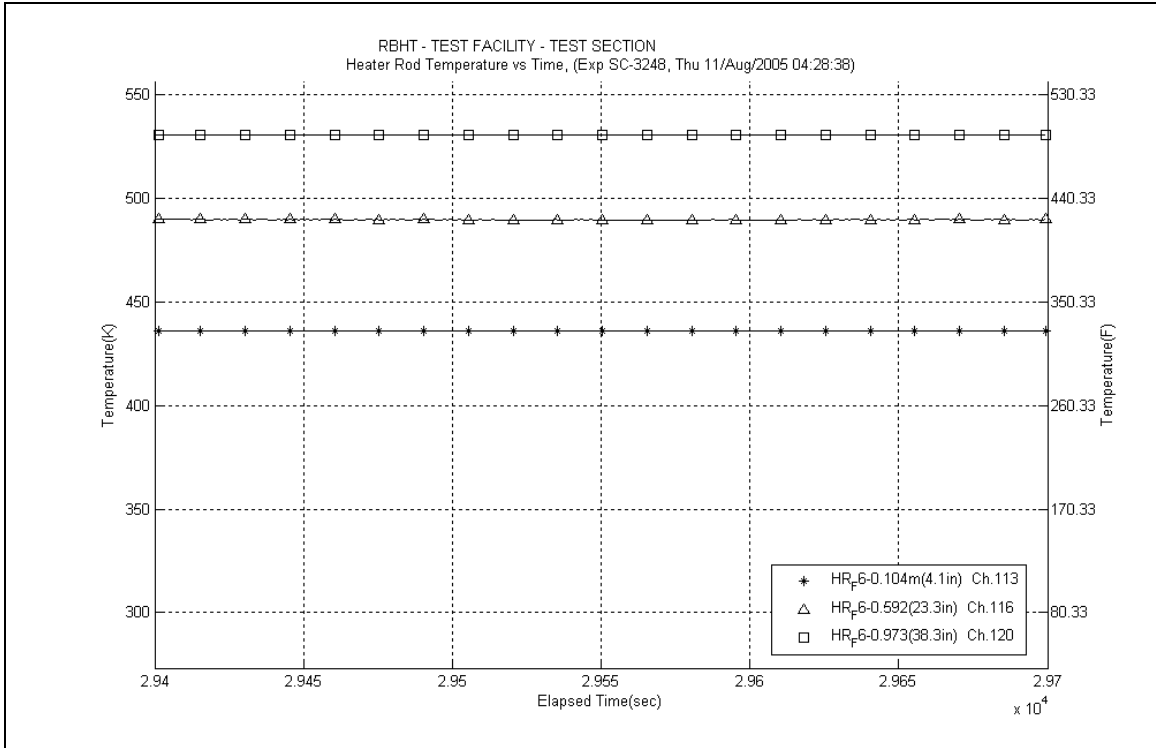
$$T_{cl} = -10.056x^3 + 62.945x^2 + 2.2908x + 419.79$$

where x is the elevation (m) and T_{cl} is in (K)









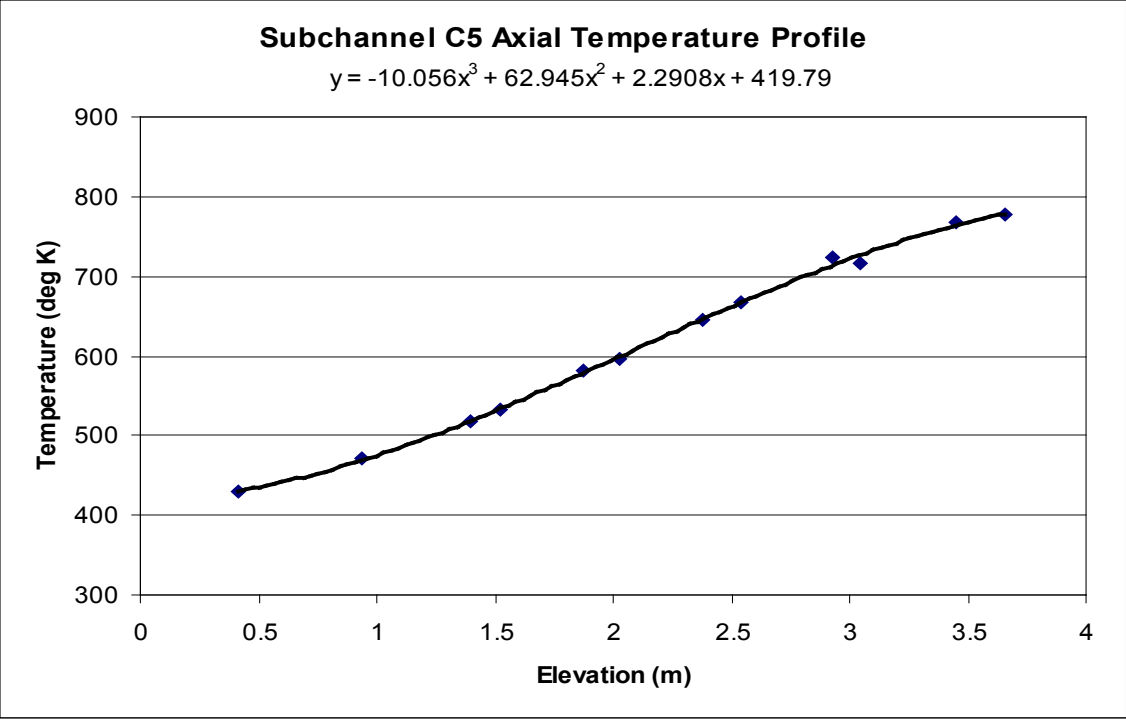


Table SC-3248-D.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{h,c} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	680.5	7918.4	645.8	1.27	653.3	2390	291.06	27.74	9.53%	65.10
RodD3_91.3	186	2.319	0.071	704.4	8088.9	657.3	1.27	667.4	2332	218.56	18.92	8.66%	47.40
RodD3_93.1	187	2.365	0.117	717.6	8189.1	664.1	1.50	682.0	2275	229.41	21.93	9.56%	48.23
RodD3_95.3	188	2.421	0.173	730.5	8314.9	672.3	1.50	691.7	2238	214.37	19.94	9.30%	44.16
RodD3_100.1	189	2.543	0.295	753.4	8585.3	689.8	1.50	711.0	2169	202.43	17.96	8.87%	40.07
RodD3_106.1	190	2.695	0.447	771.3	8923.7	710.7	1.50	730.9	2103	220.76	18.82	8.52%	41.99
RodD3_110	191	2.794	0.546	767.0	8810.7	723.5	1.50	738.0	2080	303.14	26.65	8.79%	56.86
RodD3_142.1	192	3.609	0.218	806.8	3094.5	793.2	1.50	797.7	1908	340.88	49.90	14.64%	57.13
RodC4_88.4	233	2.245	-0.003	681.0	8007.2	646.2	1.27	653.7	2388	293.26	27.75	9.46%	65.53
RodC4_91.1	234	2.314	0.066	703.2	8164.0	656.5	1.27	666.5	2335	222.50	19.22	8.64%	48.35
RodC4_93.4	235	2.372	0.124	717.6	8295.4	665.2	1.50	682.7	2272	237.79	22.63	9.52%	49.92
RodC4_95.3	236	2.421	0.173	728.9	8409.0	672.3	1.50	691.2	2240	223.05	20.71	9.29%	46.00
RodC4_100.1	237	2.543	0.295	750.8	8683.1	689.8	1.50	710.2	2172	213.60	18.95	8.87%	42.36
RodC4_106.1	238	2.695	0.447	767.9	9030.1	710.7	1.50	729.8	2106	236.53	20.22	8.55%	45.09
RodC4_110	239	2.794	0.546	763.5	8739.8	723.5	1.50	736.8	2084	327.22	29.31	8.96%	61.52
RodC4_142.2	240	3.612	0.221	809.8	3352.3	793.2	1.50	798.7	1905	304.45	38.93	12.79%	50.93
RodD4_88.3	241	2.243	-0.005	688.6	7980.3	645.8	1.27	655.0	2382	237.61	21.55	9.07%	52.94
RodD4_91.3	242	2.319	0.071	709.0	8151.6	657.3	1.27	668.4	2328	200.74	17.06	8.50%	43.45
RodD4_93.2	243	2.367	0.119	722.0	8260.6	664.5	1.50	683.7	2268	215.26	20.35	9.45%	45.10
RodD4_95.2	244	2.418	0.170	733.7	8374.4	672.0	1.50	692.5	2235	203.30	18.77	9.23%	41.80
RodD4_142.1	248	3.609	0.218	813.6	3238.7	793.2	1.50	800.0	1902	238.06	27.19	11.42%	39.73
RodE4_88.4	201	2.245	-0.003	684.5	7857.1	646.2	1.27	654.4	2385	261.33	24.41	9.34%	58.30
RodE4_91.2	202	2.316	0.069	705.5	8011.5	656.9	1.27	667.3	2332	209.76	18.18	8.66%	45.50
RodE4_95.3	204	2.421	0.173	731.8	8234.8	672.3	1.50	692.2	2236	207.52	19.34	9.32%	42.71
RodE4_100.9	205	2.563	0.315	754.9	8538.9	692.7	1.50	713.4	2161	205.85	18.25	8.86%	40.55
RodE4_142.3	208	3.614	0.224	809.9	3272.2	793.3	1.50	798.9	1905	295.49	37.74	12.77%	49.42
RodE3_63.4	193	1.610	0.417	618.2	6504.2	550.1	1.27	564.7	2834	121.57	14.85	12.21%	33.41
RodE3_113.6	194	2.885	0.022	772.0	8032.4	734.6	1.50	747.1	2052	322.63	29.45	9.13%	59.46
RodE3_115.5	195	2.934	0.070	781.3	7734.9	740.2	1.50	753.9	2031	282.56	25.25	8.93%	51.39
RodE3_118.5	196	3.010	0.146	792.4	7265.0	748.7	1.50	763.3	2003	249.34	21.99	8.82%	44.54
RodE3_122.7	197	3.117	0.253	801.0	6609.1	759.7	1.50	773.4	1974	239.52	21.31	8.90%	41.98
RodE3_126.5	198	3.213	0.349	804.1	6012.3	768.5	1.50	780.4	1955	253.51	23.32	9.20%	43.86
RodE3_131.7	199	3.345	-0.046	797.4	5197.5	779.0	1.50	785.1	1942	423.72	50.74	11.98%	72.66
RodE3_135.6	200	3.444	0.053	801.0	4589.7	785.4	1.50	790.6	1927	440.78	58.19	13.20%	74.83

Table SC-3248-D.1: Summary of Steam Cooling Data (cont.)

H.R.	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{h,c} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	616.7	6382.1	551.2	1.27	565.3	2830	123.98	15.36	12.39%	34.02
RodC5_113.6	226	2.885	0.022	765.6	7834.5	734.6	1.50	744.9	2058	379.80	36.68	9.66%	70.28
RodC5_115.7	227	2.939	0.075	777.7	7522.9	740.8	1.50	753.1	2033	305.66	28.11	9.20%	55.67
RodC5_122.7	229	3.117	0.253	798.4	6485.2	759.7	1.50	772.6	1977	251.23	22.78	9.07%	44.10
RodC5_126.7	230	3.218	0.354	802.7	5889.7	769.0	1.50	780.2	1955	261.90	24.51	9.36%	45.32
RodC5_131.6	231	3.343	-0.048	800.0	5159.5	778.8	1.50	785.9	1940	364.57	40.54	11.12%	62.43
RodC5_135.7	232	3.447	0.056	804.8	4551.7	785.6	1.50	792.0	1923	355.26	41.49	11.68%	60.16
RodE5_63.6	209	1.615	0.422	613.6	6535.7	550.9	1.27	564.3	2836	132.59	16.16	12.19%	36.47
RodE5_113.6	210	2.885	0.022	766.8	8077.0	734.6	1.50	745.3	2057	376.46	35.69	9.48%	69.61
RodE5_115.4	211	2.931	0.067	774.7	7797.8	740.0	1.50	751.5	2038	336.36	31.19	9.27%	61.45
RodE5_118.7	212	3.015	0.151	784.5	7292.5	749.3	1.50	761.0	2010	309.98	28.60	9.23%	55.62
RodE5_122.6	213	3.114	0.250	793.0	6692.0	759.4	1.50	770.6	1982	298.94	27.90	9.33%	52.67
RodE5_126.6	214	3.216	0.352	798.8	6074.1	768.8	1.50	778.8	1959	303.10	29.20	9.63%	52.59
RodE5_131.6	215	3.343	-0.048	795.8	5303.9	778.8	1.50	784.5	1944	469.16	58.81	12.54%	80.56
RodE5_135.6	216	3.444	0.053	799.0	4685.9	785.4	1.50	790.0	1929	516.78	74.78	14.47%	87.84
RodC3_79.8	177	2.027	0.227	666.3	7406.9	612.9	1.27	624.3	2519	176.53	17.37	9.84%	42.13
RodC3_85.6	178	2.174	0.374	672.8	7729.1	635.4	1.27	643.4	2432	263.26	25.45	9.67%	60.17
RodC3_88.5	179	2.248	0.000	674.1	7887.1	646.6	1.27	652.5	2393	365.46	37.34	10.22%	81.88
RodC3_92.4	180	2.347	0.099	702.9	8113.0	661.5	1.27	670.3	2320	249.33	21.89	8.78%	53.74
RodC3_94.4	181	2.398	0.150	714.7	8221.8	669.0	1.50	684.2	2266	269.84	26.06	9.66%	56.46
RodC3_97.2	182	2.469	0.221	728.8	8378.0	679.3	1.50	695.8	2223	254.25	23.75	9.34%	51.93
RodC3_108.8	183	2.764	0.516	761.7	8837.5	719.6	1.50	733.6	2094	315.13	28.03	8.89%	59.62
RodD5_50	217	1.270	0.076	563.7	5774.1	503.6	1.27	516.5	3151	122.36	18.47	15.10%	37.93
RodD5_54.1	218	1.374	0.180	584.5	6003.7	517.1	1.27	531.6	3045	113.50	15.99	14.08%	33.87
RodD5_56.9	219	1.445	0.251	595.3	6159.2	526.8	1.27	541.5	2979	114.30	15.39	13.47%	33.27
RodD5_60	220	1.524	0.330	606.8	6331.5	537.7	1.27	552.5	2908	116.61	14.96	12.83%	33.02
RodD5_66.1	221	1.679	0.485	624.5	6671.2	560.2	1.27	573.9	2780	131.94	15.48	11.73%	35.45
RodD5_69.9	222	1.775	-0.025	614.4	6880.5	574.6	1.27	583.1	2728	219.67	25.37	11.55%	57.73
RodD5_72.9	223	1.852	0.051	636.6	7048.4	586.1	1.27	596.9	2654	177.71	19.22	10.81%	45.19
RodD5_74.9	224	1.902	0.102	650.3	7160.0	593.8	1.27	605.9	2608	161.30	16.83	10.44%	40.16

Table SC-3248-D.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{h,c} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	542.1	5256.7	479.1	1.27	492.6	3335	106.19	18.64	17.55%	34.99
RodB5_52.9	154	1.344	0.150	573.6	5924.9	512.1	1.27	525.3	3088	122.62	17.68	14.42%	37.17
RodB5_55	155	1.397	0.203	581.7	6043.1	518.4	1.27	532.0	3042	121.60	16.94	13.93%	36.25
RodB5_57.8	156	1.468	0.274	593.3	6199.9	527.0	1.27	541.2	2980	118.94	15.83	13.31%	34.64
RodB5_64	157	1.626	0.432	613.0	6549.2	546.7	1.27	560.9	2857	125.55	15.19	12.10%	34.83
RodB5_73.9	158	1.877	0.077	635.8	7102.5	579.4	1.27	591.4	2683	160.14	16.93	10.57%	41.26
RodB5_75.9	159	1.928	0.128	647.3	7217.6	586.1	1.27	599.2	2642	149.96	15.32	10.22%	37.93
RodB5_76.9	160	1.953	0.153	652.3	7271.6	589.5	1.27	602.9	2623	147.27	14.83	10.07%	36.93
RodF5_41	105	1.041	0.343	542.8	5216.4	479.1	1.27	492.7	3334	104.17	18.41	17.67%	34.31
RodF5_53.1	106	1.349	0.155	572.0	5894.5	512.7	1.27	525.4	3087	126.41	18.31	14.48%	38.31
RodF5_55	107	1.397	0.203	580.6	6001.5	518.4	1.27	531.7	3044	122.81	17.22	14.02%	36.63
RodF5_57.8	108	1.468	0.274	591.0	6160.7	527.0	1.27	540.7	2984	122.55	16.42	13.40%	35.74
RodF5_64	109	1.626	0.432	609.1	6505.8	546.7	1.27	560.0	2862	132.66	16.18	12.19%	36.87
RodF5_73.8	110	1.875	0.074	628.1	7057.9	579.0	1.27	589.5	2693	183.08	19.69	10.75%	47.38
RodF5_75.8	111	1.925	0.125	639.9	7169.8	585.8	1.27	597.4	2652	168.53	17.48	10.37%	42.81
RodF5_76.8	112	1.951	0.150	645.0	7227.0	589.1	1.27	601.1	2633	164.58	16.79	10.20%	41.44
RodC2_41	57	1.041	0.343	527.1	5243.0	479.1	1.27	489.4	3362	138.98	24.64	17.73%	46.18
RodC2_53.1	58	1.349	0.155	543.3	5916.5	512.7	1.27	519.3	3131	246.47	37.31	15.14%	75.87
RodC2_55	59	1.397	0.203	577.3	6025.2	518.4	1.27	531.0	3048	130.15	18.23	14.00%	38.89
RodC2_57.8	60	1.468	0.274	584.2	6183.3	527.0	1.27	539.3	2993	137.55	18.46	13.42%	40.26
RodC2_63.9	61	1.623	0.429	593.8	6526.4	546.3	1.27	556.5	2883	174.87	21.64	12.37%	49.03
RodC2_73.8	62	1.875	0.074	610.4	7082.4	579.0	1.27	585.8	2714	286.92	32.82	11.44%	74.93
RodC2_75.8	63	1.925	0.125	632.6	7195.9	585.8	1.27	595.8	2660	195.62	20.52	10.49%	49.88
RodC2_76.8	64	1.951	0.150	636.1	7253.4	589.1	1.27	599.2	2643	196.63	20.34	10.35%	49.74
RodC6_40.9	137	1.039	0.340	543.8	5218.8	478.8	1.27	492.7	3334	102.20	18.06	17.67%	33.66
RodC6_52.8	138	1.341	0.147	574.0	5913.6	511.8	1.27	525.1	3089	120.97	17.48	14.45%	36.69
RodC6_54.8	139	1.392	0.198	583.1	6032.4	517.8	1.27	531.8	3043	117.57	16.42	13.96%	35.06
RodC6_57.8	140	1.468	0.274	594.7	6206.9	527.0	1.27	541.5	2978	116.66	15.50	13.29%	33.95
RodC6_63.8	141	1.621	0.427	614.4	6559.0	546.0	1.27	560.7	2858	121.94	14.74	12.09%	33.84
RodC6_73.7	142	1.872	0.072	637.2	7140.6	578.7	1.27	591.2	2684	155.34	16.34	10.52%	40.04
RodC6_75.8	143	1.925	0.125	646.8	7262.4	585.8	1.27	598.8	2644	151.47	15.42	10.18%	38.35
RodC6_76.8	144	1.951	0.150	652.2	7322.7	589.1	1.27	602.6	2625	147.72	14.81	10.03%	37.06

Table SC-3248-D.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hlc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	674.2	7853.5	628.4	1.27	638.2	2455	218.53	19.75	9.04%	50.53
RodB4_91.3	162	2.319	0.071	696.2	8014.1	638.2	1.27	650.6	2401	175.97	14.88	8.46%	39.59
RodB4_93.3	163	2.370	0.122	708.7	8125.2	644.9	1.27	658.6	2368	162.01	13.23	8.17%	35.82
RodB4_95.1	164	2.416	0.168	718.2	8221.9	650.9	1.50	673.3	2308	183.19	13.83	7.55%	39.23
RodB4_100	165	2.540	0.292	738.2	8487.8	666.9	1.50	690.7	2242	178.62	15.78	8.83%	36.87
RodB4_106	166	2.692	0.445	752.9	8818.6	686.0	1.50	708.3	2179	197.67	16.76	8.48%	39.35
RodB4_109.9	167	2.791	0.544	750.4	8536.2	697.9	1.50	715.4	2154	244.13	21.02	8.61%	47.90
RodB4_142.3	168	3.614	0.224	798.1	3330.1	775.6	1.50	783.1	1947	221.70	23.99	10.82%	38.16
RodF4_85.6	98	2.174	0.374	673.5	7743.4	619.0	1.27	630.7	2489	180.63	16.44	9.10%	42.49
RodF4_88.4	99	2.245	-0.003	674.2	7897.1	628.4	1.27	638.2	2455	219.75	19.80	9.01%	50.82
RodF4_92.4	100	2.347	0.099	702.9	8122.0	641.9	1.27	654.9	2383	169.41	14.01	8.27%	37.75
RodF4_94.3	101	2.395	0.147	714.2	8230.8	648.2	1.50	670.2	2320	187.10	14.25	7.62%	40.33
RodF4_97.2	102	2.469	0.221	728.6	8391.1	657.8	1.50	681.4	2277	177.72	16.04	9.02%	37.41
RodF4_108.8	103	2.764	0.516	763.4	8860.9	694.6	1.50	717.5	2147	193.26	16.09	8.33%	37.76
RodF4_111	104	2.819	-0.044	759.4	8502.1	701.2	1.50	720.6	2137	219.29	18.55	8.46%	42.58
RodD2_103.2	65	2.621	0.373	737.9	8784.9	677.2	1.50	697.4	2217	216.97	18.86	8.69%	44.17
RodD2_106	66	2.692	0.445	743.9	8937.2	686.0	1.50	705.3	2189	231.60	19.84	8.57%	46.39
RodD2_112.6	67	2.860	-0.004	742.1	8205.6	706.0	1.50	718.0	2145	340.78	31.35	9.20%	66.51
RodD2_114.9	68	2.918	0.055	757.1	7826.7	712.6	1.50	727.5	2114	263.89	23.23	8.80%	50.54
RodD2_117.4	69	2.982	0.118	766.4	7415.3	719.7	1.50	735.2	2089	238.39	20.81	8.73%	44.96
RodD2_120.8	70	3.068	0.204	778.8	6853.0	728.9	1.50	745.6	2056	206.17	17.81	8.64%	38.10
RodD2_124.8	71	3.170	0.306	785.3	6196.6	739.2	1.50	754.6	2029	201.76	17.64	8.75%	36.64
RodD2_128.6	72	3.266	0.403	788.1	5564.5	748.4	1.50	761.6	2008	210.48	18.94	9.00%	37.72
RodD6_103.1	129	2.619	0.371	745.1	8789.8	676.9	1.50	699.6	2209	193.24	16.63	8.61%	39.16
RodD6_106	130	2.692	0.445	752.5	8953.0	686.0	1.50	708.2	2179	201.95	17.06	8.45%	40.21
RodD6_112.9	131	2.868	0.004	755.6	8173.1	706.9	1.50	723.1	2128	251.35	21.78	8.66%	48.56
RodD6_114.9	132	2.918	0.055	766.4	7839.0	712.6	1.50	730.6	2104	218.59	18.68	8.55%	41.61
RodD6_116.8	133	2.967	0.103	775.3	7521.0	718.0	1.50	737.1	2083	196.82	16.69	8.48%	36.98
RodD6_120.9	134	3.071	0.207	784.4	6836.4	729.2	1.50	747.6	2050	185.86	15.84	8.52%	34.22
RodD6_124.8	135	3.170	0.306	791.1	6183.3	739.2	1.50	756.5	2023	178.85	15.37	8.59%	32.36
RodD6_128.7	136	3.269	0.405	794.4	5536.0	748.6	1.50	763.9	2002	181.45	15.90	8.76%	32.38

Table SC-3248-D.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{h,c} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	559.3	5791.6	503.9	1.27	515.8	3157	133.17	20.09	15.09%	41.36
RodE2_54	74	1.372	0.178	579.3	6012.5	515.4	1.27	529.1	3062	119.77	16.89	14.10%	35.96
RodE2_56.9	75	1.445	0.251	590.7	6177.8	524.2	1.27	538.4	2998	118.34	15.91	13.45%	34.70
RodE2_59.9	76	1.521	0.328	603.0	6349.7	533.6	1.27	548.4	2934	116.32	14.90	12.81%	33.27
RodE2_66	77	1.676	0.483	616.5	6694.4	553.1	1.27	566.7	2822	134.51	15.76	11.72%	36.78
RodE2_69.8	78	1.773	-0.027	607.1	6910.0	565.7	1.27	574.5	2776	212.31	24.35	11.47%	56.96
RodE2_72.9	79	1.852	0.051	625.2	7086.6	576.0	1.27	586.5	2710	183.45	19.81	10.80%	47.82
RodE2_74.9	80	1.902	0.102	634.9	7200.5	582.7	1.27	593.9	2670	175.53	18.34	10.45%	44.96
RodB3_50.2	169	1.275	0.081	555.2	5760.4	504.2	1.27	515.1	3161	143.76	21.85	15.20%	44.72
RodB3_54.1	170	1.374	0.180	572.3	5979.7	515.7	1.27	527.8	3070	134.33	19.10	14.22%	40.46
RodB3_56.9	171	1.445	0.251	584.0	6137.5	524.2	1.27	537.0	3008	130.67	17.74	13.57%	38.46
RodB3_60.1	172	1.527	0.333	595.8	6316.5	534.2	1.27	547.4	2940	130.46	16.83	12.90%	37.41
RodB3_66.1	173	1.679	0.485	609.9	6657.1	553.5	1.27	565.5	2829	150.26	17.78	11.83%	41.21
RodB3_69.9	174	1.775	-0.025	600.0	6865.7	566.0	1.27	573.3	2784	256.63	30.36	11.83%	69.06
RodB3_73	175	1.854	0.054	621.8	7043.3	576.3	1.27	586.1	2712	197.01	21.52	10.92%	51.41
RodB3_75	176	1.905	0.105	634.5	7156.8	583.1	1.27	594.1	2669	177.10	18.59	10.50%	45.34
RodF3_50.1	89	1.273	0.079	563.3	5758.4	503.9	1.27	516.6	3150	123.29	18.65	15.13%	38.20
RodF3_54	90	1.372	0.178	582.7	5979.9	515.4	1.27	529.8	3057	112.98	15.98	14.14%	33.86
RodF3_57	91	1.448	0.254	594.2	6154.1	524.5	1.27	539.5	2992	112.32	15.12	13.46%	32.86
RodF3_60	92	1.524	0.330	605.0	6324.3	533.9	1.27	549.1	2929	113.13	14.52	12.83%	32.31
RodF3_66.1	93	1.679	0.485	616.0	6676.0	553.5	1.27	566.9	2821	135.88	15.95	11.74%	37.14
RodF3_70	94	1.778	-0.022	608.4	6898.1	566.3	1.27	575.3	2772	208.57	23.87	11.45%	55.85
RodF3_73	95	1.854	0.054	629.0	7073.4	576.3	1.27	587.6	2704	170.80	18.34	10.74%	44.40
RodF3_75	96	1.905	0.105	642.3	7188.4	583.1	1.27	595.8	2660	154.35	15.97	10.35%	39.36
RodE6_50.2	121	1.275	0.081	557.1	5759.9	504.2	1.27	515.5	3158	138.55	21.03	15.18%	43.05
RodE6_54.1	122	1.374	0.180	574.1	5977.3	515.7	1.27	528.2	3068	130.15	18.49	14.21%	39.17
RodE6_57	123	1.448	0.254	583.9	6138.0	524.5	1.27	537.2	3007	131.58	17.85	13.57%	38.71
RodE6_60.2	124	1.529	0.335	596.3	6317.2	534.5	1.27	547.8	2938	130.00	16.75	12.89%	37.25
RodE6_66.1	125	1.679	0.485	612.6	6646.4	553.5	1.27	566.1	2825	142.99	16.89	11.82%	39.15
RodE6_70	126	1.778	-0.022	604.5	6859.7	566.3	1.27	574.5	2777	228.85	26.62	11.63%	61.40
RodE6_73.1	127	1.857	0.056	625.3	7032.9	576.7	1.27	587.1	2707	183.87	19.95	10.85%	47.86
RodE6_75	128	1.905	0.105	637.5	7139.5	583.1	1.27	594.7	2666	166.76	17.45	10.46%	42.63

RBHT Steam Cooling Test SC-3248-E

Matrix test # 2

Test date – 8/11/2005

Steady state time window: 32500 - 32800 sec

Inlet flow: 0.48 m³/min (17.0 ft³/min)

Inlet steam temperature: 407 K (274 °F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 14.0 kW

Outlet steam temperature: 585 K (594 °F)

Bundle inlet Reynolds number: 1938

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution. Experiment SC-3248 was run with the traversing probes withdrawn. Centerline steam temperatures used are from experiment SC-3166-B.

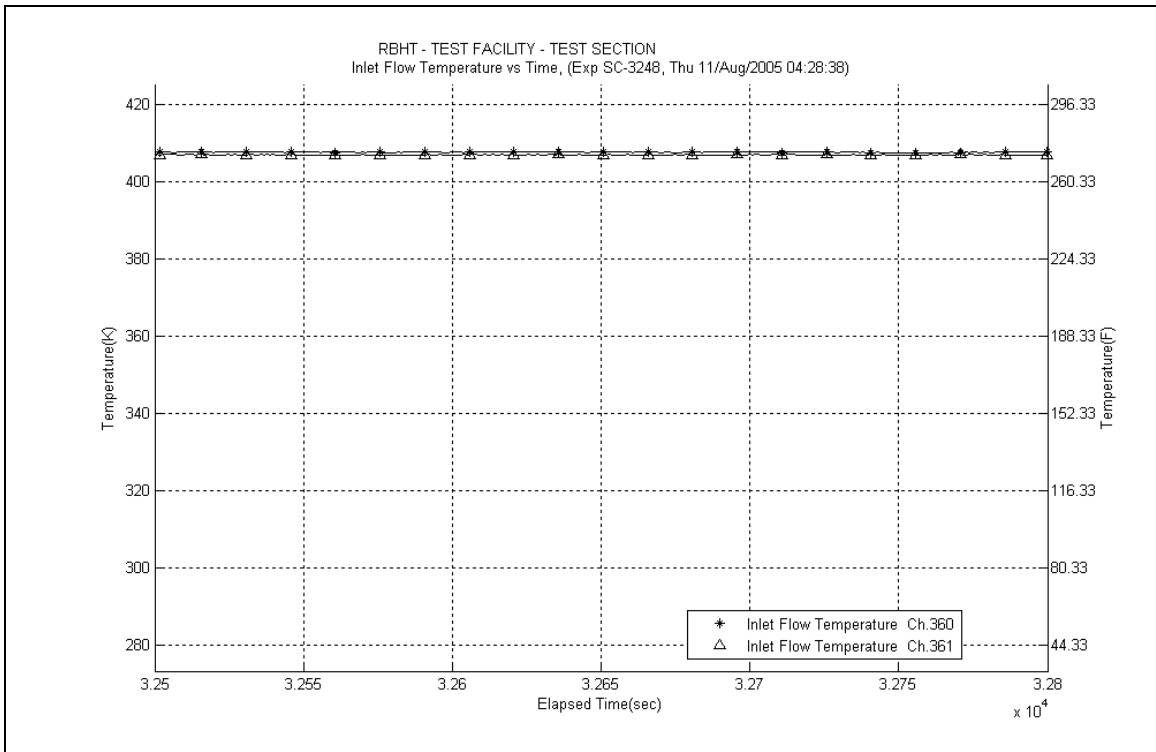
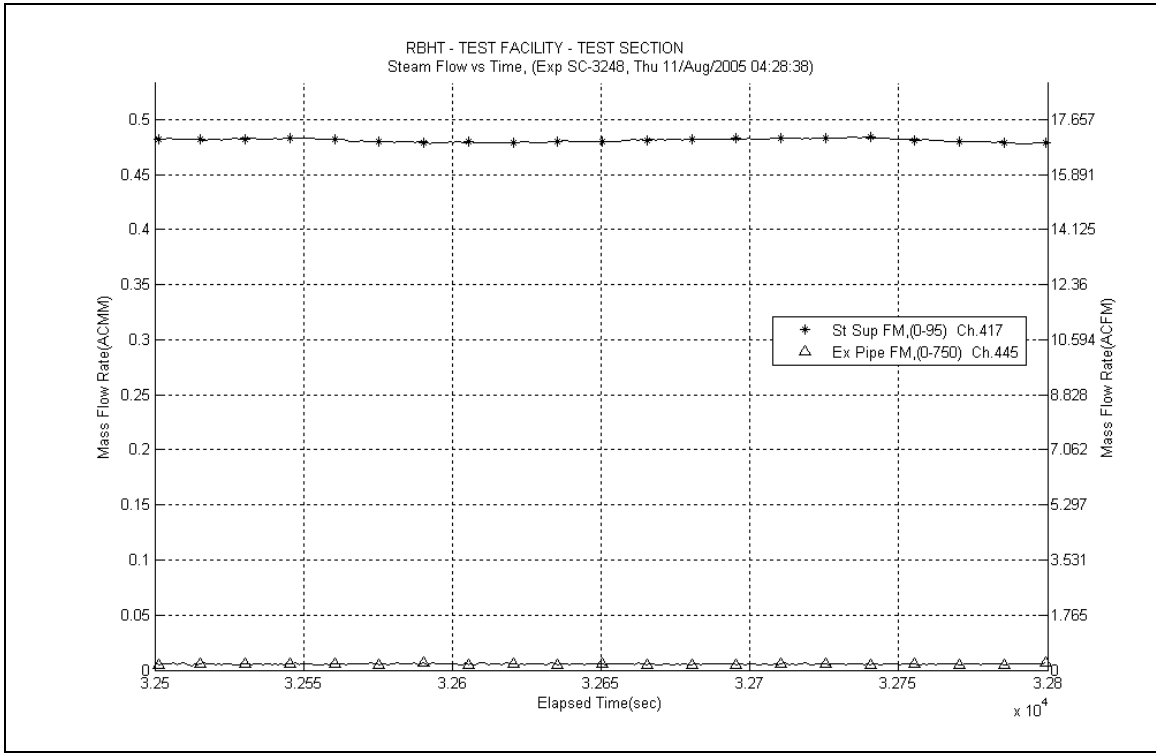
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

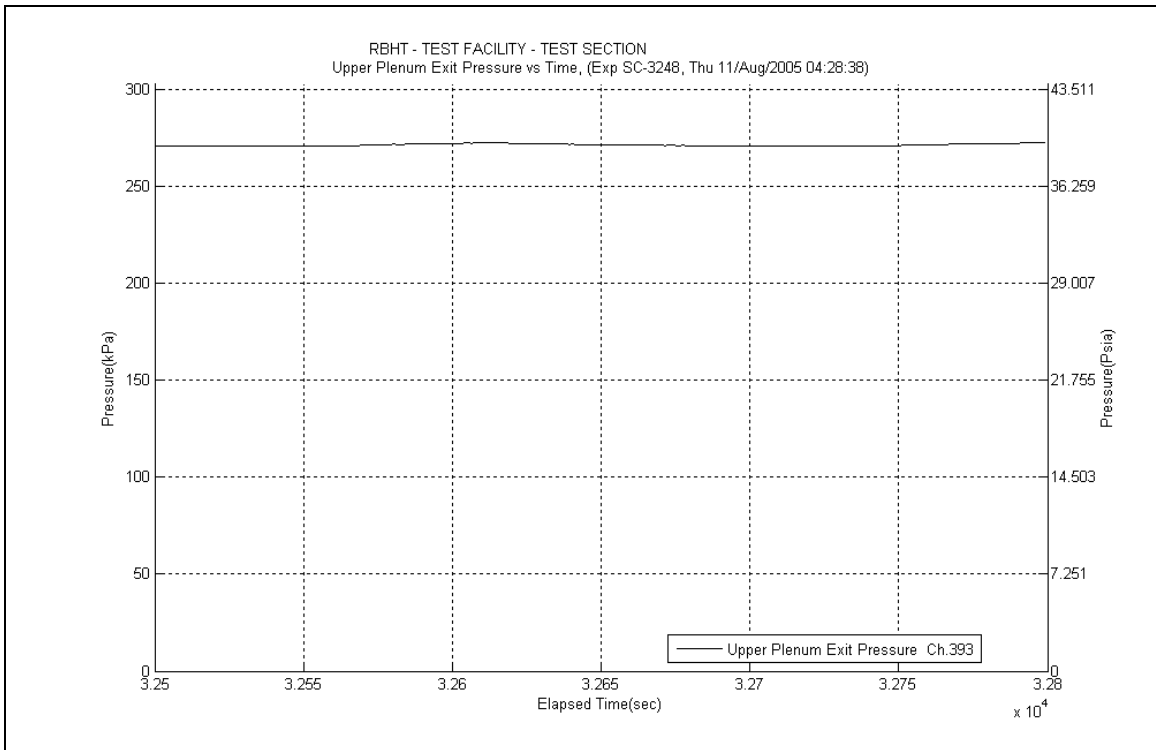
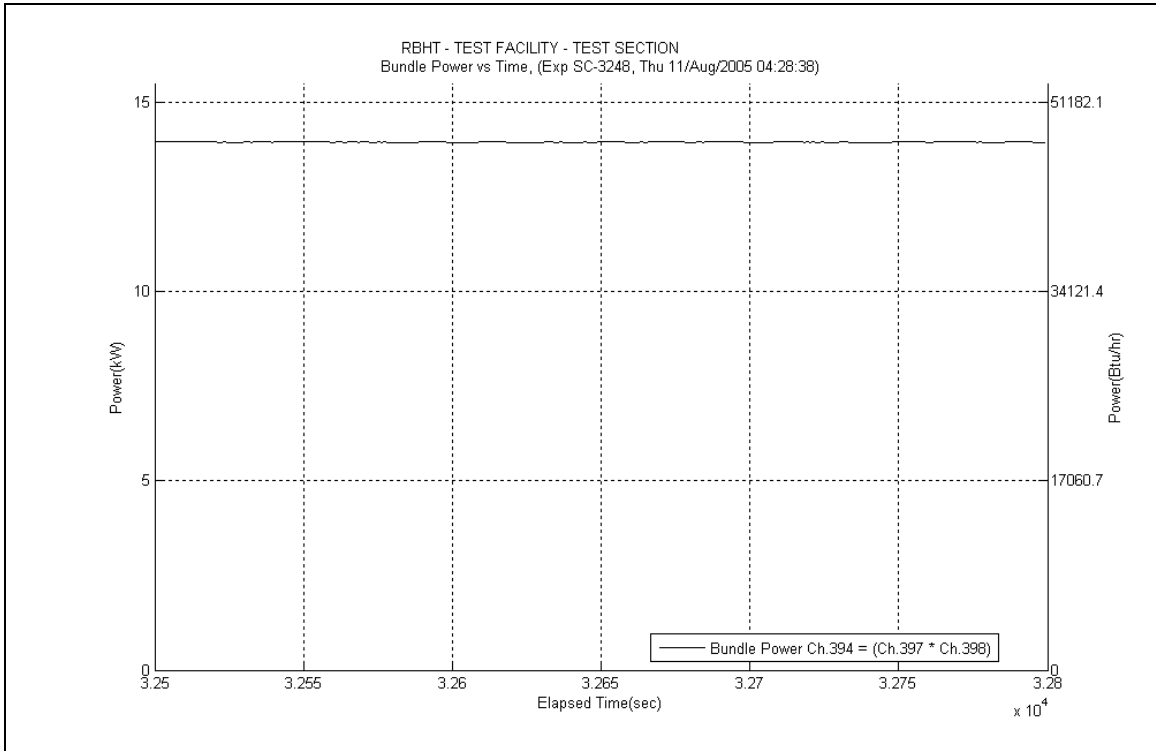
$$T_{cl} = -18.477x^3 + 106.36x^2 - 31.321x + 429.69$$

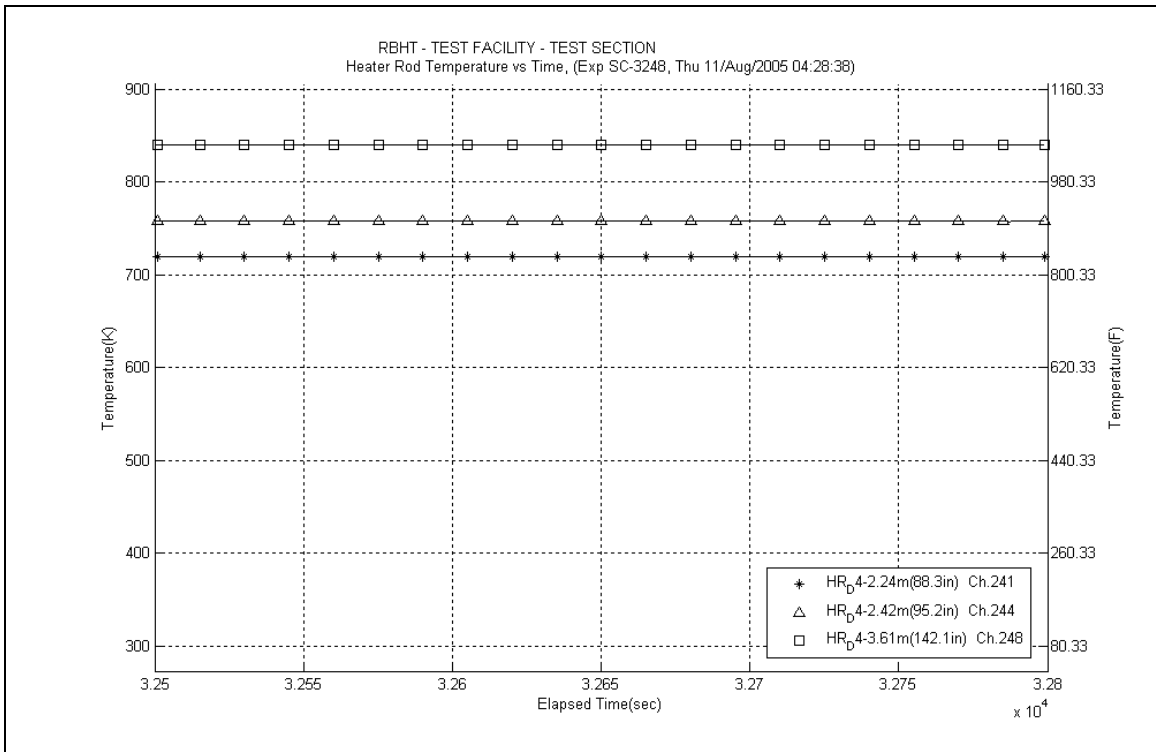
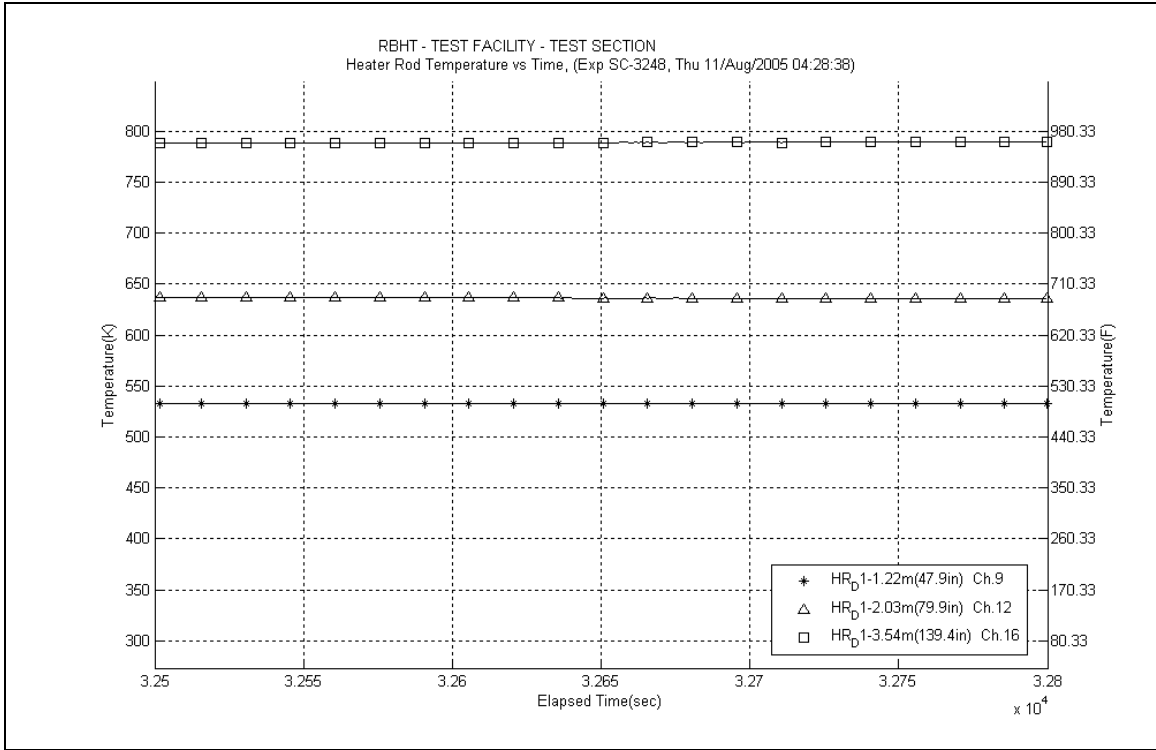
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

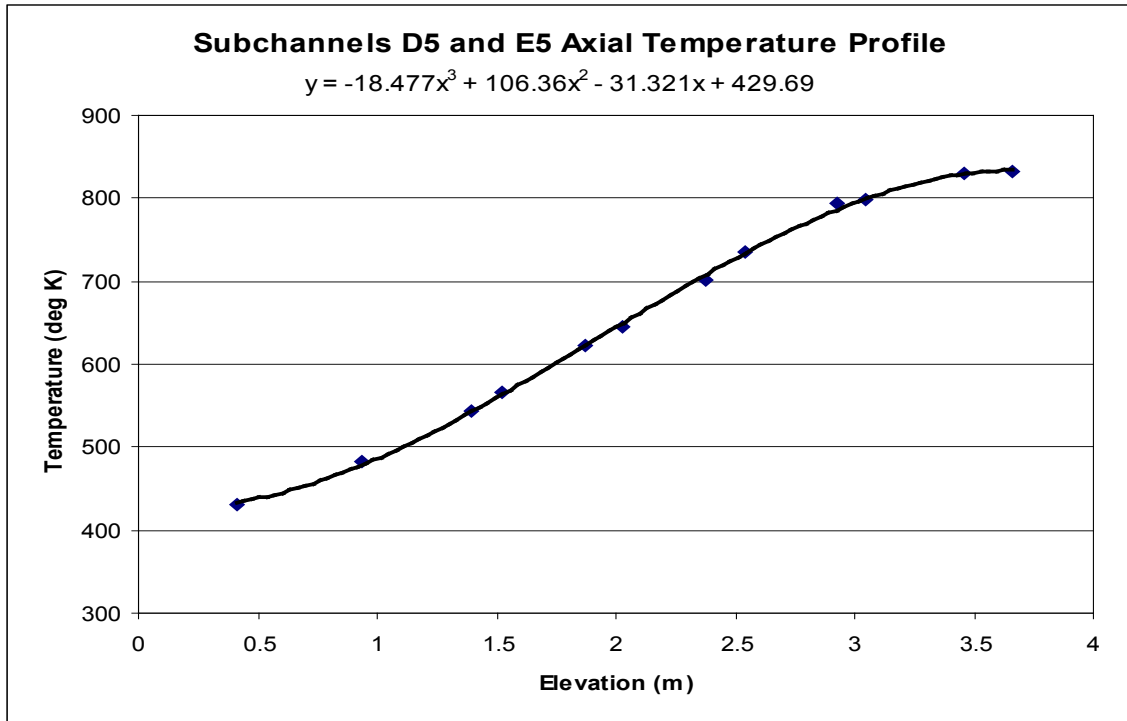
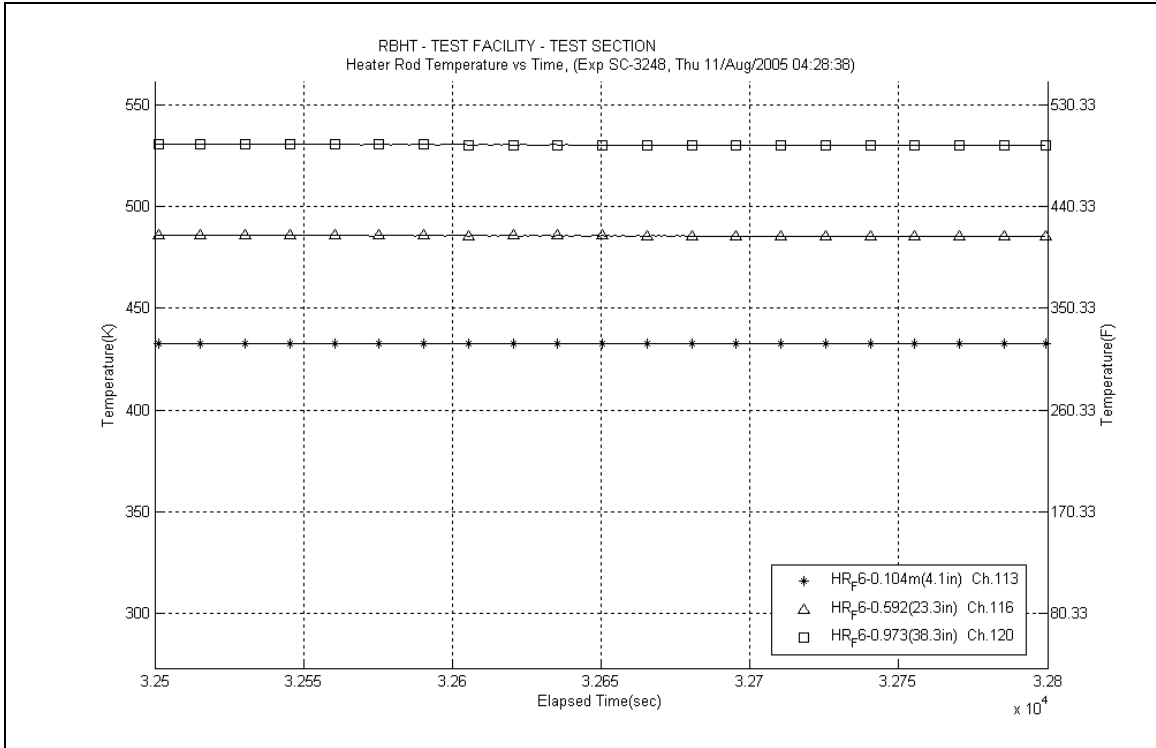
$$T_{cl} = -10.78x^3 + 62.962x^2 + 26.651x + 409.87$$

where x is the elevation (m) and T_{cl} is in (K)









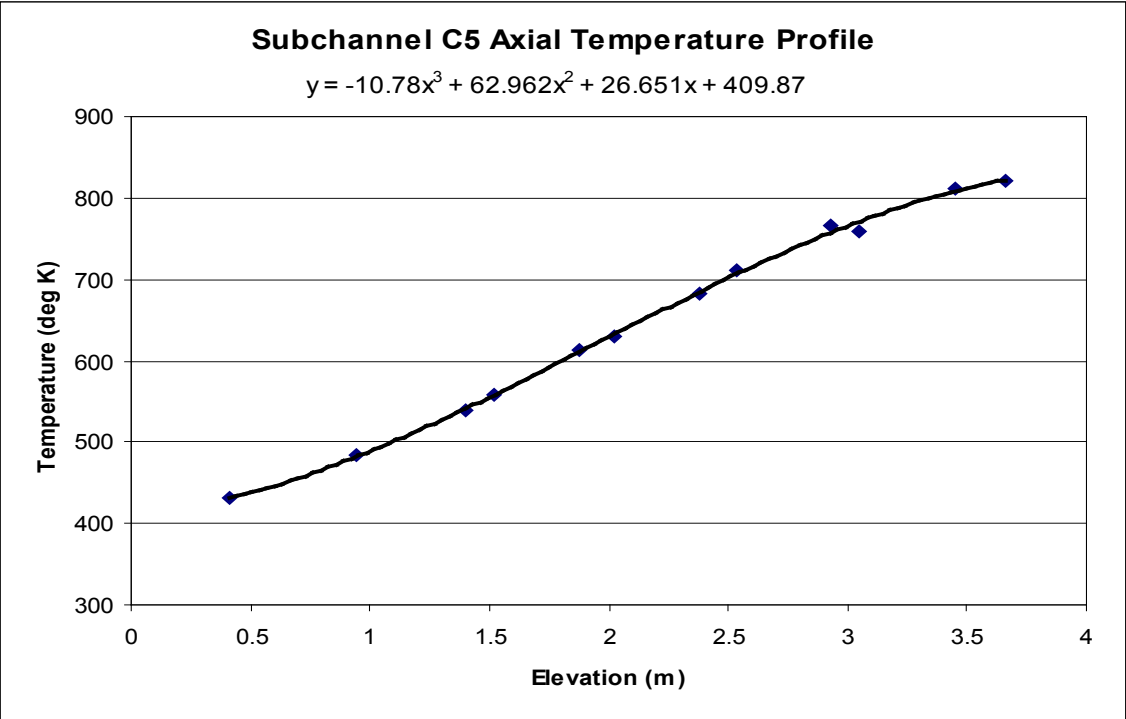


Table SC-3248-E.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	710.3	3740.0	686.0	1.50	694.1	1189	231.48	39.84	17.21%	47.45
RodD3_91.3	186	2.319	0.071	727.9	3819.3	698.6	1.50	708.4	1162	196.03	31.46	16.05%	39.01
RodD3_93.1	187	2.365	0.117	740.3	3868.3	706.1	1.50	717.5	1145	169.38	25.99	15.34%	33.09
RodD3_95.3	188	2.421	0.173	753.3	3924.0	715.0	1.50	727.8	1127	153.79	22.59	14.69%	29.43
RodD3_100.1	189	2.543	0.295	774.4	4050.9	734.0	1.50	747.4	1094	150.21	20.41	13.59%	27.66
RodD3_106.1	190	2.695	0.447	789.7	4205.4	756.1	1.50	767.3	1062	187.70	23.90	12.73%	33.27
RodD3_110	191	2.794	0.546	792.8	4156.1	769.5	1.50	777.3	1047	268.17	35.78	13.34%	46.66
RodD3_142.1	192	3.609	0.218	833.1	1437.6	831.5	1.50	832.0	972	1373.84	1457.77	106.11%	216.64
RodC4_88.4	233	2.245	-0.003	710.7	3782.8	686.5	1.50	694.5	1188	233.54	39.82	17.05%	47.82
RodC4_91.1	234	2.314	0.066	727.8	3855.7	697.8	1.50	707.8	1163	192.70	30.68	15.92%	38.40
RodC4_93.4	235	2.372	0.124	740.2	3916.7	707.3	1.50	718.3	1144	178.84	27.23	15.23%	34.89
RodC4_95.3	236	2.421	0.173	750.7	3967.0	715.0	1.50	726.9	1128	166.69	24.46	14.67%	31.96
RodC4_100.1	237	2.543	0.295	773.6	4097.4	734.0	1.50	747.2	1094	154.92	20.93	13.51%	28.54
RodC4_106.1	238	2.695	0.447	786.9	4256.3	756.1	1.50	766.4	1064	207.42	26.61	12.83%	36.84
RodC4_110	239	2.794	0.546	789.8	4120.5	769.5	1.50	776.3	1049	304.34	42.51	13.97%	53.05
RodC4_142.2	240	3.612	0.221	835.7	1557.7	833.5	1.50	834.3	969	1090.44	851.24	78.06%	171.28
RodD4_88.3	241	2.243	-0.005	719.5	3767.1	686.0	1.50	697.2	1183	168.62	27.76	16.46%	34.34
RodD4_91.3	242	2.319	0.071	734.9	3848.7	698.6	1.50	710.7	1158	159.28	24.86	15.61%	31.55
RodD4_93.2	243	2.367	0.119	746.5	3898.0	706.5	1.50	719.8	1141	146.28	22.00	15.04%	28.45
RodD4_95.2	244	2.418	0.170	757.4	3954.5	714.6	1.50	728.9	1125	138.56	20.09	14.50%	26.46
RodD4_142.1	248	3.609	0.218	840.0	1506.6	833.5	1.50	835.7	967	350.49	98.91	28.22%	54.92
RodE4_88.4	201	2.245	-0.003	716.1	3712.7	686.5	1.50	696.3	1185	187.83	31.61	16.83%	38.32
RodE4_91.2	202	2.316	0.069	730.3	3784.3	698.2	1.50	708.9	1161	176.71	28.27	16.00%	35.13
RodE4_95.3	204	2.421	0.173	753.5	3888.6	715.0	1.50	727.9	1127	151.70	22.42	14.78%	29.03
RodE4_100.9	205	2.563	0.315	775.1	4030.3	737.0	1.50	749.7	1090	158.57	21.56	13.59%	29.07
RodE4_142.3	208	3.614	0.224	836.8	1521.0	833.6	1.50	834.7	969	699.35	363.86	52.03%	109.77
RodE3_63.4	193	1.610	0.417	626.7	3074.0	577.9	1.50	594.2	1423	94.53	23.12	24.46%	24.20
RodE3_113.6	194	2.885	0.022	801.8	3783.3	781.0	1.50	787.9	1032	272.39	37.96	13.94%	46.47
RodE3_115.5	195	2.934	0.070	807.8	3647.0	786.7	1.50	793.8	1023	258.96	35.88	13.85%	43.71
RodE3_118.5	196	3.010	0.146	816.2	3419.7	795.2	1.50	802.2	1011	244.62	33.94	13.87%	40.66
RodE3_122.7	197	3.117	0.253	823.0	3110.5	805.9	1.50	811.6	999	272.28	40.60	14.91%	44.51
RodE3_126.5	198	3.213	0.349	826.4	2825.5	814.2	1.50	818.3	990	348.53	61.71	17.70%	56.30
RodE3_131.7	199	3.345	-0.046	828.5	2442.1	823.5	1.50	825.2	981	730.23	254.47	34.85%	116.53
RodE3_135.6	200	3.444	0.053	830.4	2146.9	828.7	1.50	829.3	975	1819.64	1713.38	94.16%	288.31

Table SC-3248-E.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	623.9	3021.4	579.2	1.50	594.1	1424	101.41	25.17	24.82%	25.96
RodC5_113.6	226	2.885	0.022	795.7	3696.6	781.0	1.50	785.9	1034	376.77	60.94	16.18%	64.52
RodC5_115.7	227	2.939	0.075	803.5	3548.5	787.3	1.50	792.7	1025	327.79	50.62	15.44%	55.43
RodC5_122.7	229	3.117	0.253	820.3	3055.7	805.9	1.50	810.7	1000	318.83	51.87	16.27%	52.20
RodC5_126.7	230	3.218	0.354	824.9	2770.4	814.7	1.50	818.1	990	406.10	80.42	19.80%	65.62
RodC5_131.6	231	3.343	-0.048	829.2	2428.1	823.4	1.50	825.3	981	628.10	192.78	30.69%	100.21
RodC5_135.7	232	3.447	0.056	833.4	2134.3	828.8	1.50	830.3	974	688.01	256.50	37.28%	108.81
RodE5_63.6	209	1.615	0.422	625.1	3091.3	578.8	1.50	594.2	1423	100.11	24.34	24.31%	25.62
RodE5_113.6	210	2.885	0.022	799.9	3807.6	781.0	1.50	787.3	1032	301.66	43.34	14.37%	51.52
RodE5_115.4	211	2.931	0.067	805.5	3679.6	786.4	1.50	792.8	1025	289.23	41.37	14.30%	48.91
RodE5_118.7	212	3.015	0.151	813.1	3439.4	795.7	1.50	801.5	1012	297.86	44.15	14.82%	49.58
RodE5_122.6	213	3.114	0.250	819.9	3152.5	805.6	1.50	810.4	1000	332.10	53.79	16.20%	54.40
RodE5_126.6	214	3.216	0.352	825.2	2859.9	814.4	1.50	818.0	990	399.35	76.10	19.06%	64.53
RodE5_131.6	215	3.343	-0.048	829.9	2493.9	823.4	1.50	825.5	980	569.25	156.67	27.52%	90.78
RodE5_135.6	216	3.444	0.053	831.8	2200.4	828.7	1.50	829.7	975	1038.59	552.72	53.22%	164.42
RodC3_79.8	177	2.027	0.227	679.5	3501.2	649.3	1.50	659.4	1261	174.23	33.31	19.12%	38.45
RodC3_85.6	178	2.174	0.374	692.3	3651.6	674.5	1.50	680.4	1216	307.81	58.57	19.03%	64.93
RodC3_88.5	179	2.248	0.000	701.3	3727.3	686.9	1.50	691.7	1194	388.60	75.96	19.55%	80.05
RodC3_92.4	180	2.347	0.099	724.5	3827.1	703.2	1.50	710.3	1158	269.43	45.04	16.72%	53.41
RodC3_94.4	181	2.398	0.150	736.1	3882.7	711.4	1.50	719.6	1141	235.69	37.22	15.79%	45.85
RodC3_97.2	182	2.469	0.221	750.5	3952.7	722.6	1.50	731.9	1120	213.19	31.76	14.90%	40.47
RodC3_108.8	183	2.764	0.516	782.3	4164.0	765.5	1.50	771.1	1056	371.00	55.95	15.08%	65.31
RodD5_50	217	1.270	0.076	571.2	2731.8	523.6	1.50	539.5	1596	86.10	26.43	30.70%	25.18
RodD5_54.1	218	1.374	0.180	591.5	2837.7	539.5	1.50	556.9	1537	81.96	23.42	28.58%	22.96
RodD5_56.9	219	1.445	0.251	603.6	2913.7	550.8	1.50	568.4	1500	82.85	22.54	27.20%	22.56
RodD5_60	220	1.524	0.330	615.8	2993.7	563.6	1.50	581.0	1461	86.05	22.21	25.81%	22.73
RodD5_66.1	221	1.679	0.485	634.9	3155.1	589.5	1.50	604.6	1395	104.31	24.34	23.34%	26.05
RodD5_69.9	222	1.775	-0.025	638.6	3252.1	606.0	1.50	616.8	1362	149.45	33.16	22.19%	36.28
RodD5_72.9	223	1.852	0.051	656.6	3332.9	619.1	1.50	631.6	1325	133.22	27.97	21.00%	31.27
RodD5_74.9	224	1.902	0.102	668.7	3385.9	627.8	1.50	641.4	1302	124.46	25.20	20.25%	28.57

Table SC-3248-E.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	544.0	2483.3	493.7	1.50	510.5	1704	74.09	26.78	36.14%	23.32
RodB5_52.9	154	1.344	0.150	581.4	2799.8	533.2	1.50	549.3	1562	87.17	25.51	29.26%	24.88
RodB5_55	155	1.397	0.203	588.9	2856.5	540.6	1.50	556.7	1537	88.62	25.00	28.21%	24.83
RodB5_57.8	156	1.468	0.274	600.0	2929.1	550.6	1.50	567.1	1504	88.94	23.91	26.88%	24.30
RodB5_64	157	1.626	0.432	618.9	3093.9	573.3	1.50	588.5	1440	101.66	24.62	24.21%	26.38
RodB5_73.9	158	1.877	0.077	647.2	3354.8	610.4	1.50	622.7	1347	137.05	28.35	20.69%	32.83
RodB5_75.9	159	1.928	0.128	657.8	3408.0	618.0	1.50	631.3	1326	128.63	25.68	19.97%	30.21
RodB5_76.9	160	1.953	0.153	662.4	3433.1	621.8	1.50	635.4	1316	126.73	24.88	19.63%	29.50
RodF5_41	105	1.041	0.343	544.7	2463.2	493.7	1.50	510.7	1703	72.53	26.41	36.42%	22.82
RodF5_53.1	106	1.349	0.155	579.4	2790.2	533.9	1.50	549.1	1563	91.99	26.98	29.33%	26.27
RodF5_55	107	1.397	0.203	588.1	2839.3	540.6	1.50	556.4	1538	89.71	25.45	28.37%	25.16
RodF5_57.8	108	1.468	0.274	598.7	2912.5	550.6	1.50	566.6	1505	90.85	24.56	27.03%	24.85
RodF5_64	109	1.626	0.432	617.3	3078.5	573.3	1.50	588.0	1441	104.76	25.50	24.34%	27.21
RodF5_73.8	110	1.875	0.074	646.1	3336.7	610.1	1.50	622.1	1349	138.79	28.90	20.82%	33.29
RodF5_75.8	111	1.925	0.125	657.4	3388.4	617.6	1.50	630.9	1327	127.97	25.70	20.08%	30.09
RodF5_76.8	112	1.951	0.150	662.2	3417.4	621.4	1.50	635.0	1317	125.69	24.79	19.72%	29.27
RodC2_41	57	1.041	0.343	523.2	2476.0	493.7	1.50	503.6	1732	125.98	46.01	36.52%	40.36
RodC2_53.1	58	1.349	0.155	541.8	2797.4	533.9	1.50	536.5	1606	529.59	188.34	35.56%	156.05
RodC2_55	59	1.397	0.203	580.6	2849.6	540.6	1.50	553.9	1546	106.91	30.32	28.36%	30.17
RodC2_57.8	60	1.468	0.274	587.0	2922.6	550.6	1.50	562.7	1518	120.26	32.59	27.10%	33.20
RodC2_63.9	61	1.623	0.429	596.4	3085.0	572.9	1.50	580.7	1462	196.91	49.25	25.01%	52.04
RodC2_73.8	62	1.875	0.074	613.0	3346.6	610.1	1.50	611.0	1377	1696.53	993.87	58.58%	417.40
RodC2_75.8	63	1.925	0.125	644.4	3400.3	617.6	1.50	626.6	1338	190.74	39.12	20.51%	45.29
RodC2_76.8	64	1.951	0.150	647.0	3428.2	621.4	1.50	629.9	1329	201.47	40.85	20.27%	47.47
RodC6_40.9	137	1.039	0.340	544.9	2465.3	493.4	1.50	510.6	1704	71.84	26.16	36.42%	22.61
RodC6_52.8	138	1.341	0.147	581.1	2793.3	532.9	1.50	548.9	1563	86.85	25.49	29.35%	24.81
RodC6_54.8	139	1.392	0.198	589.5	2849.9	539.9	1.50	556.4	1538	86.11	24.38	28.31%	24.15
RodC6_57.8	140	1.468	0.274	599.9	2931.9	550.6	1.50	567.0	1504	89.26	23.97	26.86%	24.39
RodC6_63.8	141	1.621	0.427	620.1	3098.0	572.5	1.50	588.4	1440	97.77	23.67	24.21%	25.37
RodC6_73.7	142	1.872	0.072	651.7	3371.8	609.7	1.50	623.7	1345	120.45	24.74	20.54%	28.79
RodC6_75.8	143	1.925	0.125	659.3	3431.2	617.6	1.50	631.5	1326	123.59	24.51	19.83%	29.01
RodC6_76.8	144	1.951	0.150	663.7	3456.6	621.4	1.50	635.5	1316	122.61	23.91	19.50%	28.53

Table SC-3248-E.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	697.8	3709.6	665.1	1.50	676.0	1225	170.29	28.39	16.67%	36.26
RodB4_91.3	162	2.319	0.071	715.0	3782.6	675.8	1.50	688.9	1199	144.75	22.74	15.71%	29.99
RodB4_93.3	163	2.370	0.122	724.8	3833.2	683.2	1.50	697.0	1183	138.00	20.92	15.16%	28.11
RodB4_95.1	164	2.416	0.168	732.2	3882.0	689.7	1.50	703.9	1170	136.85	20.14	14.71%	27.49
RodB4_100	165	2.540	0.292	749.9	4005.2	707.1	1.50	721.4	1138	140.55	19.17	13.64%	27.25
RodB4_106	166	2.692	0.445	766.9	4153.4	727.7	1.50	740.7	1105	158.75	19.98	12.59%	29.62
RodB4_109.9	167	2.791	0.544	772.6	4021.3	740.4	1.50	751.1	1088	187.45	23.69	12.64%	34.27
RodB4_142.3	168	3.614	0.224	820.0	1544.5	801.0	1.50	807.3	1004	122.05	0.00	0.00%	20.10
RodF4_85.6	98	2.174	0.374	695.3	3662.9	654.7	1.50	668.2	1242	135.18	23.05	17.05%	29.27
RodF4_88.4	99	2.245	-0.003	701.4	3733.6	665.1	1.50	677.2	1223	154.27	25.37	16.45%	32.76
RodF4_92.4	100	2.347	0.099	724.9	3839.7	679.9	1.50	694.9	1188	127.93	19.47	15.22%	26.18
RodF4_94.3	101	2.395	0.147	735.3	3892.3	686.8	1.50	703.0	1172	120.29	17.68	14.69%	24.21
RodF4_97.2	102	2.469	0.221	749.9	3968.6	697.2	1.50	714.8	1150	113.10	15.80	13.97%	22.22
RodF4_108.8	103	2.764	0.516	785.6	4182.8	736.9	1.50	753.1	1085	128.72	15.32	11.90%	23.45
RodF4_111	104	2.819	-0.044	789.4	4016.6	743.9	1.50	759.1	1075	132.50	15.85	11.96%	23.86
RodD2_103.2	65	2.621	0.373	753.7	4138.0	718.2	1.50	730.0	1123	174.73	22.98	13.15%	33.29
RodD2_106	66	2.692	0.445	761.0	4211.6	727.7	1.50	738.8	1108	189.63	24.18	12.75%	35.52
RodD2_112.6	67	2.860	-0.004	773.1	3859.7	748.9	1.50	757.0	1078	239.70	31.99	13.35%	43.34
RodD2_114.9	68	2.918	0.055	783.1	3681.4	756.0	1.50	765.0	1066	203.17	26.35	12.97%	36.17
RodD2_117.4	69	2.982	0.118	790.7	3488.7	763.4	1.50	772.5	1054	191.48	24.80	12.95%	33.62
RodD2_120.8	70	3.068	0.204	802.1	3218.5	773.0	1.50	782.7	1039	165.81	21.21	12.79%	28.56
RodD2_124.8	71	3.170	0.306	809.3	2905.6	783.7	1.50	792.2	1025	170.33	22.42	13.16%	28.83
RodD2_128.6	72	3.266	0.403	813.5	2605.9	793.0	1.50	799.8	1015	191.11	26.84	14.04%	31.90
RodD6_103.1	129	2.619	0.371	762.3	4149.9	717.9	1.50	732.7	1119	140.21	18.00	12.84%	26.58
RodD6_106	130	2.692	0.445	769.5	4224.3	727.7	1.50	741.6	1103	151.25	18.71	12.37%	28.17
RodD6_112.9	131	2.868	0.004	785.2	3852.5	749.9	1.50	761.6	1071	163.65	20.20	12.35%	29.33
RodD6_114.9	132	2.918	0.055	790.5	3691.1	756.0	1.50	767.5	1062	160.53	19.90	12.40%	28.45
RodD6_116.8	133	2.967	0.103	796.2	3542.4	761.6	1.50	773.2	1053	153.59	19.03	12.39%	26.93
RodD6_120.9	134	3.071	0.207	804.8	3218.3	773.3	1.50	783.8	1038	153.06	19.27	12.59%	26.31
RodD6_124.8	135	3.170	0.306	811.7	2910.8	783.7	1.50	793.0	1024	155.64	20.05	12.88%	26.31
RodD6_128.7	136	3.269	0.405	817.5	2603.3	793.3	1.50	801.3	1013	161.14	21.50	13.34%	26.83

Table SC-3248-E.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R. Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	566.5	2738.0	523.5	1.50	537.8	1601	95.67	29.32	30.65%	28.10
RodE2_54	74	1.372	0.178	586.8	2842.9	537.1	1.50	553.6	1547	85.80	24.51	28.57%	24.23
RodE2_56.9	75	1.445	0.251	597.6	2921.4	547.4	1.50	564.1	1513	87.27	23.70	27.16%	24.02
RodE2_59.9	76	1.521	0.328	608.5	3000.7	558.2	1.50	575.0	1480	89.48	23.08	25.80%	23.98
RodE2_66	77	1.676	0.483	625.1	3166.5	580.7	1.50	595.5	1420	106.90	24.90	23.30%	27.28
RodE2_69.8	78	1.773	-0.027	629.8	3266.6	595.0	1.50	606.6	1389	140.81	31.06	22.06%	35.01
RodE2_72.9	79	1.852	0.051	642.9	3350.3	606.7	1.50	618.8	1357	138.49	28.98	20.92%	33.47
RodE2_74.9	80	1.902	0.102	651.8	3404.5	614.2	1.50	626.7	1337	136.09	27.53	20.23%	32.30
RodB3_50.2	169	1.275	0.081	560.1	2721.0	523.9	1.50	536.0	1608	112.50	34.76	30.90%	33.20
RodB3_54.1	170	1.374	0.180	576.2	2823.7	537.4	1.50	550.4	1558	109.07	31.46	28.84%	31.05
RodB3_56.9	171	1.445	0.251	587.7	2896.8	547.4	1.50	560.8	1524	107.59	29.56	27.47%	29.85
RodB3_60.1	172	1.527	0.333	599.2	2984.2	558.9	1.50	572.4	1488	111.12	28.88	25.99%	29.97
RodB3_66.1	173	1.679	0.485	615.3	3140.9	581.1	1.50	592.5	1428	137.54	32.51	23.64%	35.34
RodB3_69.9	174	1.775	-0.025	619.0	3243.0	595.3	1.50	603.2	1398	205.59	46.75	22.74%	51.51
RodB3_73	175	1.854	0.054	633.9	3323.2	607.0	1.50	616.0	1365	185.30	39.72	21.44%	45.07
RodB3_75	176	1.905	0.105	644.8	3377.3	614.6	1.50	624.7	1342	167.80	34.54	20.58%	40.01
RodF3_50.1	89	1.273	0.079	570.4	2724.6	523.5	1.50	539.1	1597	87.24	26.83	30.75%	25.54
RodF3_54	90	1.372	0.178	588.8	2825.3	537.1	1.50	554.3	1545	81.98	23.54	28.72%	23.11
RodF3_57	91	1.448	0.254	599.6	2910.2	547.7	1.50	565.0	1510	84.17	22.91	27.22%	23.11
RodF3_60	92	1.524	0.330	609.4	2988.5	558.6	1.50	575.5	1478	88.24	22.82	25.87%	23.62
RodF3_66.1	93	1.679	0.485	624.9	3154.9	581.1	1.50	595.7	1419	107.90	25.20	23.36%	27.52
RodF3_70	94	1.778	-0.022	629.9	3260.8	595.7	1.50	607.1	1388	142.92	31.54	22.07%	35.49
RodF3_73	95	1.854	0.054	645.9	3344.1	607.0	1.50	620.0	1354	128.97	26.92	20.87%	31.08
RodF3_75	96	1.905	0.105	658.2	3398.2	614.6	1.50	629.1	1331	116.92	23.52	20.12%	27.60
RodE6_50.2	121	1.275	0.081	564.4	2720.8	523.9	1.50	537.4	1603	100.72	31.06	30.83%	29.62
RodE6_54.1	122	1.374	0.180	581.3	2824.6	537.4	1.50	552.0	1553	96.53	27.77	28.77%	27.37
RodE6_57	123	1.448	0.254	591.7	2898.7	547.7	1.50	562.4	1519	98.93	27.09	27.39%	27.34
RodE6_60.2	124	1.529	0.335	604.4	2983.8	559.3	1.50	574.3	1482	99.33	25.74	25.91%	26.66
RodE6_66.1	125	1.679	0.485	622.5	3138.6	581.1	1.50	594.9	1421	113.62	26.70	23.50%	29.03
RodE6_70	126	1.778	-0.022	626.8	3240.6	595.7	1.50	606.1	1391	156.52	34.90	22.30%	38.96
RodE6_73.1	127	1.857	0.056	642.1	3322.2	607.4	1.50	619.0	1357	143.73	30.30	21.08%	34.72
RodE6_75	128	1.905	0.105	652.5	3372.9	614.6	1.50	627.2	1336	133.60	27.20	20.36%	31.67

RBHT Steam Cooling Test SC-3248-F

Matrix test # 1

Test date – 8/11/2005

Steady state time window: 34900 - 35200 sec

Inlet flow: 0.34 m³/min (12.0 ft³/min)

Inlet steam temperature: 407 K (273 °F)

Upper plenum pressure: 271.7 kPa (39.4 psia)

Bundle power: 10.2 kW

Outlet steam temperature: 580 K (585 °F)

Bundle inlet Reynolds number: 1370

Subchannel Centerline Temperatures

The equations below were correlated using the axial subchannel centerline temperature distribution. Experiment SC-3248 was run with the traversing probes withdrawn. Centerline steam temperatures used are from experiment SC-3166-C.

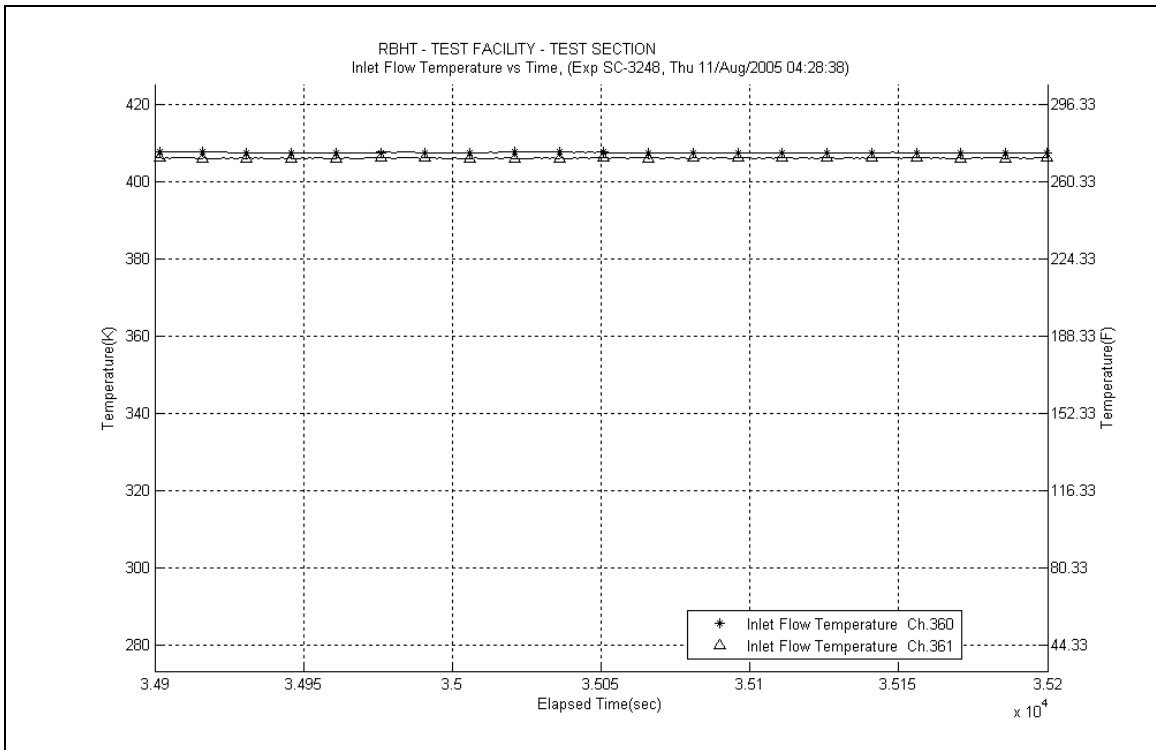
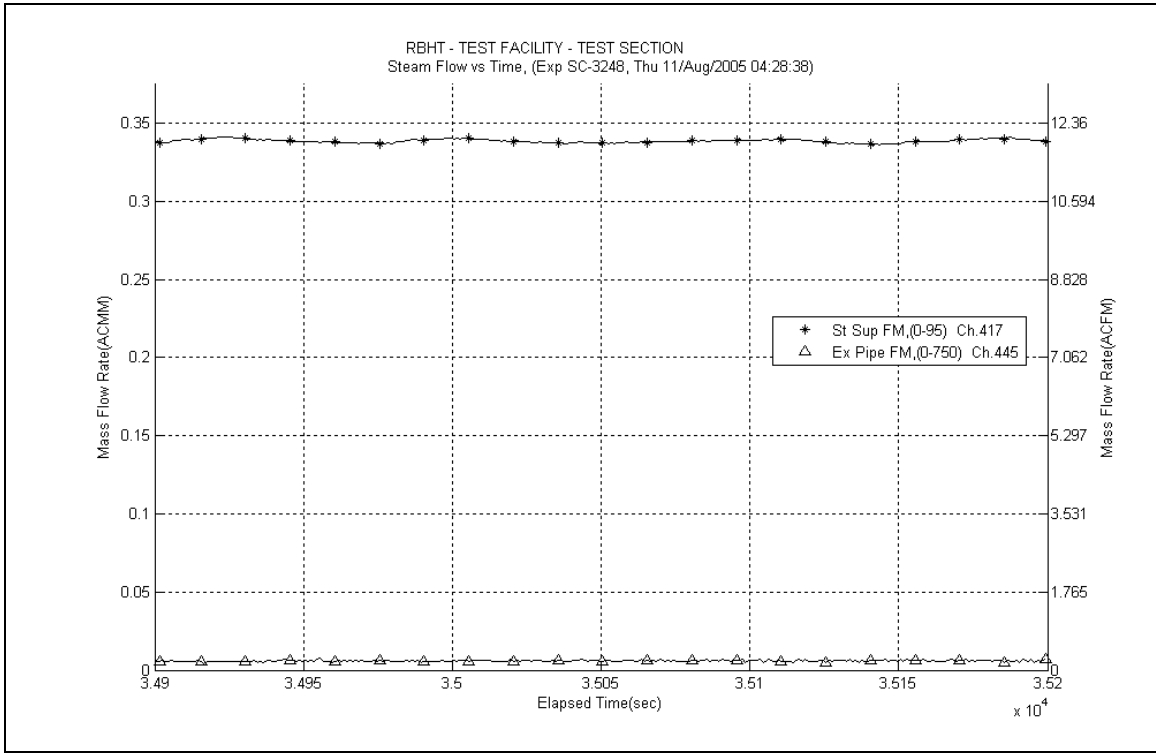
Subchannels D5 and E5 (use for inner 3x3 rod bundle thermocouple locations)

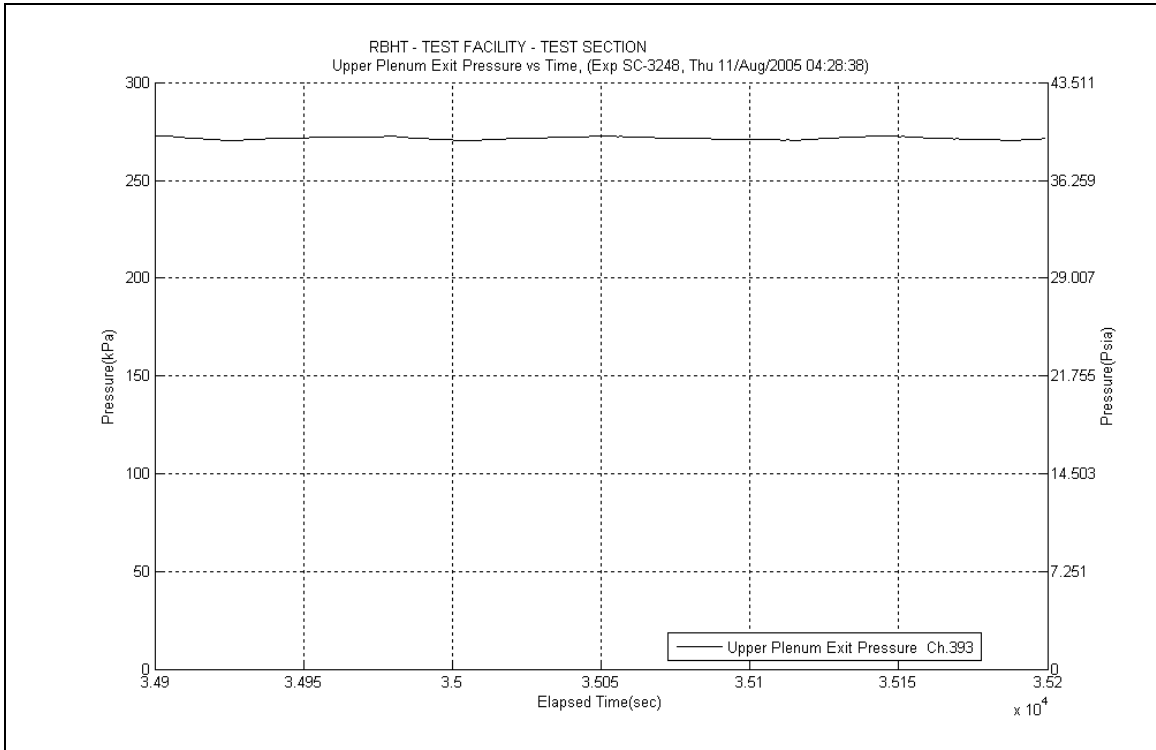
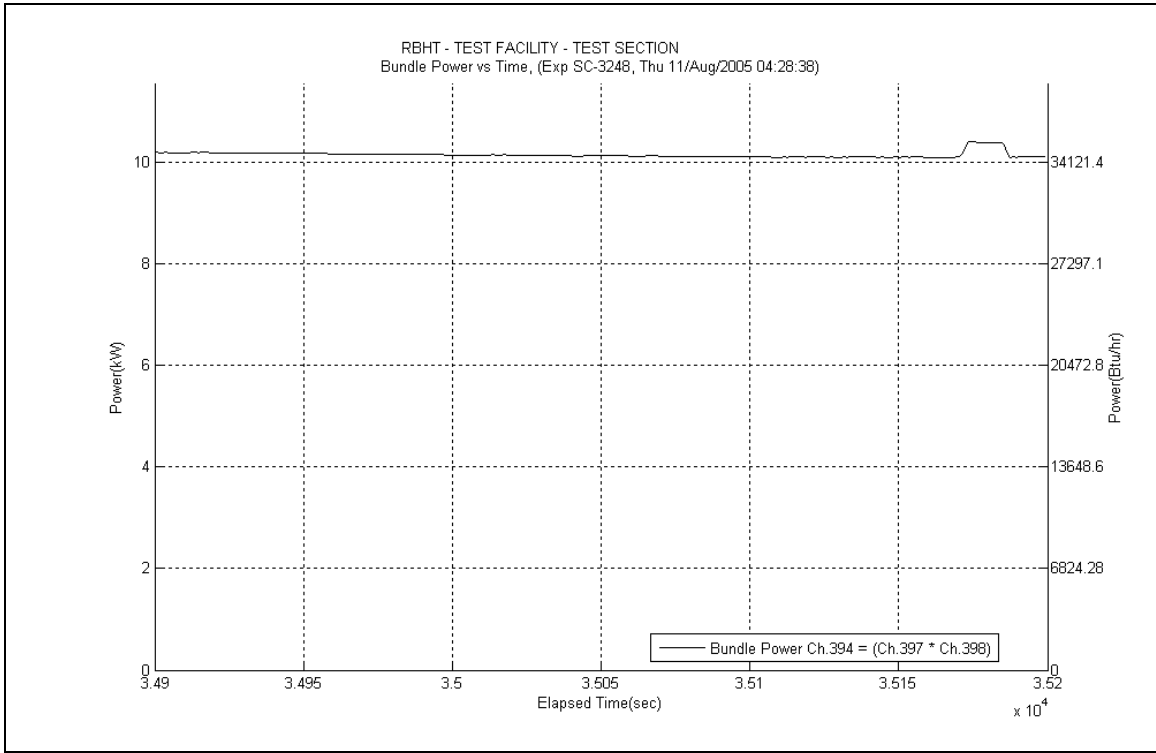
$$T_{cl} = -15.802x^3 + 89.248x^2 - 6.8734x + 421.94$$

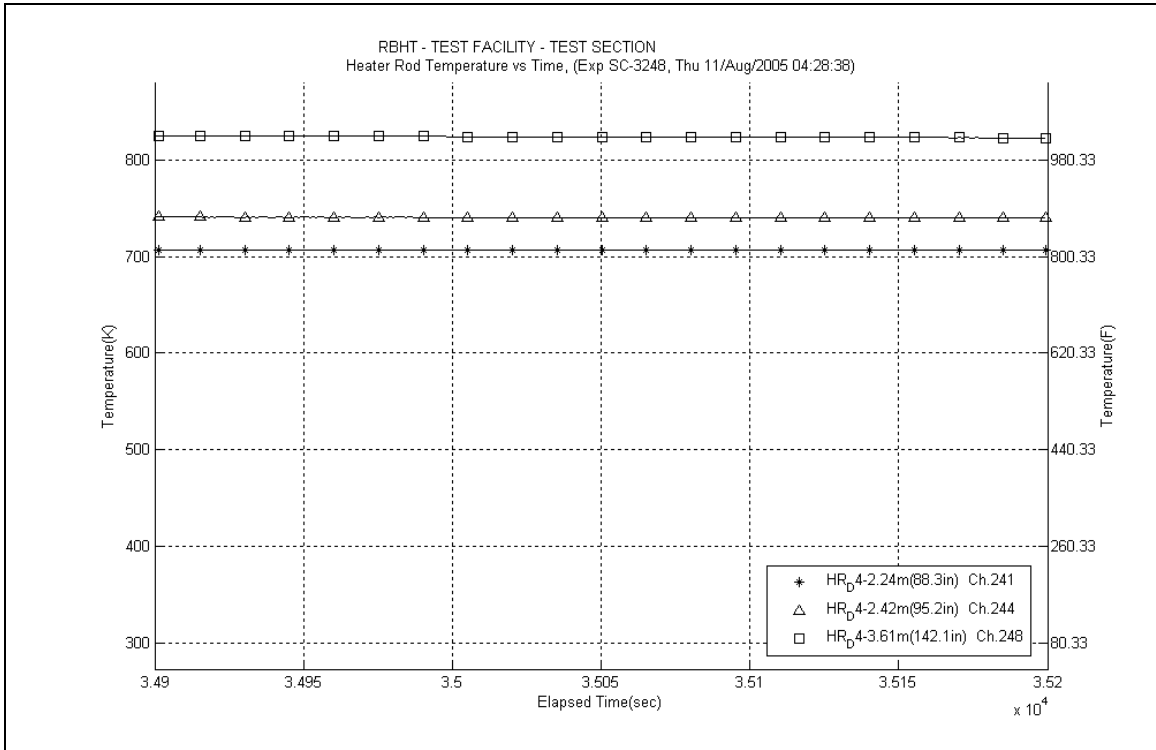
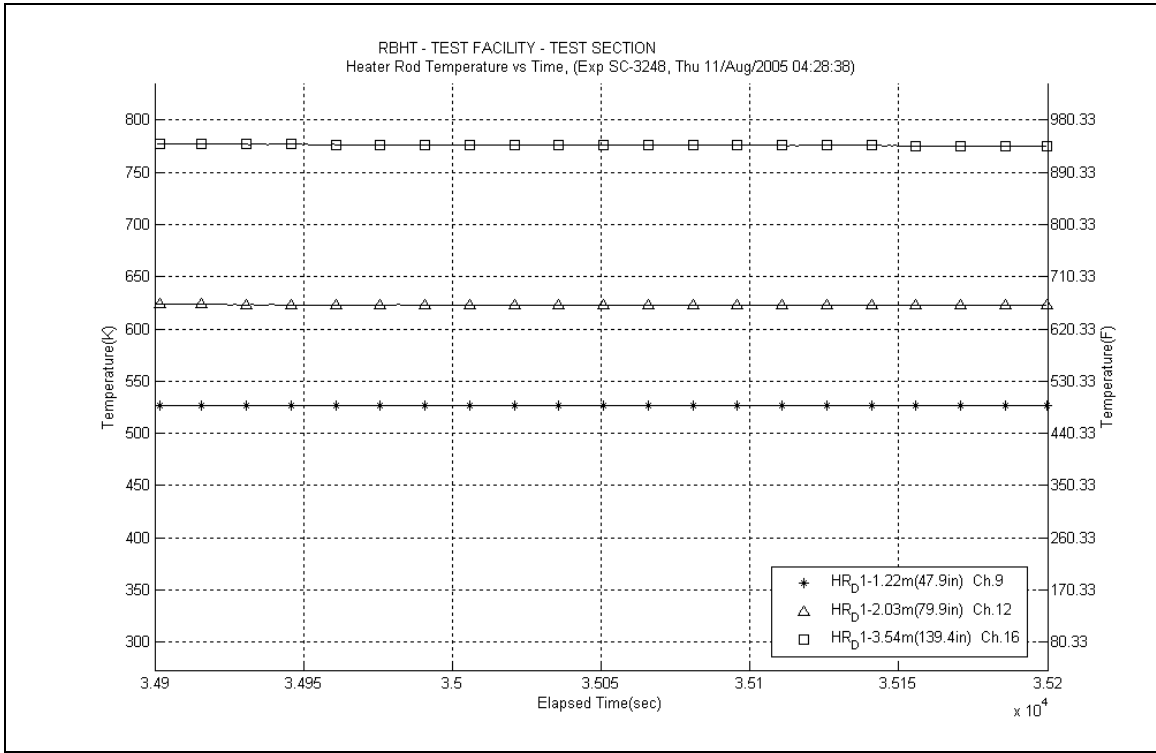
Subchannel C5 (use for 5x5 peripheral rod bundle thermocouple locations)

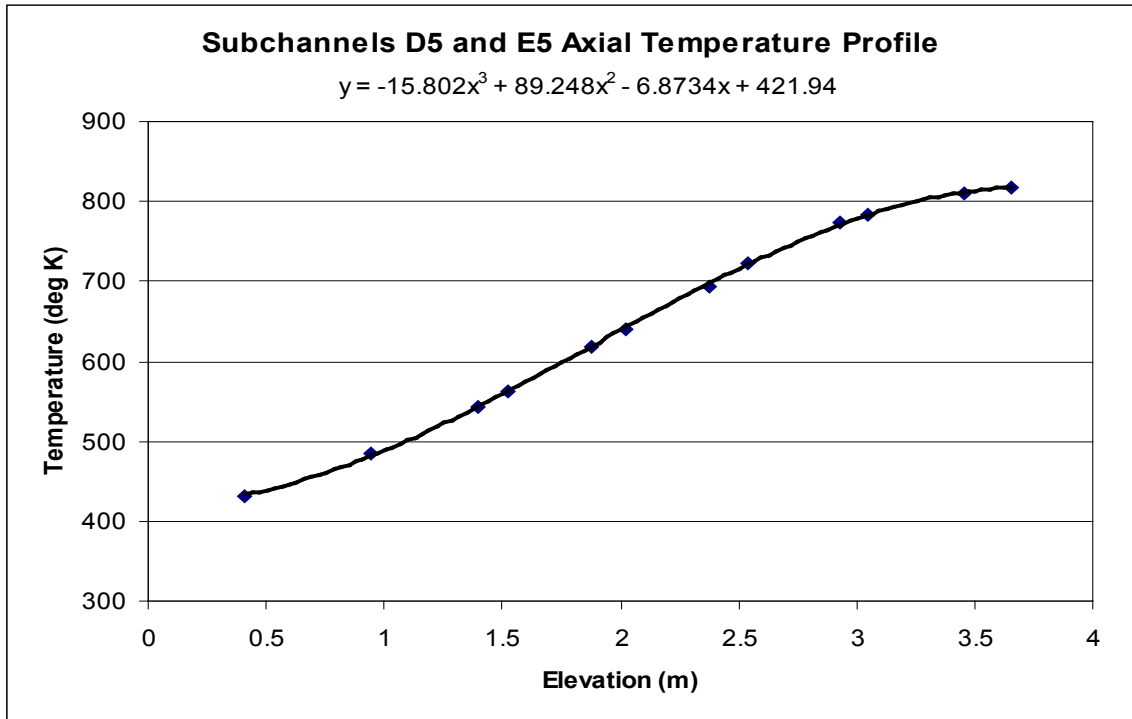
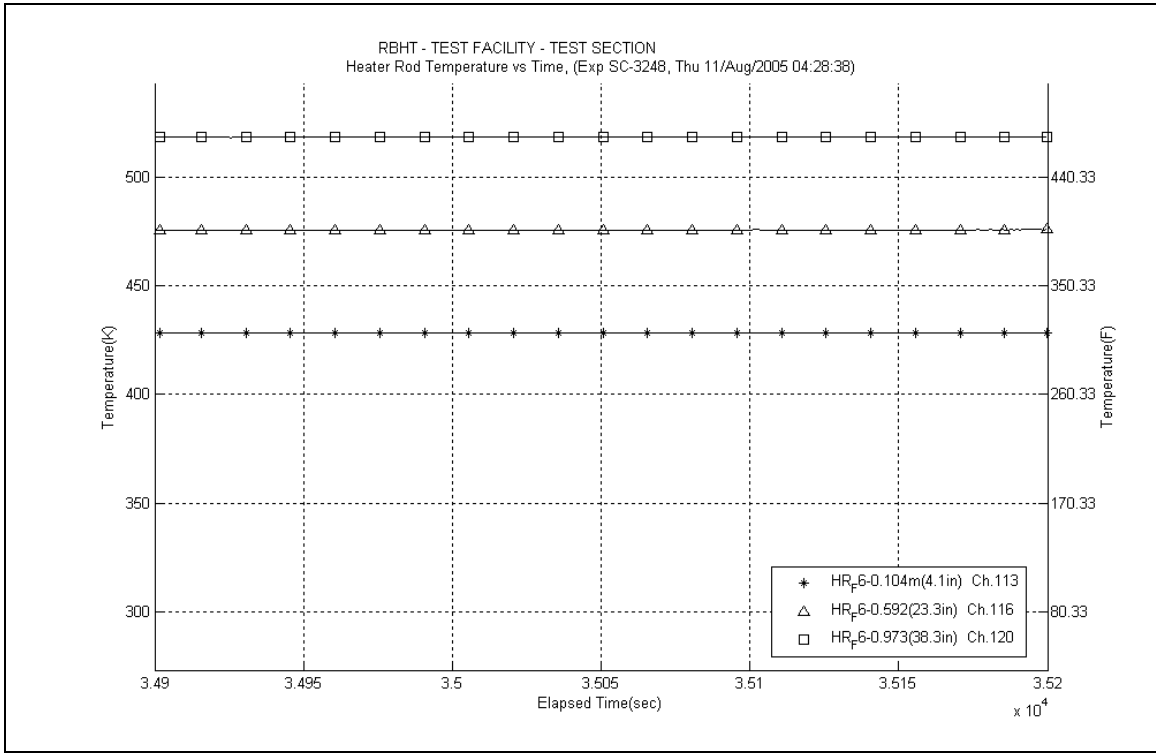
$$T_{cl} = -10.723x^3 + 60.253x^2 + 30.582x + 409.62$$

where x is the elevation (m) and T_{cl} is in (°C)









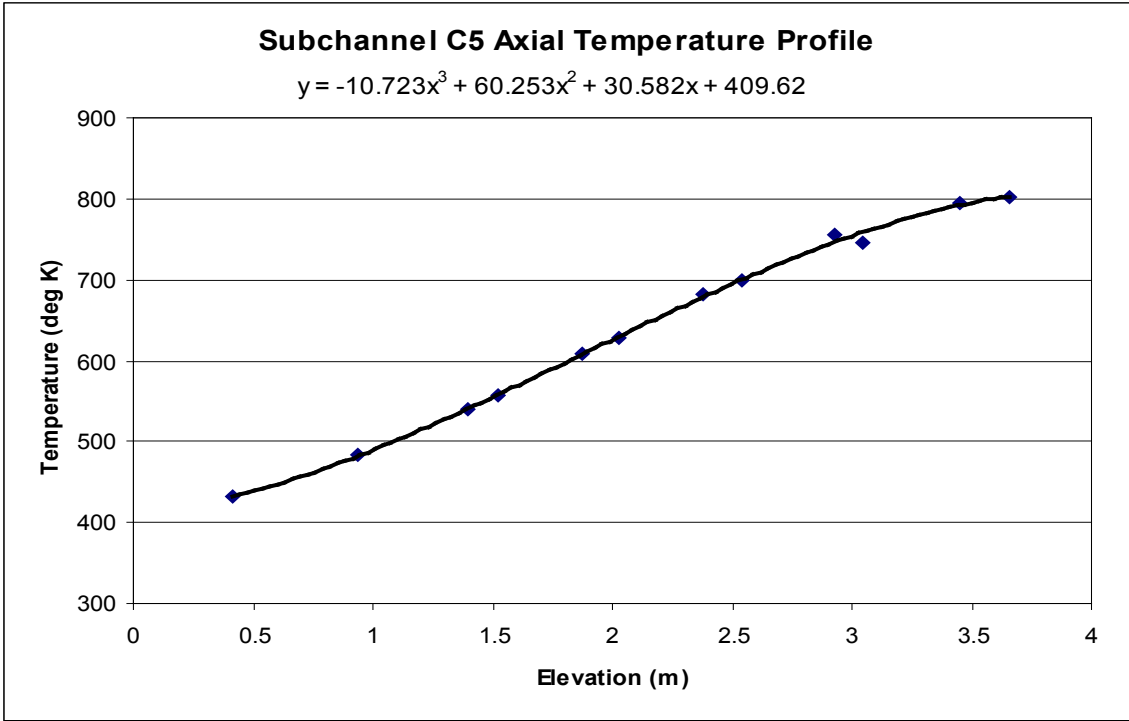


Table SC-3248-F.1: Summary of Steam Cooling Data

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodD3_88.3	185	2.243	-0.005	697.6	2718.9	677.2	1.50	684.0	853	199.94	44.63	22.32%	41.86
RodD3_91.3	186	2.319	0.071	712.8	2776.4	688.9	1.50	696.9	835	174.30	36.35	20.86%	35.52
RodD3_93.1	187	2.365	0.117	723.9	2812.4	695.8	1.50	705.2	824	150.32	29.92	19.91%	30.11
RodD3_95.3	188	2.421	0.173	735.3	2860.4	704.1	1.50	714.5	812	137.57	26.10	18.97%	27.04
RodD3_100.1	189	2.543	0.295	753.6	2962.8	721.7	1.50	732.3	789	139.50	24.25	17.38%	26.46
RodD3_106.1	190	2.695	0.447	768.0	3078.6	742.3	1.50	750.9	768	179.77	29.01	16.14%	32.88
RodD3_110	191	2.794	0.546	773.6	3036.9	754.8	1.50	761.1	756	242.49	40.37	16.65%	43.50
RodD3_142.1	192	3.609	0.218	817.9	1121.2	816.8	1.50	817.2	699	1607.53	2553.23	158.83%	260.17
RodC4_88.4	233	2.245	-0.003	697.2	2752.3	677.6	1.50	684.1	853	210.99	46.88	22.22%	44.16
RodC4_91.1	234	2.314	0.066	712.7	2803.1	688.1	1.50	696.3	836	171.18	35.40	20.68%	34.92
RodC4_93.4	235	2.372	0.124	724.4	2849.5	697.0	1.50	706.1	823	155.62	30.61	19.67%	31.12
RodC4_95.3	236	2.421	0.173	733.9	2890.2	704.1	1.50	714.0	812	145.64	27.51	18.89%	28.65
RodC4_100.1	237	2.543	0.295	753.6	2995.3	721.7	1.50	732.3	789	140.76	24.26	17.24%	26.70
RodC4_106.1	238	2.695	0.447	765.2	3116.3	742.3	1.50	749.9	769	204.71	33.46	16.35%	37.52
RodC4_110	239	2.794	0.546	770.4	3014.6	754.8	1.50	760.0	757	289.96	51.42	17.73%	52.12
RodC4_142.2	240	3.612	0.221	819.3	1216.2	816.9	1.50	817.7	699	750.51	521.06	69.43%	121.36
RodD4_88.3	241	2.243	-0.005	706.4	2741.4	677.2	1.50	686.9	849	140.77	30.13	21.41%	29.29
RodD4_91.3	242	2.319	0.071	720.2	2798.5	688.9	1.50	699.3	832	134.00	27.12	20.24%	27.17
RodD4_93.2	243	2.367	0.119	730.5	2837.7	696.2	1.50	707.6	821	124.04	24.12	19.45%	24.72
RodD4_95.2	244	2.418	0.170	740.3	2879.1	703.7	1.50	715.9	810	118.12	22.08	18.69%	23.15
RodD4_142.1	248	3.609	0.218	823.7	1177.5	816.8	1.50	819.1	697	255.97	71.14	27.79%	41.29
RodE4_88.4	201	2.245	-0.003	702.2	2701.2	677.6	1.50	685.8	850	164.61	36.13	21.95%	34.33
RodE4_91.2	202	2.316	0.069	714.8	2752.0	688.5	1.50	697.3	834	157.21	32.74	20.83%	32.01
RodE4_95.3	204	2.421	0.173	735.0	2835.2	704.1	1.50	714.4	812	137.78	26.35	19.12%	27.09
RodE4_100.9	205	2.563	0.315	754.7	2944.4	724.5	1.50	734.6	787	146.55	25.48	17.39%	27.67
RodE4_142.3	208	3.614	0.224	820.7	1187.7	816.9	1.50	818.2	698	466.71	212.37	45.50%	75.40
RodE3_63.4	193	1.610	0.417	611.5	2237.0	576.3	1.50	588.1	1016	95.28	31.46	33.02%	24.74
RodE3_113.6	194	2.885	0.022	782.7	2766.9	765.6	1.50	771.3	745	242.23	41.94	17.31%	42.62
RodE3_115.5	195	2.934	0.070	788.3	2667.2	770.9	1.50	776.7	739	229.65	39.49	17.20%	40.00
RodE3_118.5	196	3.010	0.146	795.8	2510.8	778.9	1.50	784.5	731	223.17	38.64	17.31%	38.31
RodE3_122.7	197	3.117	0.253	802.5	2296.8	789.1	1.50	793.5	722	255.67	47.87	18.72%	43.17
RodE3_126.5	198	3.213	0.349	806.5	2097.7	797.1	1.50	800.2	715	334.43	75.22	22.49%	55.79
RodE3_131.7	199	3.345	-0.046	811.2	1821.9	806.2	1.50	807.8	708	543.77	194.20	35.71%	89.48
RodE3_135.6	200	3.444	0.053	814.2	1619.6	811.4	1.50	812.3	704	860.25	517.52	60.16%	140.43

Table SC-3248-F.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{htc} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodC5_63.7	225	1.618	0.424	608.1	2193.5	577.5	1.50	587.7	1017	107.55	36.18	33.65%	27.95
RodC5_113.6	226	2.885	0.022	777.8	2698.1	765.6	1.50	769.6	747	331.70	66.24	19.97%	58.55
RodC5_115.7	227	2.939	0.075	784.7	2593.9	771.5	1.50	775.9	740	293.21	56.30	19.20%	51.15
RodC5_122.7	229	3.117	0.253	800.2	2251.6	789.1	1.50	792.8	723	302.08	62.28	20.62%	51.08
RodC5_126.7	230	3.218	0.354	804.8	2056.7	797.5	1.50	799.9	716	418.54	111.12	26.55%	69.86
RodC5_131.6	231	3.343	-0.048	811.1	1811.3	806.0	1.50	807.7	708	530.42	186.61	35.18%	87.30
RodC5_135.7	232	3.447	0.056	816.4	1612.4	811.5	1.50	813.1	703	492.18	178.82	36.33%	80.23
RodE5_63.6	209	1.615	0.422	609.8	2247.0	577.1	1.50	588.0	1016	103.14	33.91	32.87%	26.79
RodE5_113.6	210	2.885	0.022	782.5	2778.2	765.6	1.50	771.2	745	246.34	42.73	17.35%	43.35
RodE5_115.4	211	2.931	0.067	787.4	2688.7	770.6	1.50	776.2	740	240.50	41.72	17.35%	41.93
RodE5_118.7	212	3.015	0.151	794.6	2520.3	779.4	1.50	784.5	731	250.00	44.77	17.91%	42.92
RodE5_122.6	213	3.114	0.250	800.9	2324.0	788.8	1.50	792.9	723	288.51	56.57	19.61%	48.78
RodE5_126.6	214	3.216	0.352	806.1	2117.5	797.3	1.50	800.2	715	358.92	83.60	23.29%	59.88
RodE5_131.6	215	3.343	-0.048	813.2	1853.6	806.0	1.50	808.4	708	388.00	104.16	26.85%	63.78
RodE5_135.6	216	3.444	0.053	816.3	1655.5	811.4	1.50	813.0	703	506.32	183.83	36.31%	82.55
RodC3_79.8	177	2.027	0.227	664.6	2543.0	643.1	1.50	650.3	904	177.39	45.41	25.60%	39.94
RodC3_85.6	178	2.174	0.374	679.3	2652.9	666.5	1.50	670.7	872	311.58	79.45	25.50%	67.09
RodC3_88.5	179	2.248	0.000	691.7	2702.9	678.0	1.50	682.5	855	296.37	71.45	24.11%	62.24
RodC3_92.4	180	2.347	0.099	711.8	2772.2	693.1	1.50	699.4	832	222.90	47.61	21.36%	45.19
RodC3_94.4	181	2.398	0.150	721.9	2819.0	700.7	1.50	707.8	820	199.56	40.37	20.23%	39.76
RodC3_97.2	182	2.469	0.221	734.4	2877.6	711.2	1.50	718.9	806	185.95	35.44	19.06%	36.23
RodC3_108.8	183	2.764	0.516	763.8	3041.1	751.0	1.50	755.3	763	356.82	69.00	19.34%	64.72
RodD5_50	217	1.270	0.076	561.0	1956.3	524.8	1.50	536.9	1132	80.96	34.28	42.34%	23.84
RodD5_54.1	218	1.374	0.180	578.7	2045.2	540.0	1.50	552.9	1093	79.26	31.00	39.11%	22.42
RodD5_56.9	219	1.445	0.251	589.6	2103.0	550.7	1.50	563.7	1068	81.16	30.14	37.13%	22.36
RodD5_60	220	1.524	0.330	600.5	2168.9	562.8	1.50	575.4	1043	86.23	30.23	35.06%	23.09
RodD5_66.1	221	1.679	0.485	619.9	2286.5	587.2	1.50	598.1	996	104.91	33.13	31.58%	26.61
RodD5_69.9	222	1.775	-0.025	628.8	2350.9	602.6	1.50	611.4	971	134.81	40.28	29.88%	33.15
RodD5_72.9	223	1.852	0.051	644.8	2407.8	614.9	1.50	624.9	947	120.88	34.12	28.22%	28.81
RodD5_74.9	224	1.902	0.102	654.8	2448.5	623.1	1.50	633.6	931	115.84	31.50	27.19%	27.06

Table SC-3248-F.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R.q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hic} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB5_41	153	1.041	0.343	532.8	1791.5	494.7	1.50	507.4	1211	70.47	35.00	49.67%	22.36
RodB5_52.9	154	1.344	0.150	569.9	2021.4	533.5	1.50	545.6	1111	83.30	33.32	40.00%	24.00
RodB5_55	155	1.397	0.203	576.4	2067.4	540.7	1.50	552.6	1094	86.88	33.40	38.44%	24.60
RodB5_57.8	156	1.468	0.274	585.9	2126.9	550.5	1.50	562.3	1072	89.96	32.82	36.48%	24.87
RodB5_64	157	1.626	0.432	603.8	2253.3	572.5	1.50	582.9	1027	107.95	35.30	32.70%	28.38
RodB5_73.9	158	1.877	0.077	633.1	2436.4	608.4	1.50	616.6	961	147.77	41.21	27.89%	35.89
RodB5_75.9	159	1.928	0.128	642.6	2478.9	615.7	1.50	624.7	947	138.14	37.01	26.79%	32.94
RodB5_76.9	160	1.953	0.153	646.9	2499.2	619.3	1.50	628.5	940	136.17	35.80	26.29%	32.19
RodF5_41	105	1.041	0.343	530.9	1785.5	494.7	1.50	506.8	1213	74.07	36.93	49.85%	23.54
RodF5_53.1	106	1.349	0.155	565.8	2017.0	534.2	1.50	544.7	1113	95.67	38.36	40.10%	27.62
RodF5_55	107	1.397	0.203	573.8	2057.4	540.7	1.50	551.7	1096	93.11	36.00	38.66%	26.42
RodF5_57.8	108	1.468	0.274	583.7	2115.4	550.5	1.50	561.6	1073	95.30	34.99	36.71%	26.39
RodF5_64	109	1.626	0.432	601.9	2237.8	572.5	1.50	582.3	1028	114.13	37.62	32.96%	30.05
RodF5_73.8	110	1.875	0.074	632.2	2418.9	608.0	1.50	616.1	962	150.17	42.24	28.13%	36.52
RodF5_75.8	111	1.925	0.125	641.8	2462.4	615.3	1.50	624.1	948	139.43	37.64	27.00%	33.29
RodF5_76.8	112	1.951	0.150	646.1	2483.5	619.0	1.50	628.0	941	137.11	36.31	26.48%	32.44
RodC2_41	57	1.041	0.343	510.0	1790.9	494.7	1.50	499.8	1233	175.58	88.89	50.63%	56.80
RodC2_53.1	58	1.349	0.155	529.1	2022.3	534.2	1.50	532.5	1143	-596.71	304.07	-50.96%	-177.65
RodC2_55	59	1.397	0.203	568.2	2055.7	540.7	1.50	549.9	1100	112.19	43.57	38.83%	31.98
RodC2_57.8	60	1.468	0.274	574.1	2113.5	550.5	1.50	558.3	1081	134.19	49.73	37.06%	37.46
RodC2_63.9	61	1.623	0.429	582.4	2235.4	572.1	1.50	575.5	1043	327.90	118.82	36.24%	87.76
RodC2_73.8	62	1.875	0.074	599.3	2430.5	608.0	1.50	605.1	983	-415.13	136.57	-32.90%	-103.56
RodC2_75.8	63	1.925	0.125	632.8	2458.3	615.3	1.50	621.1	953	211.27	59.01	27.93%	50.78
RodC2_76.8	64	1.951	0.150	634.4	2479.8	619.0	1.50	624.1	948	240.42	67.05	27.89%	57.40
RodC6_40.9	137	1.039	0.340	531.8	1781.2	494.4	1.50	506.8	1213	71.50	35.75	49.99%	22.72
RodC6_52.8	138	1.341	0.147	567.3	2019.4	533.1	1.50	544.5	1113	88.73	35.59	40.11%	25.63
RodC6_54.8	139	1.392	0.198	574.9	2064.3	540.0	1.50	551.6	1096	88.72	34.22	38.58%	25.18
RodC6_57.8	140	1.468	0.274	584.1	2131.1	550.5	1.50	561.7	1073	94.90	34.59	36.45%	26.27
RodC6_63.8	141	1.621	0.427	603.3	2258.6	571.8	1.50	582.3	1028	107.47	35.12	32.68%	28.30
RodC6_73.7	142	1.872	0.072	636.9	2448.7	607.7	1.50	617.4	960	125.46	34.62	27.59%	30.42
RodC6_75.8	143	1.925	0.125	643.3	2494.4	615.3	1.50	624.6	947	133.66	35.58	26.62%	31.87
RodC6_76.8	144	1.951	0.150	647.1	2516.7	619.0	1.50	628.3	941	134.01	35.01	26.13%	31.69

Table SC-3248-F.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hic} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodB4_88.4	161	2.245	-0.003	698.9	2751.9	660.7	1.50	673.4	888	107.87	22.65	21.00%	23.10
RodB4_91.3	162	2.319	0.071	698.9	2751.9	670.8	1.50	680.2	858	146.91	30.39	20.68%	31.00
RodB4_93.3	163	2.370	0.122	707.1	2792.1	677.8	1.50	687.5	848	142.98	28.46	19.91%	29.71
RodB4_95.1	164	2.416	0.168	713.4	2827.9	683.9	1.50	693.8	839	143.77	27.72	19.28%	29.49
RodB4_100	165	2.540	0.292	729.2	2927.1	700.3	1.50	710.0	818	151.71	26.90	17.73%	30.10
RodB4_106	166	2.692	0.445	746.6	3037.2	719.4	1.50	728.5	794	167.71	27.11	16.17%	32.05
RodB4_109.9	167	2.791	0.544	754.8	2937.1	731.2	1.50	739.1	781	187.10	30.19	16.14%	35.02
RodB4_142.3	168	3.614	0.224	803.3	1209.0	801.0	1.50	801.8	714	775.64	559.05	72.08%	129.04
RodF4_85.6	98	2.174	0.374	678.0	2674.7	650.7	1.50	659.8	889	147.39	33.36	22.63%	32.50
RodF4_88.4	99	2.245	-0.003	686.4	2721.9	660.7	1.50	669.2	875	158.90	34.52	21.73%	34.33
RodF4_92.4	100	2.347	0.099	706.9	2799.7	674.7	1.50	685.4	851	130.34	25.98	19.93%	27.21
RodF4_94.3	101	2.395	0.147	716.3	2841.5	681.2	1.50	692.9	840	121.42	23.25	19.15%	24.95
RodF4_97.2	102	2.469	0.221	730.0	2899.0	691.0	1.50	704.0	825	111.56	20.16	18.07%	22.40
RodF4_108.8	103	2.764	0.516	765.0	3065.8	728.0	1.50	740.3	780	124.15	18.57	14.96%	23.18
RodF4_111	104	2.819	-0.044	770.5	2937.8	734.5	1.50	746.5	773	122.44	18.37	15.00%	22.59
RodD2_103.2	65	2.621	0.373	735.0	3019.6	710.7	1.50	718.8	806	185.90	31.72	17.06%	36.23
RodD2_106	66	2.692	0.445	742.4	3071.6	719.4	1.50	727.1	796	200.71	33.12	16.50%	38.47
RodD2_112.6	67	2.860	-0.004	759.4	2814.2	739.1	1.50	745.9	773	207.31	34.29	16.54%	38.29
RodD2_114.9	68	2.918	0.055	767.1	2686.4	745.5	1.50	752.7	766	186.60	30.43	16.31%	34.02
RodD2_117.4	69	2.982	0.118	773.7	2546.2	752.3	1.50	759.4	758	177.94	29.05	16.32%	32.02
RodD2_120.8	70	3.068	0.204	785.1	2363.2	761.0	1.50	769.0	748	147.11	23.39	15.90%	26.00
RodD2_124.8	71	3.170	0.306	792.4	2140.7	770.5	1.50	777.8	738	146.42	23.69	16.18%	25.46
RodD2_128.6	72	3.266	0.403	796.9	1935.7	778.7	1.50	784.8	731	159.22	26.88	16.88%	27.32
RodD6_103.1	129	2.619	0.371	743.0	3028.9	710.3	1.50	721.2	803	139.24	22.89	16.44%	27.00
RodD6_106	130	2.692	0.445	749.9	3082.0	719.4	1.50	729.6	793	151.93	23.96	15.77%	28.97
RodD6_112.9	131	2.868	0.004	768.0	2814.2	739.9	1.50	749.3	769	150.66	23.36	15.51%	27.65
RodD6_114.9	132	2.918	0.055	772.8	2702.3	745.5	1.50	754.6	763	148.40	23.09	15.56%	26.95
RodD6_116.8	133	2.967	0.103	778.1	2597.6	750.7	1.50	759.8	758	142.30	22.11	15.54%	25.59
RodD6_120.9	134	3.071	0.207	786.2	2371.1	761.2	1.50	769.5	747	142.46	22.42	15.74%	25.15
RodD6_124.8	135	3.170	0.306	792.9	2156.7	770.5	1.50	777.9	738	144.33	23.13	16.03%	25.08
RodD6_128.7	136	3.269	0.405	799.2	1937.3	778.9	1.50	785.7	730	142.72	23.35	16.36%	24.45

Table SC-3248-F.1: Summary of Steam Cooling Data (cont.)

H.R. Location	Channel Number	Elevation (m)	Zgrid (m)	H.R.Tw (K)	H.R. q" (W/m ²)	Tcl (K)	Correction Factor	Tbulk (K)	Re (z)	h (z) (W/m ² -K)	±σ _{hic} (W/m ² -K)	Fractional Uncertainty	Nu(z)
RodE2_50.1	73	1.273	0.079	555.4	1969.3	524.0	1.50	534.5	1138	94.08	39.62	42.11%	27.87
RodE2_54	74	1.372	0.178	573.1	2055.0	537.2	1.50	549.2	1102	85.95	33.52	39.00%	24.54
RodE2_56.9	75	1.445	0.251	582.3	2117.8	547.3	1.50	559.0	1079	90.86	33.57	36.94%	25.32
RodE2_59.9	76	1.521	0.328	591.9	2181.8	557.9	1.50	569.2	1056	96.12	33.60	34.96%	26.13
RodE2_66	77	1.676	0.483	610.1	2297.8	579.7	1.50	589.8	1013	113.38	35.74	31.52%	29.32
RodE2_69.8	78	1.773	-0.027	618.5	2362.6	593.5	1.50	601.8	989	141.85	42.33	29.84%	35.66
RodE2_72.9	79	1.852	0.051	631.1	2420.8	604.8	1.50	613.5	967	137.85	38.93	28.24%	33.72
RodE2_74.9	80	1.902	0.102	638.0	2461.1	612.0	1.50	620.7	954	142.13	38.79	27.29%	34.20
RodB3_50.2	169	1.275	0.081	549.8	1960.3	524.3	1.50	532.8	1142	115.38	48.95	42.43%	34.32
RodB3_54.1	170	1.374	0.180	564.3	2043.6	537.6	1.50	546.5	1108	114.60	45.14	39.39%	32.94
RodB3_56.9	171	1.445	0.251	574.9	2103.6	547.3	1.50	556.5	1085	114.40	42.74	37.36%	32.08
RodB3_60.1	172	1.527	0.333	584.8	2171.2	558.6	1.50	567.3	1060	123.96	43.73	35.28%	33.85
RodB3_66.1	173	1.679	0.485	601.0	2288.0	580.1	1.50	587.0	1019	164.12	52.71	32.12%	42.73
RodB3_69.9	174	1.775	-0.025	610.0	2352.7	593.8	1.50	599.2	994	218.80	67.60	30.90%	55.34
RodB3_73	175	1.854	0.054	623.1	2408.0	605.1	1.50	611.1	972	200.59	58.37	29.10%	49.34
RodB3_75	176	1.905	0.105	632.1	2450.4	612.4	1.50	619.0	957	186.86	52.12	27.89%	45.14
RodF3_50.1	89	1.273	0.079	559.0	1960.1	524.0	1.50	535.7	1135	83.97	35.47	42.24%	24.80
RodF3_54	90	1.372	0.178	575.1	2045.1	537.2	1.50	549.9	1100	81.10	31.76	39.16%	23.12
RodF3_57	91	1.448	0.254	585.1	2110.6	547.6	1.50	560.1	1077	84.54	31.27	36.99%	23.49
RodF3_60	92	1.524	0.330	594.2	2171.2	558.2	1.50	570.2	1054	90.51	31.72	35.05%	24.54
RodF3_66.1	93	1.679	0.485	611.5	2290.2	580.1	1.50	590.5	1011	109.40	34.53	31.56%	28.25
RodF3_70	94	1.778	-0.022	620.3	2359.6	594.2	1.50	602.9	987	135.77	40.40	29.76%	34.05
RodF3_73	95	1.854	0.054	633.8	2418.8	605.1	1.50	614.7	965	126.69	35.63	28.13%	30.91
RodF3_75	96	1.905	0.105	643.9	2461.1	612.4	1.50	622.9	950	117.39	31.73	27.03%	28.11
RodE6_50.2	121	1.275	0.081	554.6	1954.9	524.3	1.50	534.4	1138	96.76	41.02	42.40%	28.66
RodE6_54.1	122	1.374	0.180	569.2	2039.0	537.6	1.50	548.1	1105	96.84	38.09	39.34%	27.72
RodE6_57	123	1.448	0.254	578.0	2101.2	547.6	1.50	557.8	1082	103.68	38.65	37.28%	28.98
RodE6_60.2	124	1.529	0.335	589.9	2166.3	558.9	1.50	569.2	1056	104.97	36.91	35.16%	28.53
RodE6_66.1	125	1.679	0.485	608.8	2277.4	580.1	1.50	589.6	1013	119.04	37.87	31.81%	30.80
RodE6_70	126	1.778	-0.022	617.1	2345.5	594.2	1.50	601.8	989	153.29	46.15	30.11%	38.53
RodE6_73.1	127	1.857	0.056	630.6	2402.6	605.5	1.50	613.8	967	143.64	40.85	28.44%	35.11
RodE6_75	128	1.905	0.105	638.9	2442.8	612.4	1.50	621.2	953	138.37	37.93	27.41%	33.25

Appendix B. Single Point Uncertainty Analysis

Single point uncertainty or replication analysis provides a method for predicting the uncertainty of a variable based on its component uncertainties. If one measures n quantities (or variables), x_1, x_2, \dots, x_n , and each of these quantities has a known experimental uncertainty associated with it, which shall be denoted by w , then the actual or true $x_i = \text{measured } x_i \pm w_{x_i}$, for each of the n measured x_i quantities. Furthermore, unless otherwise specified, each of these uncertainties has a confidence level of 95 percent. Suppose now that some new variable, R , is a function of each of these measured quantities, i.e. $R = R(x_1, x_2, \dots, x_n)$. The goal in replication analysis is to estimate the uncertainty in R to that same confidence level, i.e. actual or true $R = \text{calculated } R \pm w_R$, where w_R is the uncertainty on variable R . To accomplish this, the root of the sum of the squares (RSS) method (A.1 Rabinovich) will be used, which defines w_R as,

$$w_{R_{\text{RSS}}} = \left[\sum_{i=1}^n \left(w_{x_i} \frac{\partial R}{\partial x_i} \right)^2 \right]^{1/2} \quad (\text{B-1})$$

where w_{x_i} is the uncertainty of a specific variable and $\frac{\partial R}{\partial x_i}$ is the sensitivity coefficient for that particular variable.

B.1. Heat Transfer Coefficient

In the case of the RBHT steam cooling tests, it is desired to calculate the overall RSS uncertainty associated with the experimental heat transfer coefficient, which is defined as,

$$h = \frac{q''}{(T_w - T_{\text{bulk}})} \quad (\text{B-2})$$

where T_w is the rod surface temperature and T_{bulk} is the mean bulk fluid temperature for a subchannel, defined as

$$T_{\text{bulk}} = T_w + \frac{(T_c - T_w)}{F} \quad (\text{B-3})$$

where T_c is the measured subchannel centerline temperature and F is the T_{bulk} correlation factor.

The local heat flux, q'' is defined as

$$q'' = \frac{P / HR}{A} \cdot f(z) \quad (\text{B-4})$$

where P is the measured bundle power, HR is the number of heater rods, A is the rod surface

area, and $f(z)$ is the axial power factor.

Using Equations (B-1) through (B-4) along with the uncertainties of the measured quantities T_w , T_c , and bundle power it is possible to calculate the total uncertainty associated with the convective heat transfer coefficient.

The uncertainty of the convective heat transfer coefficient will be calculated for test 3163-A, heater rod D3, at 2.24m elevation using the RSS replication analysis.

Test 3163-A conditions:

Upper Plenum Pressure: 2.76 bar (40 psia)
Bundle power: 30 kW
Inlet Reynolds number: 6000
Steam flow 122.5 kg/hr
Heater Rods= 45

Heater rod geometry:

Diameter: 9.5 mm Length: 3.66 m
Surface Area: 0.107m²

Data for heater rod D3 at 2.24m (88.3 in) is given as:

$T_{wi} = 684.1$ K $T_c = 646.8$ K
 $F = 1.27$ $f(z) = 1.32$

Uncertainties from Table 8 are given as:

$w_{T_w} = \pm 1.17$ K $w_{T_c} = \pm 1.17$ K
 $w_P = \pm 1290.35$ W $w_D = \pm 0.05$ mm

Throughout this sample calculation, the uncertainty in the heater rod length and the $f(z)$ measurements has been neglected because it is sufficiently smaller than the largest uncertainty. Also, since there is no uncertainty in the measurement of the number of heater rods, this value does not contribute to the final value of the convection coefficient uncertainty. Finally, the uncertainty in the temperature difference between the inside wall of the heater rod cladding, where the thermocouple has been attached, and the outside surface temperature can be neglected.

Although the measurements were taken from the inside of the heater rod, the uncertainty in moving this to the outer surface is negligible. This can be shown by first performing an uncertainty analysis on the following equation for Q , the total amount of heat transferred,

$$Q = \frac{(T_i - T_o) \cdot (2 \cdot \pi \cdot k \cdot L)}{\ln\left(\frac{r_o}{r_i}\right)} \quad (\text{B-5})$$

where T_i is the inside wall temperature, T_o is the temperature at the outermost surface of the fuel rod, k is the thermal conductivity, L is the rod length, r_o is the outside radius of the rod and r_i is the inside radius of the rod.

This equation must first be solved for T_o resulting in the following expression;

$$T_o = T_i - \frac{Q \cdot \ln\left(\frac{r_o}{r_i}\right)}{2 \cdot \pi \cdot k \cdot L}$$

Applying Equation B-1 for the uncertainty gives a general formula for the uncertainty in T_o ,

$$w_{T_o} = \left[\left(\frac{\partial T_o}{\partial T_i} \cdot w_{T_i} \right)^2 + \left(\frac{\partial T_o}{\partial Q} \cdot w_Q \right)^2 + \left(\frac{\partial T_o}{\partial r_o} \cdot w_{r_o} \right)^2 + \left(\frac{\partial T_o}{\partial r_i} \cdot w_{r_i} \right)^2 + \left(\frac{\partial T_o}{\partial k} \cdot w_k \right)^2 + \left(\frac{\partial T_o}{\partial L} \cdot w_L \right)^2 \right]^{\frac{1}{2}}$$

where

$$\frac{\partial T_o}{\partial T_i} = 1$$

$$w_{T_i} = 1.17K$$

$$\frac{\partial T_o}{\partial Q} = \frac{-\ln\left(\frac{r_o}{r_i}\right)}{2 \cdot \pi \cdot k \cdot L}$$

$$w_Q = \frac{f(z)}{HR} \cdot w_P = \frac{1.32}{45} \cdot 1290.35W = 37.85W$$

$$\frac{\partial T_o}{\partial r_o} = \frac{-Q}{2 \cdot \pi \cdot k \cdot L \cdot r_o}$$

$$w_{r_o} = 2.54 \times 10^{-5} m$$

$$\frac{\partial T_o}{\partial r_i} = \frac{Q}{2 \cdot \pi \cdot k \cdot L \cdot r_i}$$

$$w_{r_i} = 2.54 \times 10^{-5} m$$

$$\frac{\partial T_o}{\partial k} = \frac{\ln\left(\frac{r_o}{r_i}\right) \cdot Q}{2 \cdot \pi \cdot k^2 \cdot L}$$

$$w_k = 0.627 \frac{W}{m \cdot K}$$

$$\frac{\partial T_o}{\partial L} = \frac{\ln\left(\frac{r_o}{r_i}\right) \cdot Q}{2 \cdot \pi \cdot k \cdot L^2}$$

$$w_L = 0m$$

Combining these terms with their respective uncertainties results in the following equation for the uncertainty in the outer wall temperature measurement.

$$w_{T_o} = \left[\begin{aligned} & \left(1 \cdot w_{T_i} \right)^2 + \left(\frac{-\ln\left(\frac{r_o}{r_i}\right)}{2 \cdot \pi \cdot k \cdot L} \cdot w_Q \right)^2 + \left(\frac{-Q}{2 \cdot \pi \cdot k \cdot L \cdot r_o} \cdot w_{r_o} \right)^2 + \\ & \left(\frac{Q}{2 \cdot \pi \cdot k \cdot L \cdot r_i} \cdot w_{r_i} \right)^2 + \left(\frac{\ln\left(\frac{r_o}{r_i}\right) \cdot Q}{2 \cdot \pi \cdot k^2 \cdot L} \cdot w_k \right)^2 + \left(\frac{\ln\left(\frac{r_o}{r_i}\right) \cdot Q}{2 \cdot \pi \cdot k \cdot L^2} \cdot w_L \right)^2 \end{aligned} \right]^{\frac{1}{2}}$$

At 2.24 m the uncertainty in the outside wall temperature measurement is found by using the above equation with the correct values

$$w_{T_o} = \left[\begin{aligned} & \left(1 \cdot 1.17K \right)^2 + \left(\frac{-\ln\left(\frac{0.00475m}{0.00292m}\right)}{2 \cdot \pi \cdot 20.9 \frac{W}{m \cdot K}} \cdot 37.85W \right)^2 + \\ & \left(\frac{-880W}{2 \cdot \pi \cdot 20.9 \frac{W}{m \cdot K}} \cdot 2.54 \times 10^{-5} m \right)^2 + \\ & \left(\frac{880W}{2 \cdot \pi \cdot 20.9 \frac{W}{m \cdot K}} \cdot 2.54 \times 10^{-5} m \right)^2 + \left(\frac{\ln\left(\frac{0.00475m}{0.00292m}\right) \cdot 880W}{2 \cdot \pi \cdot \left(20.9 \frac{W}{m \cdot K}\right)^2 \cdot 3.66m} \cdot 0.627 \frac{W}{m \cdot K} \right)^2 + \\ & \left(\frac{\ln\left(\frac{0.00475m}{0.00292m}\right) \cdot 880W}{2 \cdot \pi \cdot 20.9 \frac{W}{m \cdot K}} \cdot 0m \right)^2 \end{aligned} \right]^{\frac{1}{2}}$$

$$= 1.171K$$

As can be seen, this value is nearly identical to that used in the initial calculation, showing that its temperature difference can be neglected. The uncertainty analysis on the convective heat transfer coefficient can now be performed, neglecting all terms with uncertainties that are sufficiently small.

To begin the uncertainty analysis of the convective heat transfer coefficient, the heat flux (q'') in Equation B-2 must first be determined because it is a function of various components each with their own uncertainty that must be found. The heat flux Equation is given as

$$q'' = \frac{P / HR}{A} \cdot f(z)$$

where the axial power shape factor is given as:

$$f(z) = -1.087 \cdot z + 4.4783 \quad (\text{B-6a})$$

for elevations between 2.74 m and 3.66 m (z measured in meters)

and

$$f(z) = 0.365 \cdot z + 0.5 \quad (\text{B-6b})$$

for elevations ≤ 2.74 m (z measured in meters).

For an elevation of 2.24 m (88.3 in) where $f(z)$ is 1.32, the heat flux is found to be

$$q'' = \frac{P / HR}{A} \cdot f(z) = \frac{30000W \cdot 1.32}{45\text{rods} \cdot 0.107m^2} = 8161.99 \frac{W}{m^2}.$$

The uncertainty is now calculated for the heat flux by taking the partial derivatives of q'' with respect to each variable and putting these into Equation B-1 with their respective uncertainties

$$w_{q''} = \left[\left(\frac{\partial q''}{\partial P} \cdot w_P \right)^2 + \left(\frac{\partial q''}{\partial HR} \cdot w_{HR} \right)^2 + \left(\frac{\partial q''}{\partial A} \cdot w_A \right)^2 + \left(\frac{\partial q''}{\partial f(z)} \cdot w_{f(z)} \right)^2 \right]^{\frac{1}{2}}$$

Where;

$$\frac{\partial q''}{\partial P} = \frac{f(z)}{HR \cdot A} \quad w_P = 1290.35W$$

$$\frac{\partial q''}{\partial HR} = -\frac{P \cdot f(z)}{(HR)^2 \cdot A} \quad w_{HR} = 0$$

$$\frac{\partial q''}{\partial A} = -\frac{P \cdot f(z)}{HR \cdot A^2} \quad w_A = \pi \cdot L \cdot w_D$$

$$\frac{\partial q''}{\partial f(z)} = \frac{P}{HR \cdot A} \quad w_{f(z)} = \text{negligible}$$

Combining these terms with their respective uncertainties and dismissing the negligible terms with component uncertainties of zero results in the following Equation for the uncertainty of the

heat flux.

$$w_{q''} = \left[\left(\frac{f(z) \cdot w_p}{HR \cdot A} \right)^2 + \left(\frac{P \cdot f(z) \cdot (\pi \cdot L \cdot w_D)}{HR \cdot A^2} \right)^2 \right]^{\frac{1}{2}}$$

At 2.24 m this uncertainty becomes

$$w_{q''} = \left[\left(\frac{1.32 \cdot 1.29 \times 10^3 W}{45 \cdot 0.107 m^2} \right)^2 + \left(\frac{3.0 \times 10^4 W \cdot 1.32 \cdot (\pi \cdot 3.66 m \cdot 5.08 \times 10^{-5} m)}{45 \cdot (0.107 m^2)^2} \right)^2 \right]^{\frac{1}{2}}$$

$$= 353.78 \frac{W}{m^2}$$

The heat flux can now be expressed with its uncertainty as;

$$q'' = 8161.99 \frac{kW}{m^2} \pm 353.78 \frac{kW}{m^2}$$

Combining Equation B-2 and B-3 it is now possible to calculate the convective heat transfer coefficient

$$h = \frac{q''}{(T_w - T_{bulk})} = \frac{q''}{T_w - \left(T_w + \frac{(T_c - T_w)}{F} \right)} = \frac{q'' \cdot F}{(T_w - T_c)}$$

$$h = \frac{8161.99 \frac{W}{m^2} \cdot 1.27}{(684.1K - 646.8K)} = 277.9 \frac{W}{m^2 \cdot K}$$

The uncertainty can now be calculated using a method identical to that used for the uncertainty in the heat flux

$$w_h = \left[\left(\frac{\partial h}{\partial q''} \cdot w_{q''} \right)^2 + \left(\frac{\partial h}{\partial F} \cdot w_F \right)^2 + \left(\frac{\partial h}{\partial T_w} \cdot w_{T_w} \right)^2 + \left(\frac{\partial h}{\partial T_c} \cdot w_{T_c} \right)^2 \right]^{\frac{1}{2}}$$

Where each partial derivative is listed with its respective uncertainty, including the uncertainty for the heat flux found above. The values for w_F depend on Reynold's number and can be found listed below. The values for w_{T_c/T_w} due to the wall and center line temperatures are taken from

Table 8 and are repeated below.

$$\frac{\partial h}{\partial q''} = \frac{F}{(T_w - T_c)} \quad w_{q''} = \left[\left(\frac{f(z) \cdot w_p}{HR \cdot A} \right)^2 + \left(\frac{P \cdot f(z) \cdot (\pi \cdot L \cdot w_D)}{HR \cdot A^2} \right)^2 \right]^{\frac{1}{2}}$$

$$\frac{\partial h}{\partial F} = \frac{q''}{(T_w - T_c)}$$

$w_F = 0.04$ for $Re > 5000$
 $w_F = 0.06$ for $2300 < Re < 5000$
 $w_F = 0.10$ for $Re < 2300$

$$\frac{\partial h}{\partial T_c} = \frac{q'' \cdot F}{(T_c - T_w)^2}$$

$w_{T_c/T_w} = 1.15$ for 0-648.15 K
 $w_{T_c/T_w} = 1.17$ for 648.15 K - 1073.15 K
 $w_{T_c/T_w} = 1.23$ for 1073.15 K - 1644.15K

$$\frac{\partial h}{\partial T_w} = \frac{q'' \cdot F}{(T_w - T_c)^2}$$

Combining these terms with their respective uncertainties results in the following Equation for the uncertainty in the convective heat transfer coefficient.

$$w_h = \left[\frac{F^2}{(T_w - T_c)^2} \cdot \left[\left(\frac{f(z) \cdot w_p}{HR \cdot A} \right)^2 + \left(\frac{P \cdot f(z) \cdot (\pi \cdot L \cdot w_D)}{HR \cdot A^2} \right)^2 \right] + \left[\left(\frac{q'' \cdot F \cdot w_{T_w}}{(T_w - T_c)^2} \right)^2 + \left(\frac{q'' \cdot F \cdot w_{T_c}}{(T_c - T_w)^2} \right)^2 + \left(\frac{q'' \cdot w_F}{(T_w - T_c)} \right)^2 \right] \right]^{\frac{1}{2}}$$

At 2.24 m the uncertainty in the convective heat transfer coefficient is found by using the above Equation with the correct values for w_F and w_{T_c/T_w} found in Table 8 and also above.

$$w_h = \left[\frac{1.27^2}{(684.1K - 646.8K)^2} \cdot \left[\left(\frac{1.32 \cdot 1290.35W}{45 \cdot 0.107m^2} \right)^2 + \left(\frac{30000W \cdot 1.32 \cdot (\pi \cdot 3.66 \cdot 5.08 \times 10^{-5})}{45 \cdot (0.107m^2)^2} \right)^2 \right] + \left[\left(\frac{8161.99 \frac{W}{m^2} \cdot 1.27 \cdot 1.17K}{(684.1K - 646.8K)^2} \right)^2 + \left(\frac{8161.99 \frac{W}{m^2} \cdot 1.27 \cdot 1.17K}{(646.8K - 684.1K)^2} \right)^2 + \left(\frac{8161.99 \frac{W}{m^2} \cdot 0.06}{(684.1K - 646.8K)} \right)^2 \right] \right]^{\frac{1}{2}}$$

$$w_h = 21.67 \frac{W}{m^2 \cdot K}$$

The convective heat transfer coefficient at an elevation of 2.24 m can now be expressed with its uncertainty by applying the result from the above calculation.

$$h = 277.9 \frac{W}{m^2 \cdot K} \pm 21.67 \frac{W}{m^2 K}$$

The uncertainty associated with the heat transfer coefficient is at 95 percent confidence level since all of the measured variables used to calculate the heat transfer coefficient were at a 95 percent confidence level. With the uncertainty in the heat transfer coefficient known, the fractional uncertainty can be found to see how heat flux and the temperature difference affect the RSS uncertainty.

Fractional uncertainty is simply defined as the uncertainty divided by the measured or calculated variable.

The fractional uncertainty in the heat flux is:

$$\frac{w_{q''}}{q''} = \frac{353.78 \frac{W}{m^2}}{8161.99 \frac{W}{m^2}} \times 100\% = 4.33\%$$

While the fractional uncertainty in the final convective heat transfer coefficient calculation becomes

$$\frac{w_h}{h} = \frac{21.67 \frac{W}{m^2 \cdot K}}{277.9 \frac{W}{m^2 \cdot K}} \times 100\% = 7.80\%$$

The above results apply only to rod D3 at an elevation of 2.24 m, however, by applying the Equation for the convective heat transfer coefficient given above, the uncertainty can be obtained for any rod at any elevation.

B.2. Grid Loss Coefficient

In a similar fashion, the overall RSS uncertainty associated with the experimental grid loss coefficient can be found. The grid loss coefficient is defined as,

$$k_{grid} = \frac{2(\Delta P_{meas} - \Delta P_{bare})}{\rho V^2} \quad (B-7)$$

where ΔP_{meas} is the pressure differential over a particular grid span for which the grid loss will be calculated, ΔP_{bare} is the pressure differential over a particular span containing no grids, ρ is the average density over the grid span of interest, and V is the average velocity over that particular grid span. ΔP_{bare} can be found with the following equation

$$\Delta P_{bare} = \frac{\rho f L V^2}{2 D_H} \quad (B-8)$$

where f is the friction factor over the given span, L is the length of the span and D_H is the hydraulic diameter for the rod bundle. Also from equation A-2 and equation A-3, the velocity, V , can be found using the following equation

$$V = \frac{\dot{m}}{A_f \rho} \quad (B-9)$$

where \dot{m} is the mass flow rate of the steam, and A_f is the bundle flow area. Using Equations (B-1) and (B-7) through (B-9) along with the known uncertainties of the measured quantities ΔP_{meas} , and \dot{m} , it is possible to calculate the total uncertainty associated with the grid loss coefficient.

Combining equations B-7, B-8, and B-9 results in the following result for k_{grid} in its most general form, where the uncertainty of each parameter is known.

$$k_{grid} = 2 \left(\frac{A_f}{\dot{m}} \right)^2 \Delta P_{meas} \rho - \left(\frac{f \cdot L}{D_H} \right)$$

Applying Equation B-1 for the uncertainty gives a general formula for the uncertainty in k_{grid} ,

$$w_{k_{grid}} = \left[\left(\frac{\partial k_{grid}}{\partial A_f} \cdot w_{A_f} \right)^2 + \left(\frac{\partial k_{grid}}{\partial \dot{m}} \cdot w_{\dot{m}} \right)^2 + \left(\frac{\partial k_{grid}}{\partial \Delta P_{meas}} \cdot w_{\Delta P_{meas}} \right)^2 + \left(\frac{\partial k_{grid}}{\partial \rho} \cdot w_{\rho} \right)^2 + \left(\frac{\partial k_{grid}}{\partial f} \cdot w_f \right)^2 + \left(\frac{\partial k_{grid}}{\partial L} \cdot w_L \right)^2 + \left(\frac{\partial k_{grid}}{\partial D_H} \cdot w_{D_H} \right)^2 \right]^{\frac{1}{2}}$$

Where the partial derivatives and their parameter's respective uncertainty are given as shown below:

$$\begin{aligned} \frac{\partial k_{grid}}{\partial A_f} &= \frac{4A_f \Delta P_{meas} \rho}{\dot{m}^2} & w_{A_f} &= negligible \\ \frac{\partial k_{grid}}{\partial \dot{m}} &= \frac{-4\rho A_f^2 \Delta P_{meas}}{\dot{m}^3} & w_{\dot{m}} &= Given \\ \frac{\partial k_{grid}}{\partial \Delta P_{meas}} &= \frac{2\rho A_f^2}{\dot{m}^2} & w_{\Delta P_{meas}} &= Given \\ \frac{\partial k_{grid}}{\partial \rho} &= \frac{2A_f^2 \Delta P_{meas}}{\dot{m}^2} & w_{\rho} &= negligible \\ \frac{\partial k_{grid}}{\partial f} &= \frac{-L}{D_H} & w_f &= negligible \\ \frac{\partial k_{grid}}{\partial L} &= \frac{-f}{D_H} & w_L &= negligible \\ \frac{\partial k_{grid}}{\partial D_H} &= \frac{f \cdot L}{D_H^2} & w_{D_H} &= negligible \end{aligned}$$

The uncertainties in the bundle flow area (A_f), the average density (ρ), the friction factor (f), the span length (L), and the hydraulic diameter (D_H) are sufficiently small and can be neglected for this calculation.

Combining the above partial derivatives with their respective uncertainties results in the following equation for the uncertainty in the grid loss coefficient (k_{grid}).

$$w_{k_{grid}} = \left[\left(\frac{-4\rho A_f^2 \Delta P_{meas}}{\dot{m}^3} \cdot w_{\dot{m}} \right)^2 + \left(\frac{2\rho A_f^2}{\dot{m}^2} \cdot w_{\Delta P_{meas}} \right)^2 \right]^{\frac{1}{2}}$$

With the uncertainty in the grid loss coefficient now known, the fractional uncertainty can be found. This allows for a comparison of the uncertainty in all grid loss coefficients.

Fractional uncertainty is simply defined as the uncertainty divided by the measured or calculated variable. That is:

The fractional uncertainty in the grid loss coefficient is:

$$\text{Fractional Uncertainty} = \frac{W_{kgrid}}{kgrid}$$

The above results apply to all cases and can be used to find the uncertainty in any grid loss coefficient as long as the necessary variables are known.

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K. Tien, NRC Project Manager

11. ABSTRACT (200 words or less)

A total of 35 steady-state steam cooling experiments was performed in the Rod Bundle Heat Transfer Test (RBHT) Facility at the Penn State University. The purpose of the experiments was to examine the steady-state convective heat transfer from the heater rods to single-phase super heated steam in prototypical rod bundle geometry for computer code model development and validation. The Rod Bundle Heat Transfer Facility has a full length, 3.66 m (12 ft), 7 by 7 rod array with typical Pressurized Water Reactor rod diameters of 9.49 mm (0.374 in) and a rod pitch of 12.59 mm (0.496 in). The heater rods had a top skewed power shape with a peak to average power of 1.5 at the 2.74 m (9 ft) elevation. The RBHT facility has been designed using prototypical mixing vane spacer grids. The bundle inlet steam temperature was held at saturation for the given test pressure and the inlet Reynolds number ranged from 1,400 to 30,000 with most of the experiments at the lower Reynolds number range. The facility was instrumented to measure the quantities necessary for determining local convective heat transfer coefficients that reflect the heat transfer enhancement caused by mixing vane grids. The measured quantities include vapor temperatures at sub-channel centerlines, mixing vane grid temperatures, a detailed axial pressure drop along the bundle length, absolute pressure in the upper plenum, rod temperatures upstream and downstream of mixing vane grids, and vapor flow rate in and out of the bundle.

12. KEY WORDS/DESCRIPTORS (List words or phrases that will assist researchers in locating the report.)

heat transfer enhancement, mixing vane, super heated steam, reactor safety, reactor systems codes, reflood heat transfer, rod bundle, spacer grid, thermal hydraulics

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