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Andrew C. Klein

Critical Heat Flux (CHF) is an important safety parameter for the design of nuclear reactors. The most commonly used predictive tool for determination of CHF is a look-up table developed using tube data with an average hydraulic test diameter of 8 mm. There exist in the world today nuclear reactors whose geometry is annular, not tubular, and whose hydraulic diameter is significantly smaller than 8 mm. In addition, any sub-channel thermal hydraulic model of fuel assemblies is annular and not tubular. Comparisons were made between this predictive tool and annular correlations developed from test data. These comparisons showed the look-up table over-predicts the CHF values for annular channels, thus questioning its ability to perform correct safety evaluations.

Since no better tool exists to predict CHF for annular geometry, an effort was undertaken to produce one. A database of open literature annular CHF values was created as a basis for this new tool. By compiling information from eighteen sources and requiring that the data be inner wall, unilaterally, uniformly heated with no spacers or

heat transfer enhancement devices, a database of 1630 experimental values was produced.

After a review of the data in the database, a new look-up table was created. A look-up table provides localized control of the prediction to overcome sparseness of data. Using Shepard's Method as the extrapolation technique, a regular mesh look-up table was produced using four main variables: pressure, quality, mass flux, and hydraulic diameter. The root mean square error of this look-up table was found to be 0.8267. However, by fixing the hydraulic diameter locations to the database values, the root mean square error was further reduced to 0.2816. This look-up table can now predict CHF values for annular channels over a wide range of fluid conditions.

Critical Heat Flux Estimation for Annular Channel Geometry

by

Richard T. Pagh

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ACKNOWLEDGMENT

But the king of Egypt said, "Moses and Aaron, why are you taking the people away from their labor? Get back to your work!" Then Pharaoh said, "Look, the people of the land are now numerous, and you are stopping them from working."

That same day Pharaoh gave this order to the slave drivers and foremen in charge of the people: "You are no longer to supply the people with straw for making bricks; let them go and gather their own straw. But require them to make the same number of bricks as before; do not reduce the quota. They are lazy; that is why they are crying out, 'Let us go and sacrifice to our God.' Make the work harder for the men so that they keep working and pay no attention to lies."

Then the slave drivers and the foremen went out and said to the people, "This is what Pharaoh says: 'I will not give you any more straw. Go and get your own straw wherever you can find it, but your work will not be reduced at all.'" So the people scattered all over Egypt to gather stubble to use for straw. The slave drivers kept pressing them, saying, "Complete the work required of you for each day, just as when you had straw." The Israelite foremen appointed by Pharaoh's slave drivers were beaten and were asked, "Why didn't you meet your quota of bricks yesterday or today, as before?"

Then the Israelite foremen went and appealed to Pharaoh: "Why have you treated your servants this way? Your servants are given no straw, yet we are told, 'Make bricks!' Your servants are being beaten, but the fault is with your own people."

Pharaoh said, "Lazy, that's what you are – lazy! That is why you keep saying, 'Let us go and sacrifice to the LORD.' Now get to work. You will not be given any straw, yet you must produce your full quota of bricks."

The Israelite foremen realized they where in trouble when they were told, "You are not to reduce the number of bricks required of you for each day." When they left Pharaoh, they found Moses and Aaron waiting to meet them, and they said, "May the LORD look upon you and judge you! You have made us a stench to Pharaoh and his officials and have put a sword in their hand to kill us."

Moses returned to the LORD and said, "O Lord, why have you brought trouble upon this people? Is this why you sent me? Ever since I went to Pharaoh to speak in your name, he has brought trouble upon this people, and you have not rescued your people at all."

Then the LORD said to Moses, "Now you will see what I will do to Pharaoh: Because of my mighty hand he will let them go; because of my mighty hand he will drive them out of his country."

God also said to Moses, "I am the LORD. I appeared to Abraham, to Isaac and Jacob as God Almighty, but by my name the LORD I did not

make myself known to them. I also established my covenant with them to give them the land of Canaan, where they lived as aliens. Moreover, I have heard the groaning of the Israelites, whom the Egyptians are enslaving, and I have remembered my covenant.

Therefore, say to the Israelites: 'I am the LORD, and I will bring you out from under the yoke of the Egyptians. I will free you from being slaves to them, and I will redeem you with an outstretched arm with mighty acts of judgment. I will take you as my own people, and I will be your God. Then you will know that I am the LORD your God, who brought you out from under the yoke of the Egyptians. And I will bring you to the land I swore with uplifted hand to give to Abraham, to Isaac and to Jacob. I will give it to you as a possession. I am the LORD.'"

Moses reported this to the Israelites, but they did not listen to him because of their discouragement and cruel bondage.

Exodus 5:4-6:9

This passage in Exodus sums up the journey that took place to complete this body of work. Initially work went very quickly, but then the straw was removed and it was a long struggle. I find it very interesting that the LORD uses these circumstances to bring Him glory, rather than us. As was true with the ancient Israelites, so it is true in this circumstance, God is the one who did the work and delivered His people. This document and degree is a testament to His faithfulness in completing what He has promised. I never would have finished without His mighty hand, guidance, support, and constant provision. Though I would have liked to see this work completed years ago, His perfect timing has made today the day of deliverance. To Him be the glory, honor, and praise forever. Amen.

Additionally, there are many people who deserve recognition for their part in this process. First, I'd like to thank my major professor, Dr. Andy Klein, for all he has done to encourage me and at times carry me down this path. He gave me the many opportunities I needed to show the work I could do and advised me wisely when I was unsure. He never gave up nor did he allow setbacks to stop my development. Rather, together we were able to find solutions to the many problems faced by a graduate student in today's world.

Next I'd like to thank my co-workers at Pacific Northwest National Laboratory for all they have done for me. Whether it is technical advice from Vladimir Korolev, wisdom and experience from Georgi Tsiklauri, or the ear of Bruce Schmitt to bounce things off and complain to no end, they all contributed significantly to my completion of this project. In addition, thanks needs to be given to Keith Pauley who believed enough in me to have me hired in the first place.

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A great big thank you to my family who sacrificed financially and in many other ways to see me through the tough times. Your faith in me never wavered, your trust in me never left, and your love for me never disappeared. Without the character you developed in me while young, I doubt that I could ever have completed this degree. At the same time you all allowed me to find my own way without making the decisions for me. I find it ironic that I started my college career to get a PhD, and then I said that I would never suffer to do what it takes to get the degree. Yet, little by little, as I accomplished the tasks that would improve me at that time I now find myself finishing what I set out to do a decade previous.

Lastly and most importantly, I would like to thank my new bride Sheryl. Though we have been married only a few months, you have made a world of difference in my life. You are a greater gift from God than this degree could ever be. I love you very much.

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1. INTRODUCTION

1.1. Purpose of Investigation

Safety has become of paramount importance in the nuclear industry in the post-Three Mile Island and post-Chernobyl climate. The U.S. Government spends a great amount of money annually in the U.S. and in the international community to ensure the safe operation of the many nuclear reactors around the world. Safety is often characterized and quantified using both deterministic techniques and probabilistic techniques. One of the important parameters in the deterministic study of reactor safety is Critical Heat Flux (CHF). It would be ideal to determine the value of CHF from a first principal physics model, however the phenomena is currently not understood well enough to predict the CHF value in general. Therefore, a best-estimate approximation methodology is used to evaluate the safety of a nuclear reactor under nominal and off-nominal conditions. The purpose of this work is to explore the current CHF prediction techniques, assess whether they are suitable for a specific nuclear reactor geometry type and create (as needed) better tools to estimate CHF.

Before the current status of CHF prediction can be investigated, it is necessary to define what CHF is as well as to describe the current set of tools available to create predictions from known data. In this chapter CHF in its physical sense will be defined and an understanding of its importance will be discussed. Next a discussion of the fluid mechanics of the problem will be conducted. Finally, the mathematics behind possible prediction tools will be covered.

1.2. Critical Heat Flux

The subject matter under which CHF is included is the physics of boiling. An appreciation for the underlying physics of boiling may be obtained by examining the different regimes of pool boiling. Once pool boiling is understood, a discussion of flow boiling will follow, as this is the condition under which most nuclear reactors operate (except during a loss of flow transient).

1.2.1. Pool Boiling

The pool boiling curve for water at one atmosphere pressure is given in Figure 1.1. Different pressures would generate different values for the graph, but the shape of the curve would be the same. This graph is a representation of excess temperature, defined as the difference between the surface temperature and the saturation temperature of the fluid, versus the surface heat flux. Four boiling regimes are identified on this graph; free convection, nucleate, transition, and film. The free convection regime is defined as the region where fluid convection exists in the bulk fluid transferring heat from the surface to the pool surface. Under this regime bubble formation is limited and no bubbles are found in the bulk fluid. The interface point between free convection boiling and nucleate boiling (identified in Figure 1.1 as point A) is called the onset of nucleate boiling (ONB). Nucleate boiling is the most commonly identified boiling regime. In this regime bubbles

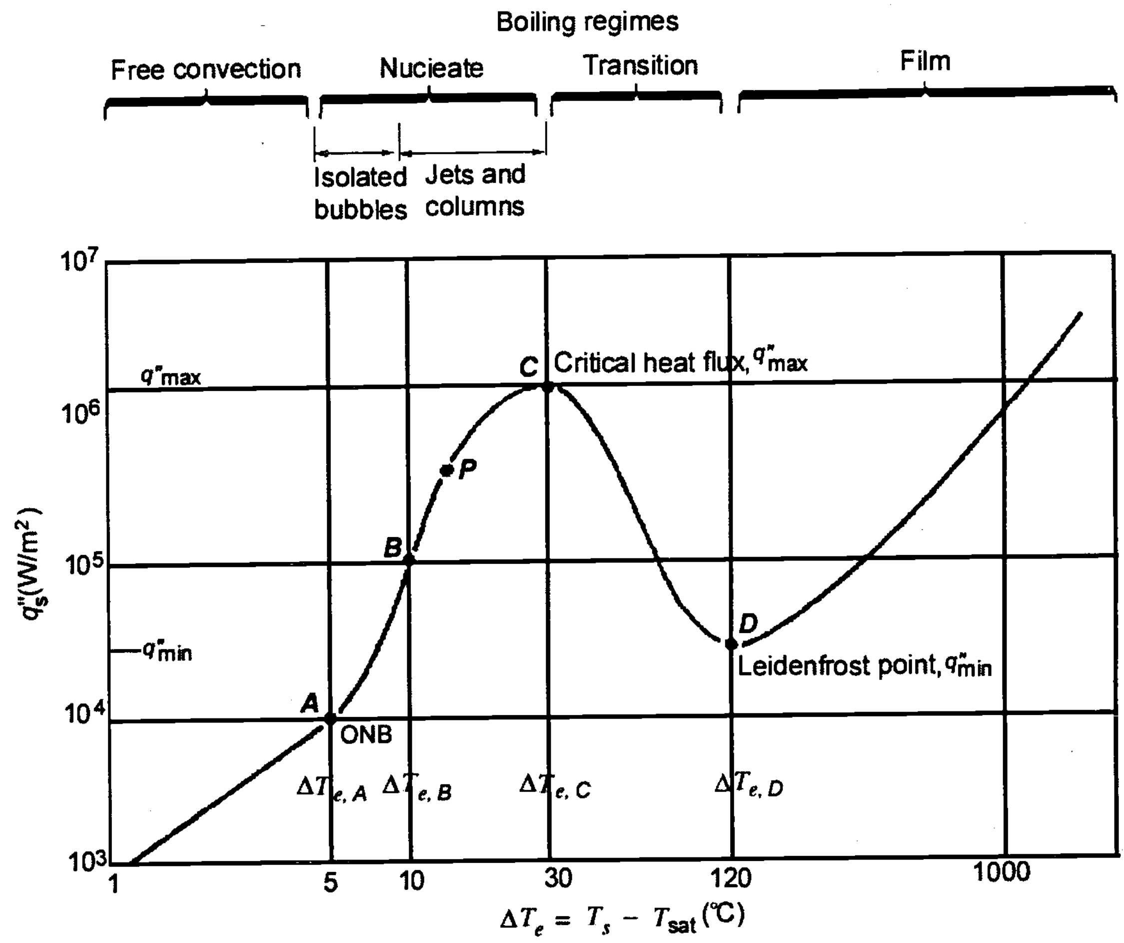

Figure 1.1 – Boiling Regimes[1]

form at nucleation sites and then separate from the surface. This separation produces fluid mixing near the surface, substantially increasing the heat transferred between the surface and the fluid. This can be of significant benefit in maximizing heat transfer. The interface point between the nucleate and transition boiling regimes is called critical heat flux (identified in Figure 1.1 as point C). Transition boiling is the region of the curve where bubble formation on the surface is now so rapid that a vapor film begins to form on the surface. This blanket is unstable and will tend to oscillate between nucleate boiling and film boiling, hence it is termed transition. The interface point between the transition boiling and film boiling regimes is called the Leidenfrost point (identified in Figure 1.1 as point D). The final regime is the film boiling regime. The vapor blanket is now stable and is present everywhere on the heated surface. Heat is conducted through the vapor blanket to the fluid, restricting the ability of the fluid to remove heat from the surface.

Now that the basic physics of pool boiling has been explained, the question arises, "What is so critical about CHF? " To answer this question Figure 1.1 must be re-examined. If the curve as a function of increasing excess temperature is followed, it is shown that the surface heat flux rises and falls as this excess temperature is increased. However, if the curve as a function of increasing surface heat flux is followed, a different phenomenon occurs. As the heat flux is increased, the temperature rises to the CHF value at an excess temperature of roughly 30 °C. If the heat flux is increased a little bit above the CHF value, the excess temperature has to jump over into the film boiling regime. In fact, according to the figure, the excess temperature rises to over 1000 °C. This equates to greater than a 900 °C surface temperature increase with a very small increase in heat flux. For most materials, a 900 °C increase can cause melting to occur or other serious material changes, such as loss of material strength. In nuclear power plant operation, the surface heat flux is what varies under operational and transient conditions, rather than excess temperature. Therefore, it is an important safety consideration to avoid exceeding the CHF point on the boiling curve.[1]

1.2.2. Flow Boiling

The presence of moving fluid significantly complicates the issue of CHF. Such factors as mass flow rate, direction of fluid flow, geometry, heat flux distribution, pressure, quality, surface tension, and wall roughness must now be considered. In addition, to complicate matters, there are two different "types" of CHF – dryout and departure from nucleate boiling (DNB).

Figure 1.2 gives an example of fluid heating in a tube. To the left, the tube wall and fluid temperatures are represented. In the center is a sketch of how the transport of the fluid might look to the eye as it travels up the tube. To the right, identifiers of flow patterns and heat transfer categories are represented. The fluid enters the bottom of the tube as a single phase liquid below its saturation temperature. Eventually the fluid next to the wall is heated to a superheated temperature, causing bubble formation, while the bulk fluid temperature remains subcooled. The bulk fluid later reaches the saturation temperature resulting in nucleate boiling of the entire fluid. Traveling up the tube, the bubbles become more numerous and begin to collect into larger pockets. This begins a region of slug or churn flow where the volume of the two phases become roughly equal. Eventually, as the vapor phase increases in volume, the fluid may be confined to a film on the tube wall with droplets entrained in the vapor. This is commonly referred to as annular flow. As the fluid continues to be entrained into the evaporated vapor, the film thickness decreases until it completely disappears. When the film has been completely removed the condition of dryout exists. It is at this point where heat transfer from the wall to the steam is degraded and the wall temperature increases dramatically. As the

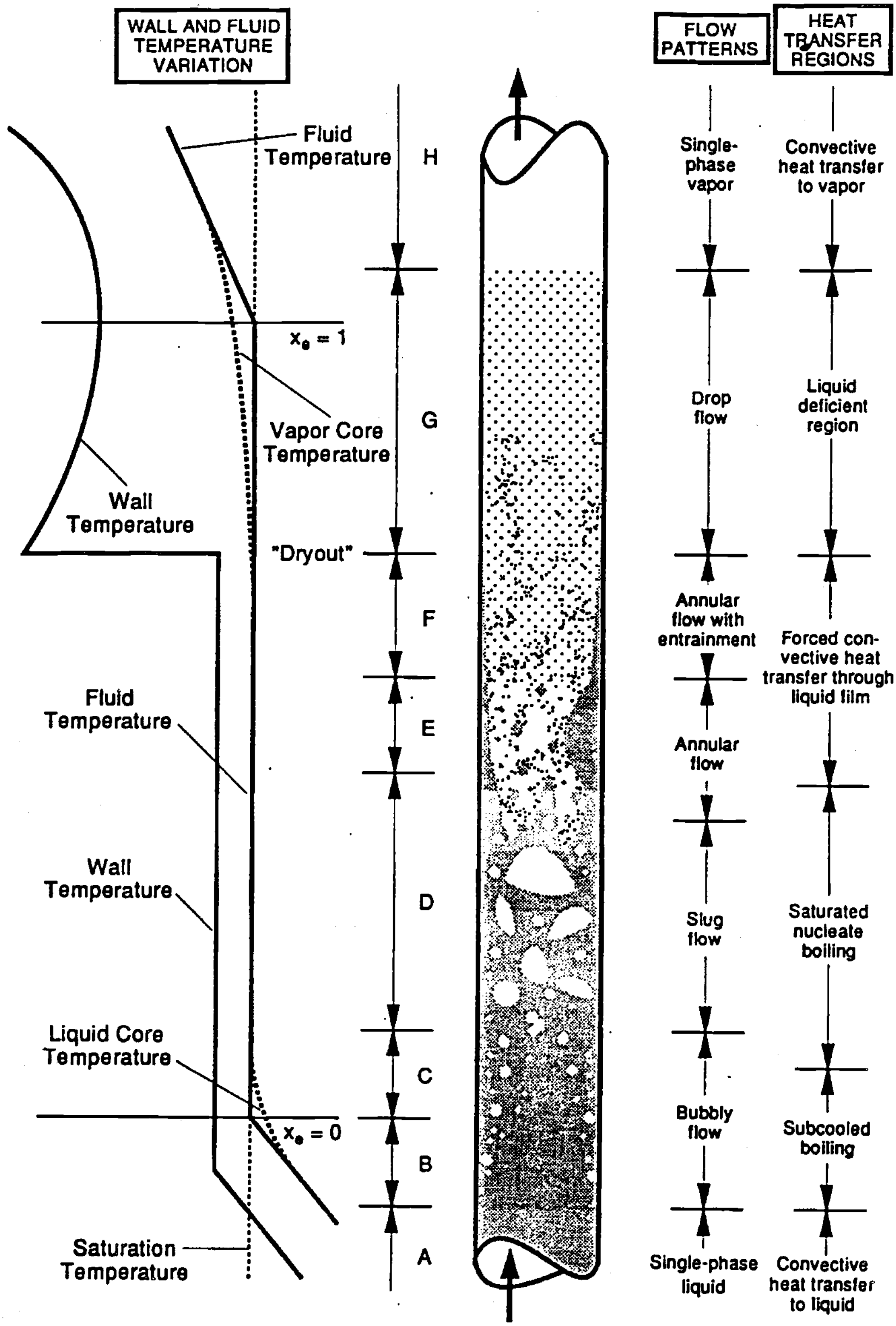

Figure 1.2 – Flow Boiling Development[2]

steam continues to flow up the tube, it moves from saturated conditions to superheated conditions.

The other way to surpass the CHF point is through DNB. This is typically achieved under high wall heat flux. Under these conditions, the vapor generation rate at the tube wall in the bubbly flow region is sufficient to create a vapor blanket between the tube wall and the bulk fluid, referred to as inverted annular flow. Again a degradation of the heat transfer between the wall and the fluid is seen causing the wall temperature to increase dramatically. This is obviously a much different condition than dryout and will occur much earlier in the tube.

The real difficulty involved with CHF being related to dryout or DNB is their respective dependence upon changes in geometry and/or fluid properties. Figure 1.3 gives an example of how the CHF values change with changing mass flux in the tube. In the lower quality region where DNB occurs, an increase in the mass flux of the bulk fluid increases the heat flux required to achieve CHF. In the higher quality region where dryout occurs, an increase in the mass flux of the bulk fluid decreases the heat flux required to achieve CHF. The reason is due to the fact that for DNB an increase of mass flux makes it harder to establish the vapor blanket around the tube wall and for dryout an increase in mass flux makes it harder to keep the fluid film on the tube wall. This essentially creates a discontinuity in trends of CHF prediction, making it all the more difficult to accurately estimate CHF conditions.[2]

In this treatment of CHF in annular geometries, a distinction will not be made between dryout CHF and DNB CHF. This is mostly due to the lack of solid evidence in experimental tests that one type of CHF occurs over the other. Typically only the effect of CHF (a sudden, large increase in wall temperature) is readily apparent. However, in the treatment of CHF, the conflicting trends of the two types of CHF must be considered.

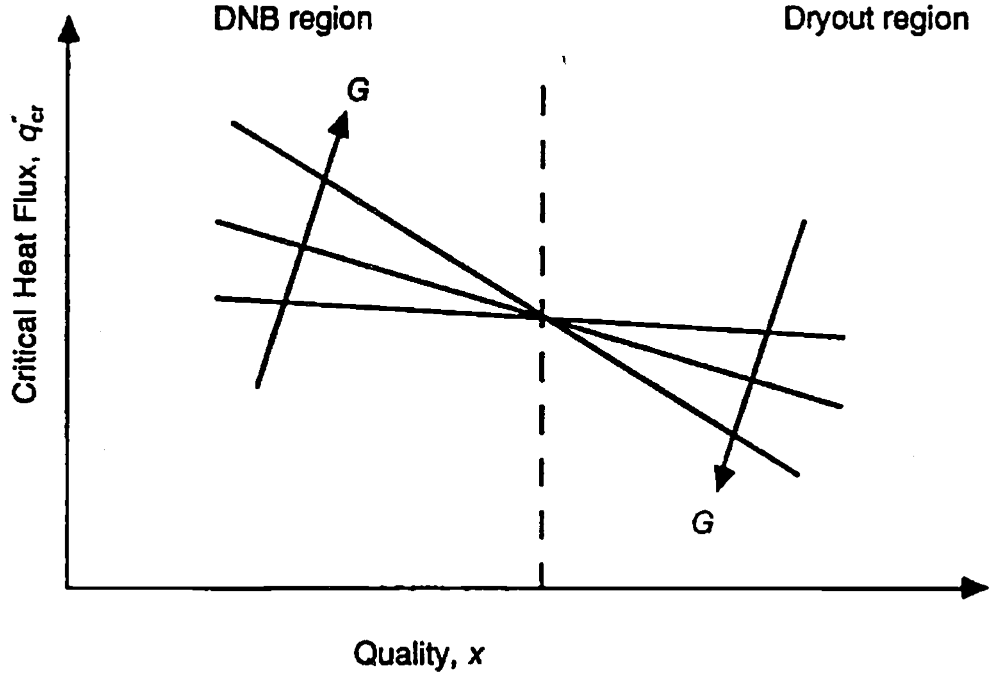

Figure 1.3 – Effect of Mass Flux upon CHF Values[2]

1.3. Fluid Mechanics of Annular Critical Heat Flux

Thus far both pool boiling and tube boiling have been discussed. The focus of this paper, however, is annular critical heat flux. This reference to annular is not the annular flow regime noted in the previous section, but annular geometry. Figure 1.4 shows the difference between tube geometry and annular geometry. Annular geometry has an additional complication that a heat flux can be applied to both the inside wall and the outside wall, called bilateral heating. Since we are only interested in nuclear reactor applications where the inner section contains the fuel (and hence 95% of the heat), we will limit the discussion to heating of the inside wall (unilateral heating).

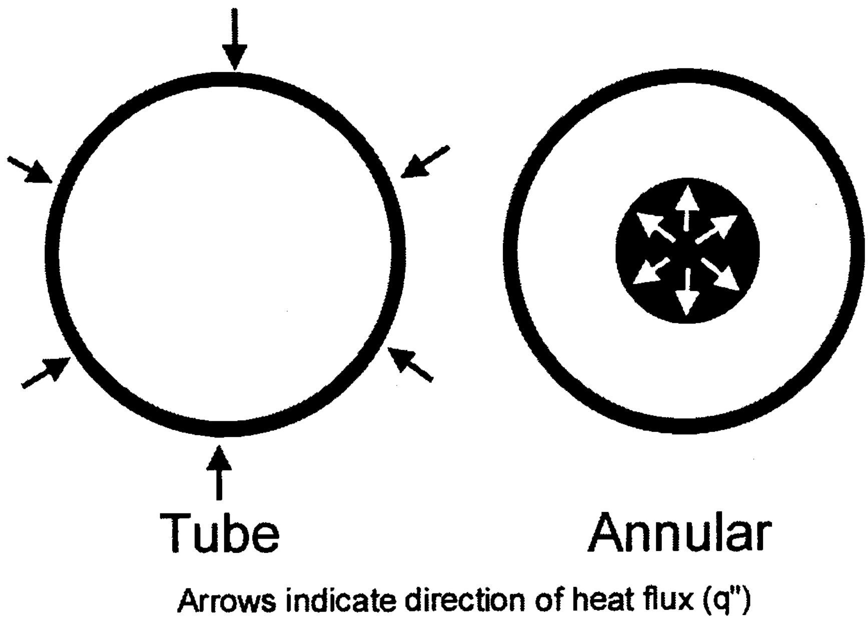

Figure 1.4 – Comparison of Heated Tube Geometry to Heated Annular Geometry

1.3.1. Difference between Critical Heat Flux in Tubes and Annuli

The physical phenomena for CHF in annuli are more complex than in tubes. This is due to the presence of the second wall (the inner wall of the flow channel) and how it affects the fluid. There are two physical phenomena that are specifically effected by the annular geometry. The first is the distribution of the droplet deposition between the two surfaces. In tube geometry there is only one surface on which to deposit droplets in a two-phase flow, while in annular geometry there are two. The deposition coefficient, K, is a function of pressure, wall heat flux, and a view factor much like a radiative heat transfer view factor.[3] In general, K decreases with increasing pressure and increases with decreasing heat flux. For constant pressure and heat flux, the K for the outer wall is greater than for the inner wall due to its larger view factor (greater circumference and area).

The second phenomenon is the shear stress distribution between the two walls. In single-phase and two-phase flow the shear stress, τ, for the inner wall is higher than for the outer wall, both for laminar and turbulent flow. This has the effect of reducing the film thickness for the inner wall in relation to the outer wall.

These two effects work in combination to decrease the heat flux required for the inner wall to achieve CHF. The decreased droplet distribution and the decrease in film thickness provide fewer opportunities to transfer heat from the inner wall to the flowing fluid, causing this reduction in critical heat flux. If we consider the tube geometry again, it can be closely correlated to the outer wall of the annular geometry. Therefore, for similar conditions we would expect that tube geometry would have a higher CHF value than a unilaterally heated annulus.[3]

1.3.2. Derivation of Phenomenological Equations for Unilaterally Heated Annuli

The basic fluid mechanics behind annular critical heat flux is best described using the model developed by Kirillov and Smogalev.[4] Looking at Figure 1.5 we see that flow develops much as it did for Figure 1.2. The formation of annular flow occurs between numbers 1 and 2 in Figure 1.5 as the vapor space becomes cohesive. Then, between 2 and 3, droplets from the wavy liquid films become entrained in the vapor core. From 3 to 4 the films become smooth and entrainment stops to a greater extent and droplet deposition can occur. If the effect of the vapor thrust velocity on droplet deposition is neglected, then deposition will continue until the core liquid mass flow rate reaches its minimum value Γ^c_n corresponding to the minimum quality x_n. At 4, dryout critical heat flux occurs on the inner wall.

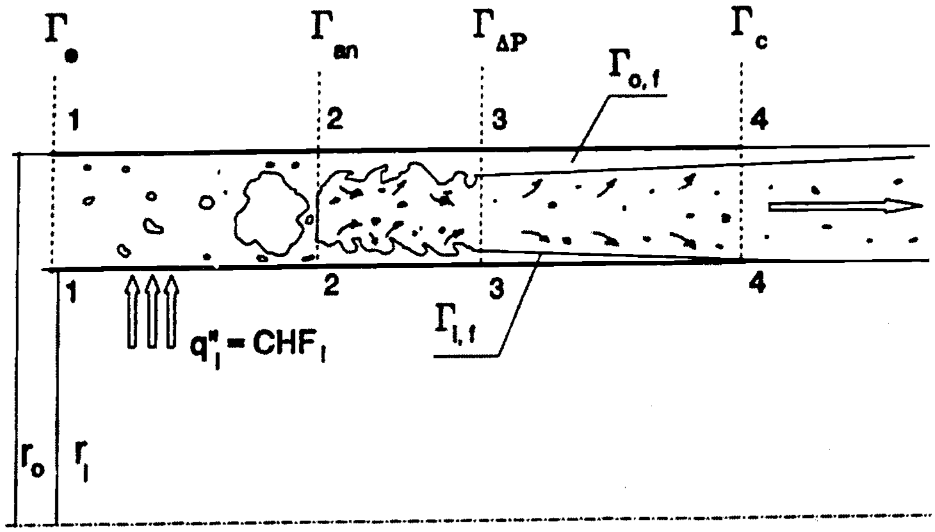

Figure 1.5 – Kirillov and Smogalev Model[4]

The mass flow rate of deposited droplets in the region between 3 and 4 is

$$\Gamma_{dep} = \Gamma^c_{\Delta P} - \Gamma^c_n. \quad \textbf{(1.1)}$$

Deposition on the inner (heated) surface is

$$\Gamma_{i,\,dep} = n_i\, \Gamma_{dep} \quad \textbf{(1.2)}$$

and on the outer (unheated) surface is

$$\Gamma_{o,\,dep} = n_o\, \Gamma_{dep} \quad \textbf{(1.3)}$$

where $n_i = r_i / (r_i + r_o)$ and $n_o = r_o / (r_i + r_o)$.

A normal component of the vapor flow, $q_i''/(H_{fg}\,\rho_g)$, decreases the droplet deposition onto the inner surface in the ratio K_q/K_a as follows:

$$\Gamma_{i,\,dep} = n_i\, \Gamma_{dep}\, (K_q/K_a). \tag{1.4}$$

Consequently, the mass flow rate of droplets in the core flow is increased by the amount:

$$\Delta\Gamma^c_n = n_i\, \Gamma_{dep}\, [1-(K_q/K_a)]. \tag{1.5}$$

The droplets mass flow rate in the core stream becomes

$$\Gamma^c_{nq} = \Gamma^c_n + n_i\, \Gamma_{dep}\, [1-(K_q/K_a)]. \tag{1.6}$$

In this case, the liquid mass flow rate at any section in the region is

$$\Gamma = \Gamma^c_{nq} + (\Gamma E - \Gamma^c_{nq}) + \Gamma_{i,f} + \Gamma_{o,f} \tag{1.7}$$

where E is the fraction of the entrained liquid. For the onset of CHF it is necessary that $\Gamma E = \Gamma^c_{nq}$ and $\Gamma_{i,f} = 0$ so that

$$\Gamma_c = \Gamma^c_{nq} + \Gamma_{o,f}. \tag{1.8}$$

If we assume that $K_q = K_a - [q_i''/(H_{fg}\, \rho_g)]$, use the relation $\Gamma^c_{\Delta P} = \Gamma_{\Delta P}\, E_{\Delta P}$, and divide equation (1.6) by the total mass flow rate (Γ_t) then

$$x_c = x_n - n_i\left[(1 - x_{\Delta P})E_{\Delta P} - 1 + x_n\right]\frac{q_i''}{K_a H_{fg} \rho_g} - \frac{\Gamma_{o,f}}{\Gamma_t} \tag{1.9}$$

where $(1 - x_c) = \Gamma_c/\Gamma_t$, $(1 - x_n) = \Gamma^c_n/\Gamma_t$ and $(1 - x_{\Delta P}) = \Gamma_{\Delta P}/\Gamma_t$. The liquid mass flow rate in the film on the outer surface is

$$\Gamma_{o,f} = 2\pi r_o \delta_o \rho_f v_f. \tag{1.10}$$

The stable film thickness, δ_o, is assessed from the Tippets formula[5]

$$\delta_o = \frac{C_3 C_4 \sigma \left(1 + \frac{\rho_f}{\rho_g}\right)}{\tau_o \left(1 + \left(\frac{\rho_f}{\rho_g}\right)^{0.5}\right)^2} \tag{1.11}$$

where the shear stress at the outer surface is assumed to follow the Knudsen and Katz[6] relationship for single-phase flow

$$\tau_o = \frac{4\mu_g v_g (r_o^2 - r_m^2)}{r_o (r_o^2 + r_i^2 - 2r_m^2)} \tag{1.12}$$

where

$$r_m = \sqrt{\left(r_o^2 - r_i^2\right) \Big/ \left(2\ln\frac{r_o}{r_i}\right)} .$$

To replace the average vapor velocity, v_g, in the shear stress equation with the average liquid velocity, v_f, the following slip ratio equation is assumed to be valid:

$$S = v_g/v_f = (\rho_g/\rho_f)^{0.5} \; . \tag{1.13}$$

Then the fraction of liquid in the film at the outer surface can be expressed as follows:

$$\Phi_{oi} = \Gamma_{o,f} / \Gamma_t = A_{oi} * B * C_{oi} \tag{1.14}$$

where A_{oi} is a constant based upon C_3 and C_4,

$$B = \frac{\sigma\rho_f \left(\frac{\rho_g}{\rho_f}\right)^{0.5} \left(1 + \frac{\rho_f}{\rho_g}\right)}{2\mu_g G \left(1 + \left(\frac{\rho_f}{\rho_g}\right)^{0.5}\right)^2},$$

and

$$C_{oi} = \frac{r_o^2 \left(r_o^2 + r_i^2 - 2r_m^2\right)}{\left(r_o^2 - r_i^2\right)\left(r_o^2 - r_m^2\right)} .$$

Rearranging the equation of x_c with the assumption $E_{\Delta P} = 1$, yields the final result of

$$CHF_{ii} = q_i'' = \frac{r_i + r_o}{r_i} * \frac{K_a H_{fg} \rho_g}{x_{nl}} * \left(x_n - \Phi_{oi} - x_c\right) \tag{1.15}$$

where $x_{nl} = x_n - x_{\Delta P}$.

1.4. Interpolation Theory

In the previous section, it was shown that annular critical heat flux is typically lower than tube critical heat flux and that, given a few assumptions, it is possible to predict using fluid mechanics the dryout critical heat flux for a unilaterally heated annulus. Unfortunately, for most engineering applications it is not possible to calculate all the factors needed in the predictive equation from the model developed by Kirillov and Smogalev. Usually data is obtained from critical heat flux experiments and then predictions of CHF are made, based upon this data, for the conditions of interest.

One way to make predictions from known experimental data is through the use of a look-up table. Using this technique a series of data locations are chosen in either a regular or irregular pattern to represent the data set. To obtain a value of this data set from the given independent experimental variables, either a value is directly obtained if the location coincides with a point on the look-up table or it is interpolated from neighboring points on the look-up table.

In general, the more points contained in a look-up table, the better the estimation of the data set. Unfortunately, most experimental data sets sparsely cover the parameter space. To improve the resolution of the look-up table, provide data points necessary in regions where data does not exist, and/or create a regular pattern from an irregular pattern, advanced interpolation techniques can be used.

1.4.1. Linear Interpolation

Linear interpolation is the most commonly used interpolation technique in engineering analysis. It is simple, quick, and provides a relatively accurate answer in smooth, slow changing functions. The basic formulation for linear interpolation in one dimension is

$$f(a) = \left[\frac{f(y) - f(x)}{y - x}\right](a - x) + f(x) \qquad \textbf{(1.16)}$$

where $f(x) < f(y)$ and x<a<y.

To linearly interpolate in more than one dimension, the process is broken down into determining intermediate points through linear interpolation in one dimension, then interpolating between these intermediate locations in another dimensional direction until the final value has been determined. For example, in a two dimensional system four points are neighbors to the point that is to be determined (assuming the unknown point is not collocated with an existing known point). These neighbor points shall be called A, B, C, and D with the desired point called T. For simplicity, define A(x)=B(x)<C(x)=D(x) and B(y)=C(y)<A(y)=D(y), which is a mathematical representation of a square mesh. To determine the function value at point T from points A, B, C, and D two intermediary points P and Q need to be created. By arbitrarily interpolating first in the y direction, points P and Q will be created. In other words, P is created by interpolating from points A and B and Q is created by interpolating from points C and D. This reduces it to a one dimensional problem, where P(y)=Q(y)=T(y). Then to obtain the value at T, interpolate between P and Q.

1.4.2. Shepard's Method

Shepard's Method is an advanced interpolation technique most often applied to scattered data with a general number of variables. In its single dimensional form, it is given by

$$s(x) = \sum_{i=1}^{N} w_i(x) f(x_i) \tag{1.17}$$

where $w_i(x) = \dfrac{\|x - x_i\|^{-p}}{\sum_{j=1}^{N} \|x_i - x_j\|^{-p}}$ and p>0. When s(x) is evaluated at a data location it must be set to that data location's value to exclude division by zero.[7] In its two dimensional form, it is given by

$$s(x,y) = \frac{\sum_{i=1}^{n} \frac{F_i}{d_i^p}}{\sum_{i=1}^{n} \frac{1}{d_i^p}} \text{ for } (x,y) \neq (x_i,y_i),\ i=1 \text{ to } n \tag{1.18}$$

where $s(x_i,y_i)=F_i$, $d_i=((x-x_i)^2+(y-y_i)^2)^{0.5}$, and p>0. When $(x,y)=(x_i,y_i)$ then $s(x_i,y_i)=F_i$ to avoid division by zero.[8] The choice of p is somewhat arbitrary, but in general it should be greater than 1 to allow the form to be differentiable. If p>1, the first derivatives vanish at the data points, which indicates "flat spots" in the interpolant.[7]

Shepard's Method is sometimes called an inverse distance method because the weights are based upon the inverse of the distance to the known data set.[8] The method is also an example of a convex space since the weights are all non-negative and sum to 1.[7] This method is easily extrapolated to a multivariate scheme, allowing a number of dimensions to be considered without the need to break down the algorithm into a number of steps as in the linear interpolation case.

2. LITERATURE REVIEW

2.1. Introduction

Critical Heat Flux (CHF) is an important safety parameter for nuclear reactors. During any safety analysis of the reactor system the CHF value must be determined for the fuel elements. Prediction of the CHF value from first principles is possible, though time consuming and contains inaccuracies due to assumptions that need to be made. What is typically done to predict CHF is to use either a correlation or look-up table based upon experimental data. A review will be made of available correlations and look-up tables and to provide an estimation of usability for general safety use in relation to annular geometry.

2.2. Comparison of Four Annular Correlations to the Groeneveld Lookup Table

There exist many correlations for the prediction of critical heat flux, including the well known Bowring correlation and the Biasi correlation. However, the better known correlations are based upon tube CHF data and, as we have shown, are not representative of annular geometry. In addition there exists well known look-up tables developed by Groeneveld that are being used in current safety analysis programs. The 1986 AECL-UO CHF look-up table[9] contains a mixture of annular data and tube data. The 1995 look-up table for critical heat flux in tubes[10] contains only tube data and is not considered usable for annular geometry.

To obtain an idea of the usefulness of annular correlations and the commonly used 1986 look-up table we shall choose a few and see how they compare to one another. Four annular correlations were chosen to compare to the Groeneveld table; V. I. Tolubinskii, Savannah River, L. Levitan, and N Reactor. These four correlations are based upon a variety of geometries and experimental conditions. All four were developed independently at separate institutions on two different continents. These four correlations were compared to the lookup table using a hypothetical test geometry.

2.2.1. Tolubinskii Annular Correlation

V. I. Tolubinskii performed CHF experiments in 1976 using annular geometry.[11] Based upon his data, he obtained a best-fit correlation to describe the results of his experiments. The correlation is valid for a pressure range of 50 to 200 bars and a mass flux range of 200 to 5000 kg/m^2-s. The hydraulic diameter was varied from 1 to 8 mm during the experiments and the heated length varied from 100 to 2000 mm. This gives a maximum length to diameter ratio of 2000, well above what is typically seen in tube experiments. The correlation is given by the following formula:

$$\mathbf{q_{cr} = q_{cr}^{pb} K_p (\rho\omega)^{0.25} \left(\frac{d_{hyd}}{d_{heated}}\right)^{0.2} L_{heated}^{-0.2} \left[1 - 0.06(\rho\omega)^{0.5} \left(\frac{d_{hyd}}{d_{heated}}\right)^{0.2} x\right]} \quad \textbf{(2.1)}$$

where,

$$q_{cr}^{pb} = \left(7h_{fg}\sqrt{\alpha f \rho_f \rho_g}\right)10^{-6}$$

and

$$K_p = 0.067 + \frac{0.72}{22.1 - P}.$$

Here, $\rho\omega$ is the coolant mass flux in kg/m^2-s, d_{hyd} is the hydraulic diameter in mm, d_{heated} is the heated diameter in mm, L_{heated} is the heated length in mm, x is quality, K_p is the pressure multiplier, and q^{pb} is the pool boiling factor. The P in the K_p formula is pressure expressed in MPa. The variables in the q^{pb} formula are defined as follows: h_{fg} is the latent heat of fusion in J/kg, α is the coolant thermal diffusivity in m^2/s, f is the bubble frequency in Hz, ρ_f is the fluid density in kg/m^3, and ρ_g is the vapor density in kg/m^3.

2.2.2. Savannah River Annular Correlation

Savannah River Laboratory and Columbia University performed CHF experiments around 1964 using annular geometry.[12] Based upon their data, a best-fit correlation was obtained to describe the results. The correlation is valid for a pressure range of 1.7 to 82.7 bars (25 to 1200 psia) and a coolant velocity range of 1.5 to 12.8 m/s (5 to 42 ft/s). The hydraulic diameter was varied from 6.35 to 25.4 mm (0.25 to 1 in) during the experiments and the heated length varied from 482.6 to 1016 mm (19 to 40 in). This gives a maximum length to diameter ratio of 160. The coolant in the experiments was always kept in a subcooled state, at least by 10 °C, making it valid only for qualities less than zero. The correlation is given by the following formula:

$$\mathbf{q_{BO} = 257000 * (1 + 0.040V)(1 + 0.030T_S)} \qquad \textbf{(2.2)}$$

where V is the coolant velocity in ft/s, T_S is the amount of subcooling in °C, and q_{BO} is given in pcu/ft^2-hr. (Note: 1 pcu = 1.8 Btu)

2.2.3. Levitan Annular Correlation

L. Levitan performed CHF experiments in 1977 using annular geometry.[13] Based upon his data, a best-fit correlation was obtained to describe the results. The correlation is valid for a pressure range of 40 to 196 bars and a mass flux range of 500 to 5000 kg/m^2-s. The annular gap was varied from 2 to 22 mm during the experiments. The length to diameter ratio was maintained such that it was always greater than 50. The correlation is given by the following formula:

$$q_{cr} = K_p K_x K_d \left[10.3 - 7.8\left(\frac{P}{9.8}\right) + 1.6\left(\frac{P}{9.8}\right)^2\right] e^{-1.5x} \left(\frac{\rho\omega}{1000}\right)^{1.2\left[0.25\left(\frac{P}{9.8}-1\right)-x\right]} \qquad (2.3)$$

where,

$$K_p = \begin{cases} 1 & P \le 6.9\text{MPa} \\ 1.2\sqrt{\dfrac{P}{9.8}} & P > 6.9\text{MPa} \end{cases}$$

$$K_x = \begin{cases} 1 & x \le 0 \\ e^{-2x} & x > 0 \end{cases}$$

$$K_d = \begin{cases} \left(\dfrac{d_{hydraulic}}{d_{heated}}\right)^{0.2} & d_{hydraulic} \le 8\text{mm} \\ \left(\dfrac{64}{d_{hydraulic} d_{heated}}\right)^{0.2} & d_{hydraulic} > 8\text{mm} \end{cases}$$

The variables for these formulas have the same definitions as the Tolubinskii correlation in section 2.1.

2.2.4. N Reactor Annular Correlation

J.K. Anderson, W.L. Thorne, and J.M. Batch performed CHF experiments in 1963 using the N Reactor fuel annular geometry.[14] Based upon their data, a best-fit correlation was generated to describe the results. The experiments were performed under 104, 70, and 7.9 bars (1500, 1000, and 100 psig) of pressure and a mass flux range of 678 to 6780 kg/m^2-s (500,000 to 5,000,000 lbm/ft^2-hr). The hydraulic diameter was equal to 7.874 mm (0.31 in) and the heated length equal to either 584.2 or 1168.4 mm (23 or 46 in). This gives a maximum length to diameter ratio of about 150. The correlation is given by the following formula:

$$q_{BO} = 10^6\left(1.640 - 0.946\left(\frac{G}{10^6}\right)^{-05} - \left[7.0\left(\frac{G}{10^6}\right)^{05} - 5.0\right]\frac{\Delta H}{1000}\right) \quad (2.4)$$

where G is mass flux in lbm/ft^2-hr, ΔH is local enthalpy minus saturated liquid enthalpy in Btu/lb, and q_{BO} is expressed in Btu/ft^2-hr.

2.2.5. Comparison of Correlations to Lookup Table

The geometry used for the comparison of the lookup table (RELAP5) to the correlations was a carbon steel annulus with inner diameter equal to 8 mm and outer diameter equal to 12 mm. The heated length was set to 6000 mm to generate a large length to diameter ratio. Pressure was chosen to be 30 bars, and two mass fluxes were initially investigated, 3000 and 5000 kg/m^2-s. The range of quality values varied from –0.2 to 0.8 to investigate both the subcooled and superheated regions. Figures 2.1 and 2.2 show the results of this comparison. The first item to note is that the results from the lookup table are greater than the four correlations. In some cases, the table is more than twice the value of a correlation. The second item to note is that the Tolubinskii correlation is the most conservative correlation of the four. Because this correlation is very conservative and valid over a wide range, it was chosen to explore a wider range of mass fluxes and different pressures. Figures 2.3 through 2.10 show the comparison of the Groeneveld table (RELAP5) to the Tolubinskii correlation for a mass flux range of 500 to 5000 kg/m^2-s and a pressure of 30 and 50 bars. The trends of the graphs show that as pressure increases and the mass flux increases the difference between the table and the correlation decreases. However, during a loss of coolant accident (LOCA) the trend in the core would be toward decreasing pressure and decreasing mass flux. This leads to the possibility that the table could significantly over-predict the heat flux at which CHF would occur during a LOCA or other postulated accident.

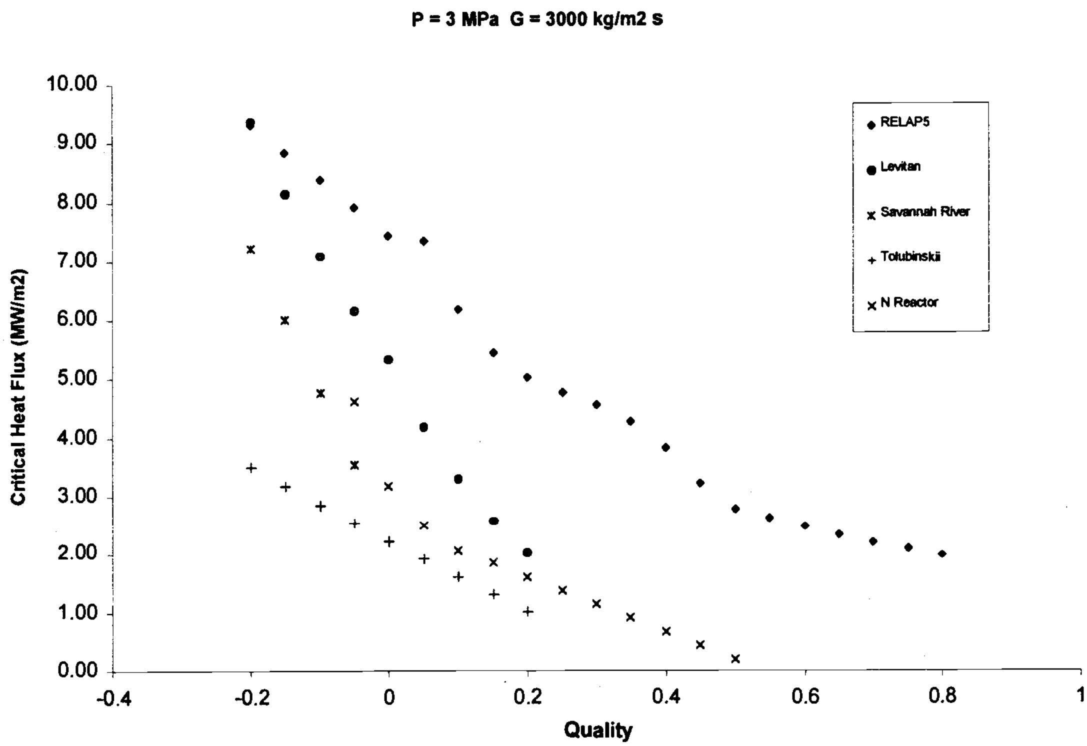

Figure 2.1 – Correlation Comparison at 3 MPa and 3000 kg/m^{2}s

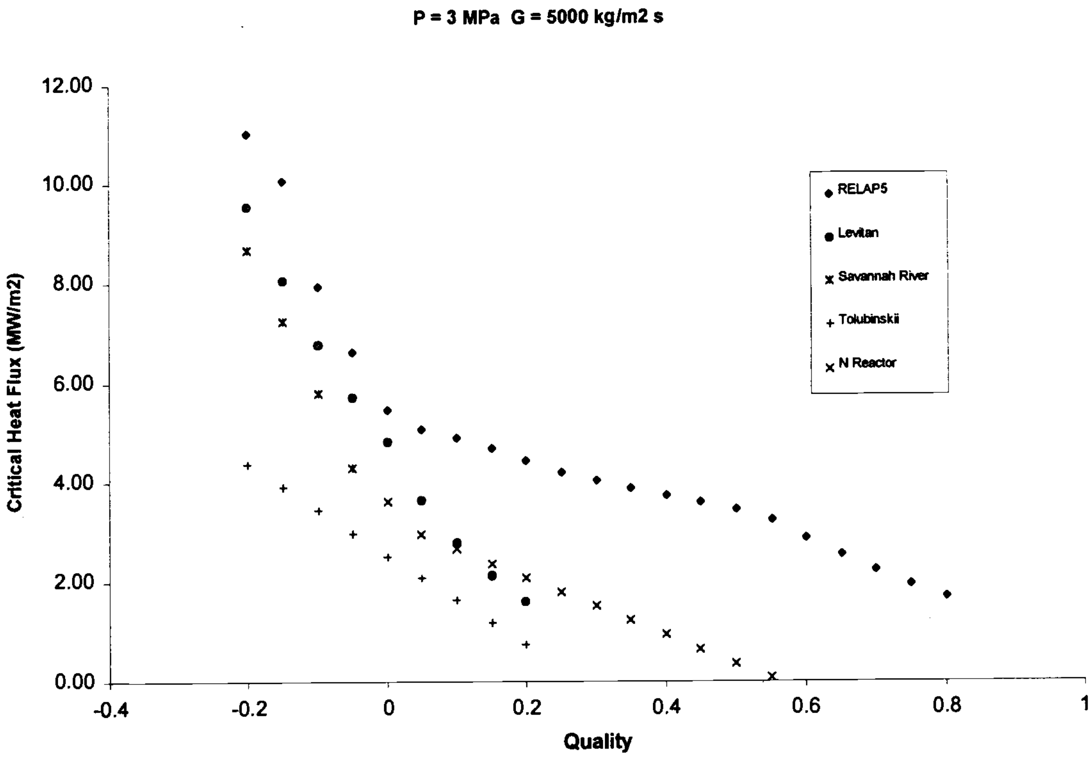

Figure 2.2 – Correlation Comparison at 3 MPa and 5000 kg/m^{2}s

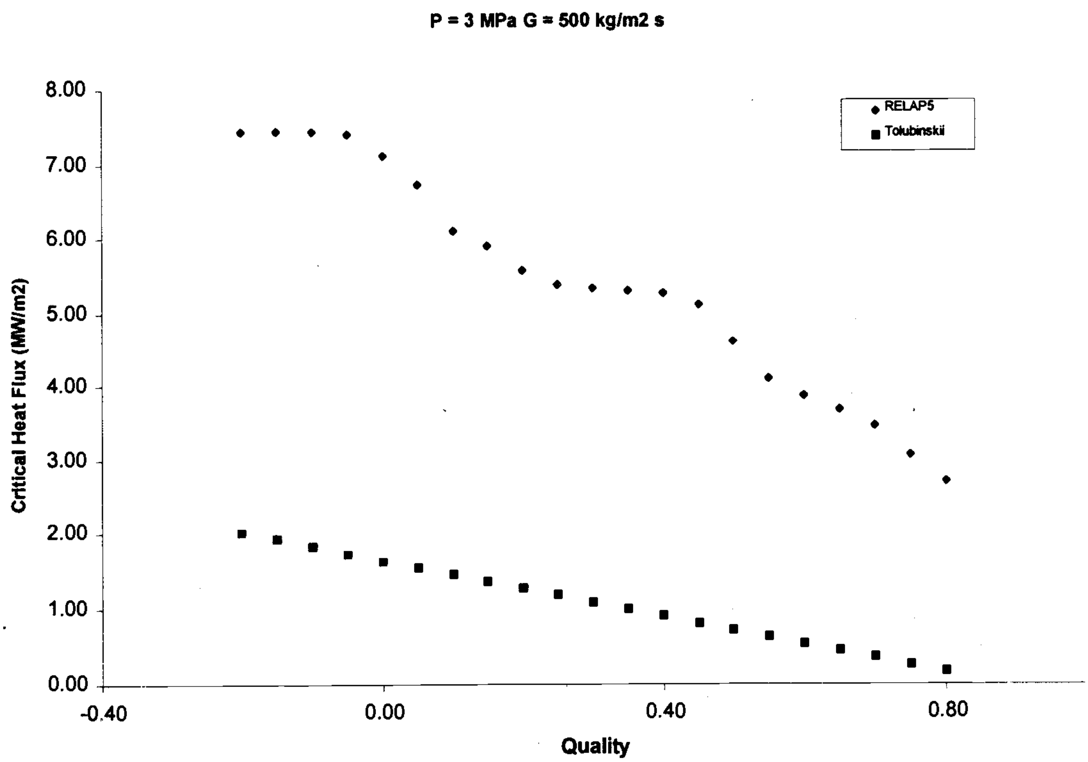

Figure 2.3 – Groeneveld Comparison at 3 MPa and 500 kg/m^{2}s

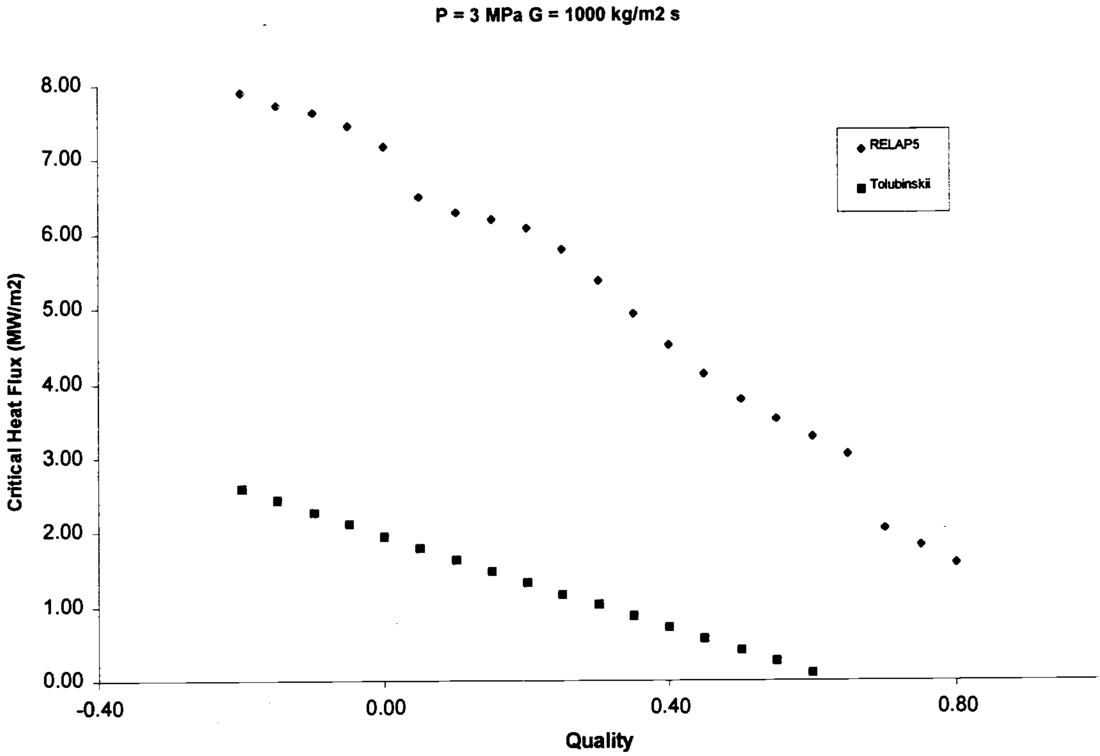

Figure 2.4 – Groeneveld Comparison at 3 MPa and 1000 kg/m^{2}s

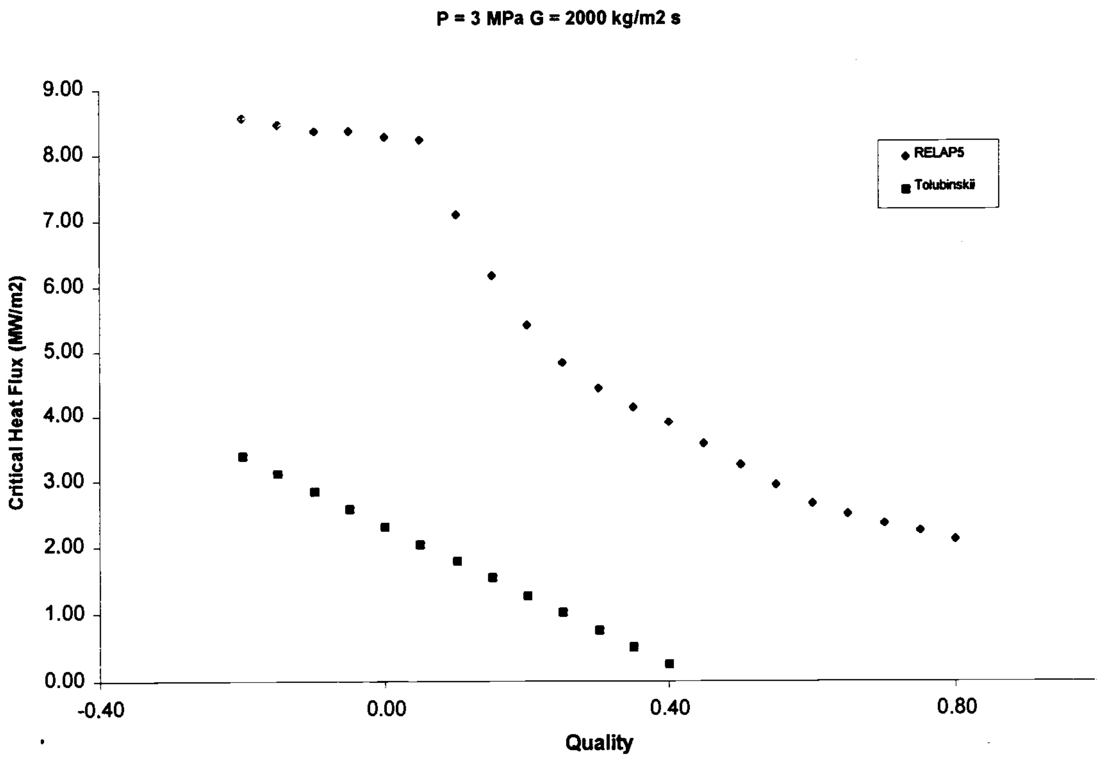

Figure 2.5 – Groeneveld Comparison at 3 MPa and 2000 kg/m^{2}s

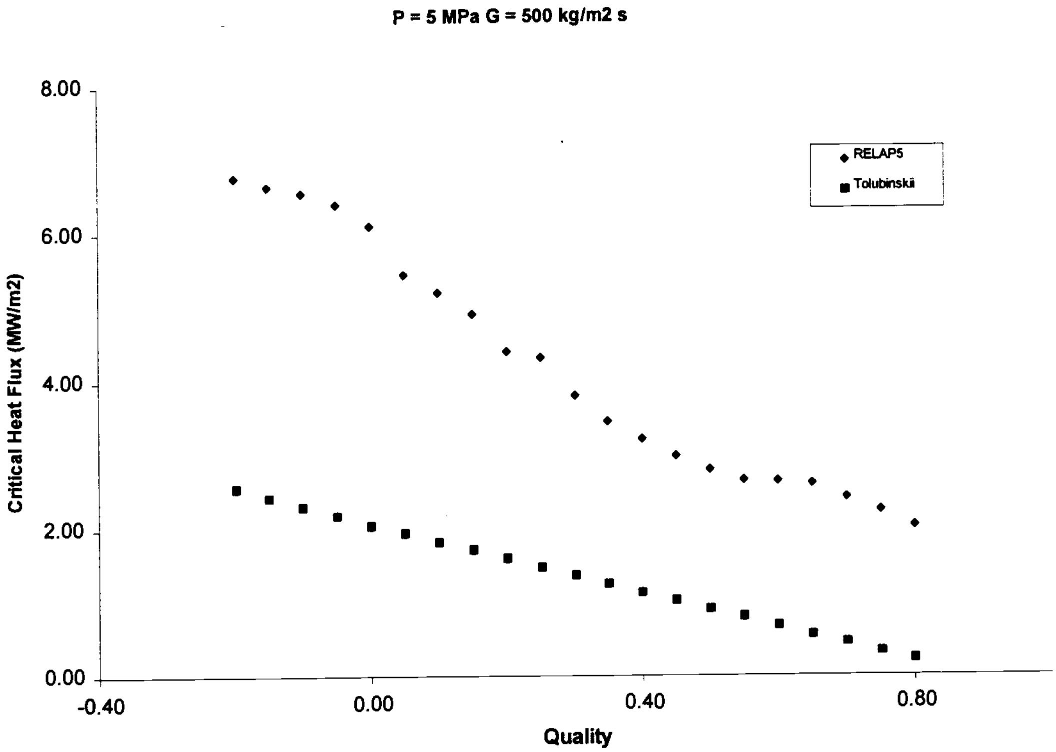

Figure 2.6 – Groeneveld Comparison at 5 MPa and 500 kg/m²s

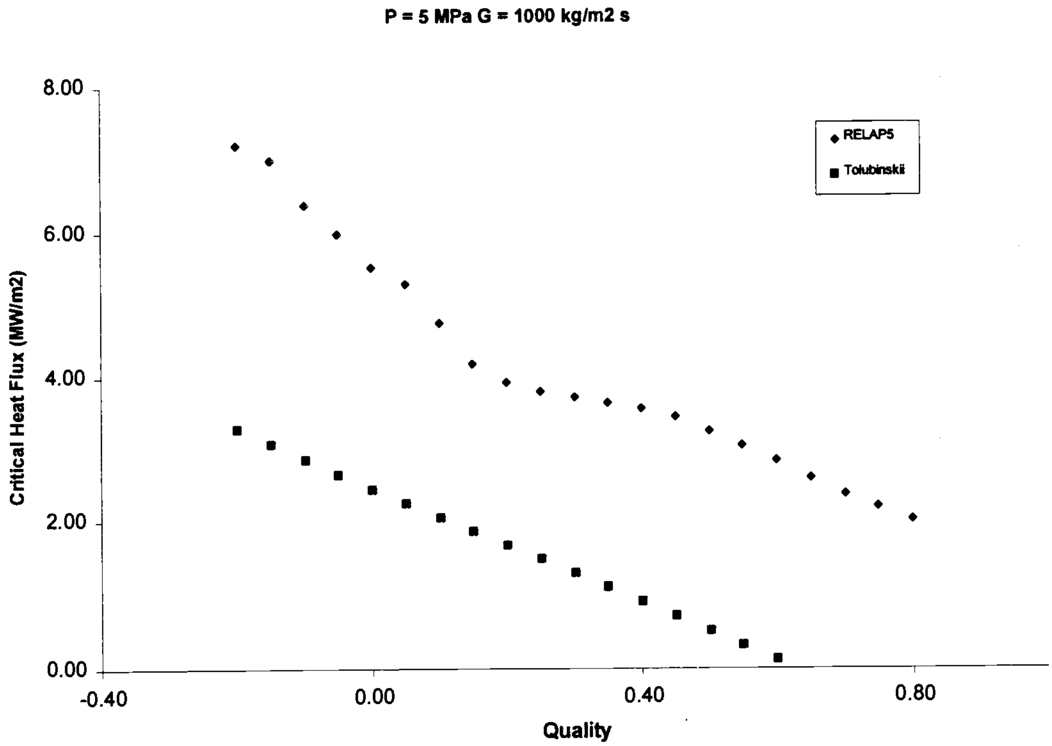

Figure 2.7 – Groeneveld Comparison at 5 MPa and 1000 kg/m²s

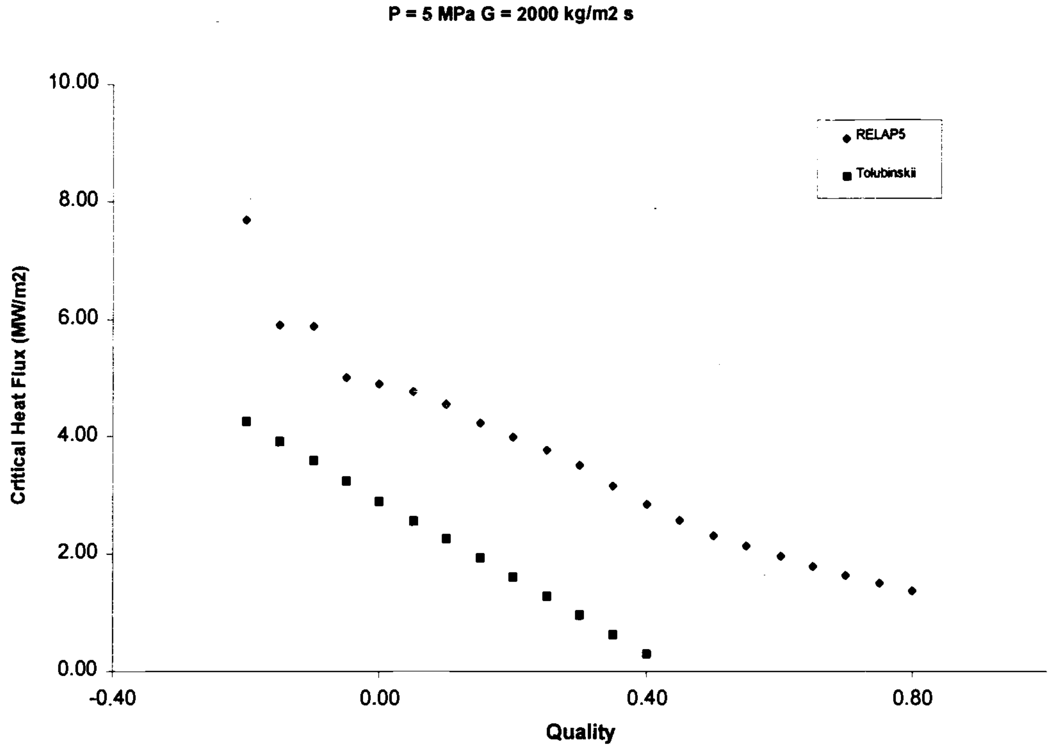

Figure 2.8 – Groeneveld Comparison at 5 MPa and 2000 kg/m^{2}s

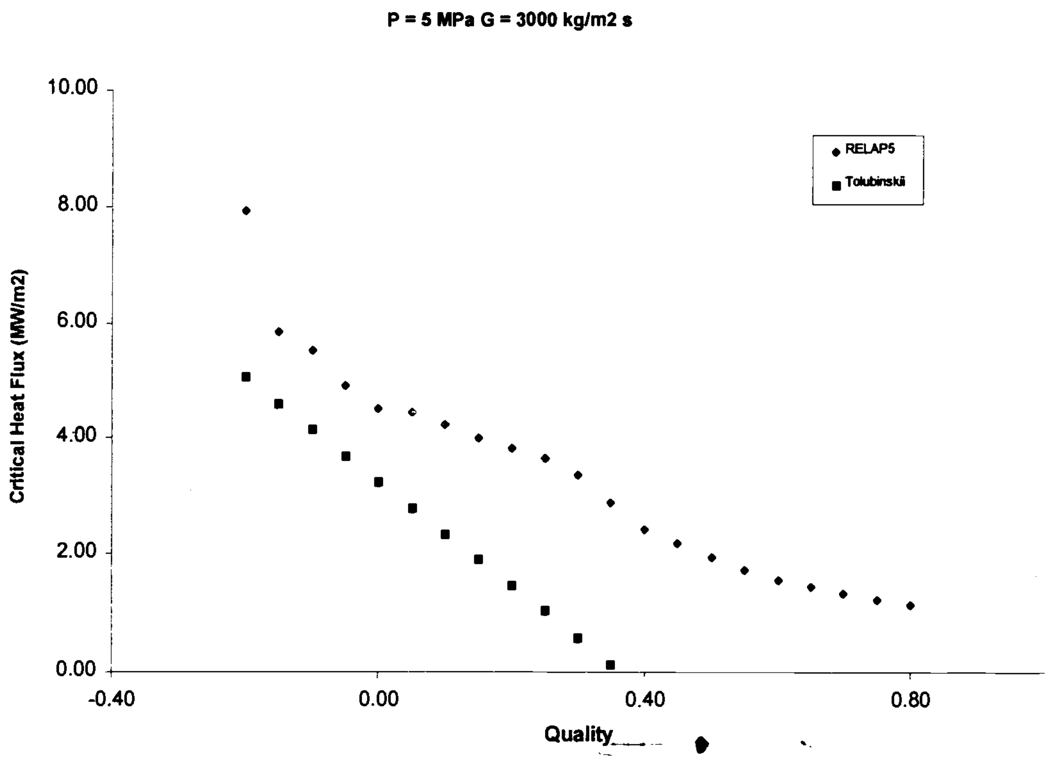

Figure 2.9 – Groeneveld Comparison at 5 MPa and 3000 kg/m^{2}s

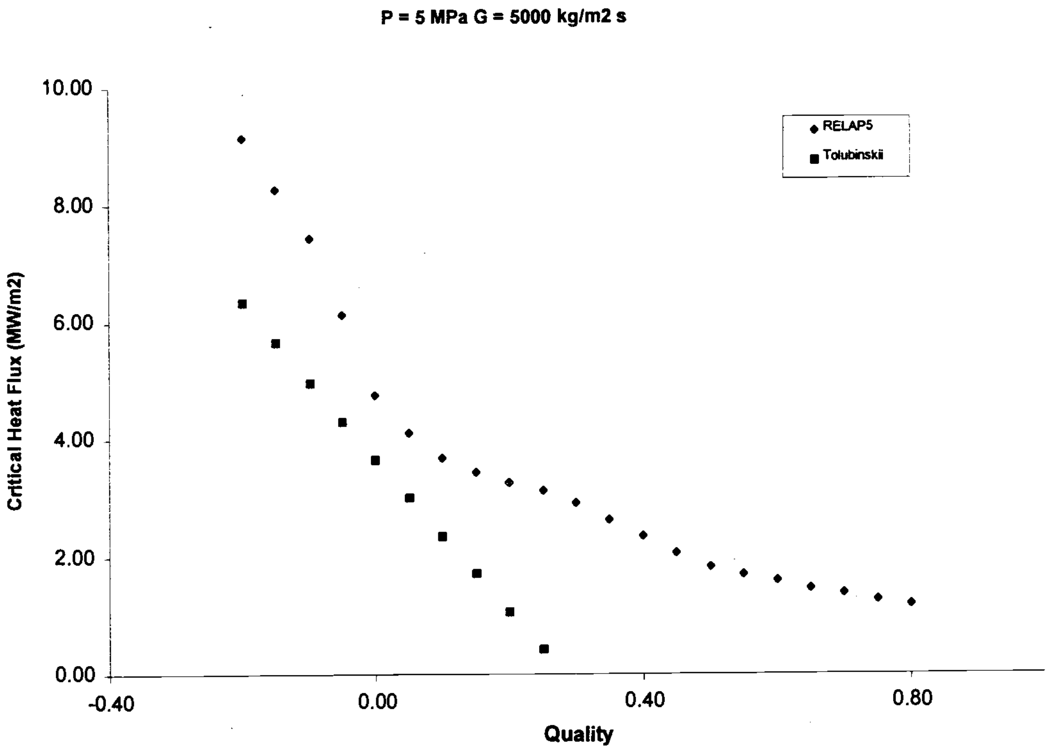

Figure 2.10 – Groeneveld Comparison at 5 MPa and 5000 kg/m^{2}s

2.3 Comparison of Tolubinskii and Lookup Table to Experimental Data

With the discrepancy between the Tolubinskii correlation and the Groeneveld lookup table, the question becomes; "Which yields better results for an annular system?" To explore this issue it is best to compare actual experimental data to both the correlation and the table. The experiments by J.K. Anderson, W.L. Thorne, and J.M. Batch in 1963 for the N Reactor fuel provide a good basis for comparison. These experiments were performed in the range of validity for both the Tolubinskii correlation and the lookup table. Figure 2.11 shows the results of the comparison of the data to the correlation and the lookup table for a pressure of 104 bars (10.4 MPa). The results show that the lookup table over-predicts the CHF value while the Tolubinskii correlation under-predicts the

CHF value. Overall the Tolubinskii correlation does a better job of predicting the experimental data, especially near the saturation quality. This is not surprising as the look-up table contains a mixture of tube and annular data. Based upon this result the Tolubinskii correlation is a reasonable, though conservative, estimate of annular CHF.

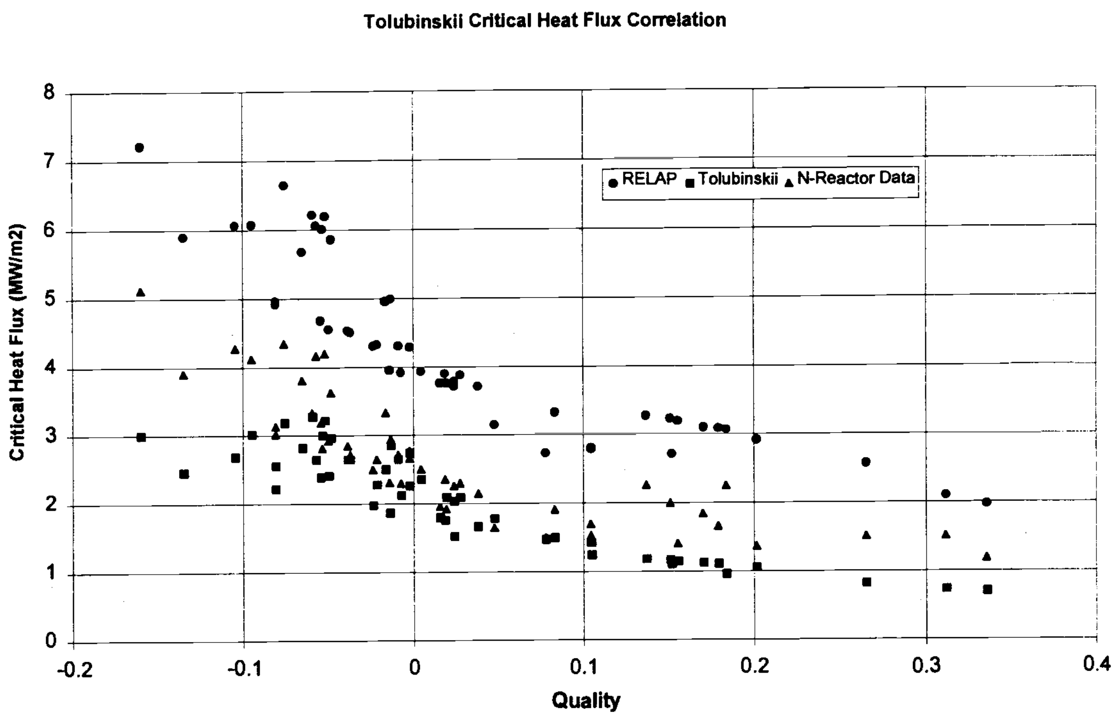

Figure 2.11 – Data Comparison to Predictive Methods

2.4. Application of Critical Heat Flux Predictive Tools

We have shown that the widely used 1986 Groeneveld look-up table does not accurately, or conservatively, predict CHF for annular geometry. We have also found that, of the four correlations analyzed, the spread in the prediction between these correlations is rather large. It is difficult to say which correlation should be used, especially given their limited regions of applicability. It would be possible to create a continuum of correlations that could span a wider range, but this would cause difficulties in correlation transitions. Which correlation would have precedence in a given range of overlap and how do you smooth jumps that occur between correlations? How does one rationalize the co-joining of a purely statistical correlation with a correlation that has a physical basis? A general correlation is the best solution to this problem.

General correlations have been attempted in the literature with varying success. First a quick overview of correlations should be given to better understand some of the difficulties. There exists in the literature, purely statistical correlations based upon data sets. A good example of this is the tube correlation by Kim and Lee.[15] The authors collected a database of roughly 13,000 tube CHF experimental data points. Then they applied the statistical technique of the alternating conditional expectation algrothim[16] and reduced the error until the correlation is optimized. The difficulty is that the forms of the resulting correlations show little physical intuitive result. For instance, the Kim and Lee correlation, in its final form, can be represented as:

$$q_{CHF} = A_1 A_2 \left(\frac{\sigma \rho_f}{G^2 L}\right)^{A_3} \left[A_4 + \left(\frac{\Delta h_i}{h_{fg}}\right)^{A_5}\right]^{A_6} \exp\left[A_7 \left(\frac{L}{D}\right)^{A_8}\right] \left(\frac{\rho_g}{\rho_f}\right)^{A_9} G h_{fg} \quad (2.5)$$

where $A_1, \ldots, A_9$ are constant values in given ranges of the independent variable. It is difficult to understand how q_{CHF} is proportional to Gh_{fg} for all flow rates. The data fit very well to the correlation and even better than some existing correlations, but it does not appear to follow the underlying physics of the problem.

Attempts have also been made to build correlations based upon the known physics of CHF. The Centre for International Studies in Education (CISE) correlation[17] attempts to determine where CHF will occur given the heat applied over a length. The correlation determines how much heat needs to be applied to produce dryout on the heated surface. The form of the correlation is:

$$\frac{q_{CHF}}{\Gamma H_{fg}} = a(P,G)\frac{L_{s,cr}}{L_{s,cr} + b(P,G,D)} \tag{2.6}$$

where a(P,G) and b(P,G,D) are the functions determined with statistical methods to fit the correlation to the data and $L_{s,cr}$ is the critical saturation length. This correlation has a physical sense but it also requires us to know more than we often do. For instance, knowing the critical saturation length in an engineering problem is not always possible with difficult geometries.

Other correlations based upon the physics of CHF can be so cumbersome to use that it is impossible to implement them in a safety analysis code. An example of this kind of correlation is the Shah correlation.[18] This correlation is based upon non-dimensional analysis and is applicable for many fluids as well as fluid state points. The correlation is based upon different regions of CHF determined through the Peclet and Froude non-dimensional numbers, called the Y factor. Using this relation the CHF value is either a function of inlet quality, length, and hydraulic diameter, or is a function of Y, inlet quality, length, hydraulic diameter, reduced pressure, and critical quality. The difficulty is that in implementing the correlation, the Y value needs to first be determined, and then the CHF value and applicable multipliers need to be determined from the appropriate table. It is difficult and computationally expensive to code a method such as this.

Given the variety of generalized correlations, it is not currently possible to identify a single unique correlation to determine CHF for annular geometry. The existing correlations are too narrow in application, are based solely upon curve-fitted data (which contains little or no physics), require information not readily available except through complicated physics calculations, or are so cumbersome that they cannot be used in safety assessment codes. Therefore, there exists no known correlations or look-up table that can be applied universally and accurately to existing thermal hydraulic codes.

2.5. Next Steps

Given that no correlation or look-up table exists to predict annular CHF for safety assessment codes, a new tool needs to be created to fill this void. The first step to creating a new tool is creating a database of experimental data. Then, exploring the available techniques for predictive analysis, a new tool will be created.

3. ANNULAR CRITICAL HEAT FLUX DATABASE CREATION

3.1. Introduction

In order to develop a new tool for the prediction of CHF in annular geometries it is necessary to have a database of experimental results. The ideal procedure for generating this database would be to enter the laboratory and systematically obtain all the data points that are necessary and sufficient to produce a quality predictive tool. Unfortunately, the laboratory work involved to accomplish this is a difficult, expensive, and time-consuming task. To obtain data at the high pressures of operating nuclear reactors is a difficult engineering design problem. This high pressure test equipment would be difficult to use for the low pressure tests as measurement of local superheating, phase velocities, and void fraction for this wide a range of conditions is not ideal. It is truly beyond the scope of this work to create an all-encompassing CHF database through experimentation.

How then can this data be obtained? The answer is to gather as much data on experiments already performed and available to the public. Unfortunately, many CHF experiments have been performed and maintained as proprietary information due to conceptual fuel designs or current commercially available reactor fuel. However, several reports from various universities and government laboratories are available which contain annular CHF experimental data.

After an extensive literature review, several potential sources of data were located. Not all reports could be obtained either due to limited distribution of the original document or the age of the report. However, 18 sources were obtained and placed into a database for use in the CHF predictive tool generation phase. This data was processed to obtain a consistent set of units, providing the final, usable annular CHF database.

3.2. Criteria for Selection of Data

The criteria used to select the data fall out under the definition of the problem we are trying to solve. With regards to geometry it must be a uniform annular flow cross-section in contact with two smooth walls. Rough wall data, non-annular geometry, or eccentric cross-section data will not be accepted. The wall heating must be located on the inner wall and be uniform. No outer wall heating, bilateral heating, or non-uniform heating will be allowed. The fluid used in the experiments will be water, not heavy water or a refrigerant fluid. It is not entirely clear what affect heavy water may have on CHF, so it will be omitted out of caution. Lastly, the presence of heat transfer enhancement devices such as fins or spacers will not be allowed. Groeneveld[9] in his look-up table applies a correction factor to account for the effects of spacers on CHF rather than including it in the look-up table itself. Spacers vary widely in their geometry and therefore there effect on CHF. It is difficult to a priori know how much the spacers in the experiments affect the results, so they will be ignored.

3.3. NPR Tube-in-Tube Experiments

In 1963, experiments were performed by workers at United Nuclear Industries, Inc. to determine the CHF values for N-Reactor fuel.[14] This fuel is composed of two rings of fuel placed in a tube in which flow passes through three channels. These three channels are the central flow channel, the inner annulus, and the outer annulus. As the concern is for annular geometry, the central flow channel was neglected. In addition, the inner annulus is bilaterally heated, due to its placement between the fuel rings, and was therefore neglected. This left only the data for the outer annulus.

Data was collected for two pressure locations, 1000 and 1500 psig, based upon the operating parameters of the reactor. Only subcooled data was generated since voiding in the N-Reactor fuel was prevented by using graphite as the moderator. The mass flux was allowed to vary between experimental runs giving some breadth in the data. In total only 55 data points were usable from the hundreds of data points reported.

3.4. Argonne National Laboratory Experiments

In 1982, researchers at Argonne National Laboratory performed experiments on CHF in annular geometry for a vertical test section.[19] The main emphasis of this work was to explore CHF under low flow and low pressure conditions. The test section was transparent in order to use visualization as well as instrumentation to record results. Special attention was given to flow rates that would simulate natural convection to investigate the CHF point and the rewet of the annulus as the heat flux was reduced.

A single geometry test section was used in these experiments, giving no information on how geometry would affect the results. In addition, the fluid was single-phase with varying degrees of subcooling. The mass flux was allowed to range from stagnant flow to 35 kg/m^2s. Out of a few hundred experimental runs, only 59 data points were reported, 8 of which were only partially reported. Therefore, only 51 data points were added to the usable database.

3.5. Savannah River Laboratory Experiments

In 1973, researchers at Savannah River Laboratory and Columbia University performed experiments to determine the difference in CHF between heavy water (D_2O) and light water (H_2O).[20] The experimenters even used different materials for the heated test section, stainless steel and aluminum. The data was primarily annular geometry, but a rectangular test section was also used. Again any non-annular geometry was ignored for the purposes of this database.

Three different annuli were used in the experiments; 0.5, 0.75, and 1.0 inches in diameter. Again only subcooled fluid was used in these experiments, though the degree of subcooling was allowed to vary. The velocity of the fluid varied between 15-60 ft/sec and was maintained for down flow or reverse flow conditions. Though heavy water was used in the experiments, it was deemed best not to include these values in the database. In addition, while examining the data there appeared to be a bad data point where other experimental data points with very similar conditions gave a very different value, so one data point was removed from those available. Therefore, 473 data points were obtained from this report.

3.6. CISE Experiments

In 1966, experimenters at the Centre for International Studies in Education (CISE) performed CHF experiments in both tubular and annular geometries.[21] The purpose behind the investigations was to "get a knowledge of the consequences of possible power, flow rate, or inlet quality variations large enough to bring the channel to (CHF)".

Though not specifically stated in the report, it is apparent that the experiments were designed to check safety margins for nuclear power plants either in design or operation.

The major benefit of these experiments to our database is that the experiments were run under two-phase conditions. Two hydraulic diameters were used, 0.201and 0.43 cm, which are smaller than most of the other experiments. The mass flux of the experiments varied from 70 to 300 kg/m^{2}s. The major drawback of this data is that spacers were present in the test section. This is probably due to the specific reactor design. Therefore, out of the 143 promising data results, none were actually used in the database, but rather they were kept for future reference.

3.7. General Electric Experiments

In 1961, the General Electric (GE) company conducted CHF experiments on annular test sections.[22] The purpose of the experiments was to investigate CHF for two-phase conditions and heat transfer coefficients for film boiling. This appears to be data supporting the development and operation of the boiling water reactors for the Atomic Energy Commissions safety assessment.

The data was collected for two annular geometries, 0.12 and 0.06 inch annular flow test sections. In addition, they investigated different two-phase qualities and mass flows. Two drawbacks are present in the data, one minor and the other major. The minor drawback is that the experiments were performed at only three pressure values, 800, 1100, and 1400 psi, corresponding to operational conditions of a reactor. The major drawback is that, much like the CISE report, the GE experimenters added spacers to the test section. So again the 185 reported results were not included in the database, though they are maintained for future reference.

3.8. AB Atomenergi Experiments

In 1965, the AB Atomenergi company collected all the experimental data it had obtained over the past few years regarding CHF and compiled them into one document.[23] This document tells little about the original experiments except that they were performed for tubes, annuli, and rod clusters. The purpose was to create a database of their data in order to help develop tools for prediction. The total database contains 5897 data points.

Again out of this large database it is possible to use only that data which matches the needs of annular unilateral heating. Therefore, the entire tube and rod cluster data set was ignored. In addition, some of the annular data reported was for heating of the outer wall rather than for the inner wall, so this data was also ignored. Finally, there was an instance where two data points had identical CHF results with the differences in the conditions being so small that they easily fall in the range of instrument error. These points were considered to be a duplicate of each other and one of them removed. Ultimately, 246 data points of various geometries, mass flows, and two-phase qualities were obtained.

3.9. Barnett Collection

In 1966, P.G. Barnett attempted to create a general correction for CHF in annular and rod clusters.[24] The reason that this correlation is not used is that the relevant fluid flow heat transfer physics is absent in the model. In addition, experiments of light water and heavy water were mixed in the creation of the correlation, making it suspect. However, in generating the correlation the database of values used was supplied.

The references used by P.G. Barnett were tracked down and several of them were found and included in this database. Unfortunately, not all the reports were available. Data points from unavailable sources were included if they were applicable to this problem. All data specifically related to heavy water was removed in addition to the duplicate data already obtained directly from the original source reports. After removing all these data points, a total of 51 points remained. Further examination showed that 3 data points were duplicates of the same variable conditions as other points. So after removing the duplicate values, 48 data points were added to the database. These are the most speculative data in this database, as it is unknown whether these experiments contain spacers or other geometric enhancers. However, the data appears to be in line with the other values. The data contains various flow test diameters and two-phase conditions.

3.10. General Electric Later Experiments

In 1963, the General Electric (GE) company conducted additional CHF experiments on annular test sections.[25] The purpose of the experiments was to validate CHF correlations in use and to explore various geometry modifications. The geometry tested was an annulus, an eccentric annulus, an annulus with spacer, a roughened outer wall, and a roughened inner wall annulus. By first appearances the solitary annulus section should be useable for our purposes. However, it was noticed that the experimenters were controlling the flow distribution by using an inlet restrictor. This was done in response to the variation in the tube flow seen during flow distribution investigations. A possible source of the misdistributions in flow could have been due to the spacer pins used to hold the test section in place. Due to these flow distribution problems it was decided to not use the 615 reported annulus results.

3.11. Columbia University Experiments

In 1965, researchers at Columbia University conducted annular CHF experiments in support of a fuel design called "Shell-in-Tube" for heavy water reactors.[26] Fortunately for this body of work, the experiments were conducted using light water, at a singular pressure of 1000 psia, for various geometrical test sections. They investigated the effects of hydraulic diameter on CHF as well as other geometrical considerations such as flow eccentricity and uneven heat distribution. From almost 200 data points in the report, it was possible to keep 140 data points that were strictly annular. The data contained various flow rates around 1.0×10^6 lbm/ft^2-hr and two-phase qualities.

3.12. Early Savannah River Laboratory Experiments

In 1964, Savannah River Laboratory conducted experiments in support of specific reactor fuel.[12] The purpose behind the work was to develop an empirical correlation for use in safety work. This correlation has been previously discussed in Section 2.3.2, so it will not be discussed here.

The benefit of these experiments to the database is low pressure down flow. These experiments were conducted entirely in downward flow conditions with a glass outer tube that was varied in size to produce different hydraulic diameters. Data was also included for a flat plate experiment, but this was ignored for the database. Also, the Columbia University data set was presented, but not re-entered, as the data already exists in the new database. In total, 71 data points were obtained from this report.

3.13. Barnett's Later Work

In 1968, P.G. Barnett re-examined the work he previously completed.[27] The purpose of the report was to compare contemporary CHF correlations of annuli and rod bundles to known experimental data. Five different correlations were examined and compared to a dataset that Barnett compiled. For the purposes of the new database, the report includes data from sources that are no longer available and are different than his previous work.

Fortunately the CHF data for the annular geometry was reported separately from the data of the rod bundles. Again we are confronted with the problem of not having a description of the original experimental set-up, so it is possible that unknown geometric additions could be present, but the data does not tend to suggest that conclusion. A duplicate data point was found in this report, so it was only entered once into the database. After removing the rod bundle data and all the previously reported data a total of 78 data points were added.

3.14. Little's Experiments

In 1970, R.B. Little conducted experiments on internally heated annuli with variations of axial power profile.[28] The purpose of this experimental work was to examine the effect of non-uniform heating on CHF in annuli. The experiments were conducted with a single test geometry and under two pressure values. The mass flux was maintained between 1 and 3 lbm/ft^2-hr and the water was always subcooled. The major problem with this data set is that Little used spacers to keep the heated rod centrally located in the channel. Additionally, the non-uniform heating data is unusable since the location of dryout is impacted by this non-uniformity. Due to these problems the 308 data points of uniformly heated experiments could not be added to the usable database, but are available for future consideration.

3.15. Babcock and Wilcox Experiments

In 1967, experimenters at Babcock and Wilcox performed CHF experiments with annular geometry.[29] The purpose of the investigation was to explore the effect of non-uniform heating on CHF values. Data was collected for a single test geometry under both uniform and non-uniform heating under a few water conditions. Three pressures, 1000, 1500, and 2000 psia, three mass fluxes, 0.5, 1.5, and 2.5 lbm/ft^2-hr, and four values of subcooling, 20, 50, 100, and 150 ^oF were used in the experimental series. In addition to non-uniform heating, the experimenters also performed bilateral heating and outside wall unilateral heating. The only data added to the database was the internal wall unilateral uniform heated results. This added a total of 127 data points to the database.

3.16. Australian Atomic Energy Commission Research

In 1969, experimenters for the Australian Atomic Energy Commission performed a series of CHF experiments with a smooth annulus and a rough annulus.[30] As might be gathered, the purpose of this experimental series was to see how the surface roughness of the inner wall effects the CHF point. For the purposes of this database only the smooth wall data was used. Only one test geometry was used in the experiments, a hydraulic diameter of 10 mm, but the other conditions of the test were varied. Another limitation of the experiments is that the liquid was always subcooled, from 0 to 150 °C. The pressure range tended to be roughly in the middle between atmospheric to operational for a reactor. The mass flux varied between 250 and 3500 kg/m^2-s. In total 211 data points were used for the database.

3.17. Chalk River Experimental Series

In 1970, experimenters at Chalk River Laboratories conducted experiments on short and long test sections with regards to annular-dispersed flow and CHF.[31] The purpose of the experiment series was to develop models for the deposition of droplets in dispersed-annular flow onto tube walls, the film thickness, and the entrainment of fluid into the vapor core. Secondarily, the researchers measured CHF to determine the dryout location on the inner annulus wall.

Two geometries were used in the experimental series, a long test section and a short test section. Unfortunately the long test section required spacers to keep the heated rod in place within the test section. Fortunately, the short test section needed no spacers and was useable in our database. The pressure used was either 500 or 1000 psia, but the mass flux and the quality of the two-phase mixture varied throughout the tests. In all, 111 data points were added to the database from this test series.

3.18. Additional General Electric Experimental Results

In 1965, General Electric reported another short experimental set of results.[32] The purpose of the experiment was to observe the effect upon CHF of adding a heat transfer enhancement device, fins. The tests were conducted with a single hydraulic diameter (0.375 in), a single pressure (1000 psia), and two mass fluxes (0.5×10^6 and 1.0×10^6 lbm/ft^2-hr). The two-phase quality was varied to give some range to the values. If the fin experiments are thrown out, then 53 data points remain to be added to the database.

3.19. United Kingdom Atomic Energy Authority Experiments

In 1964, investigators in the United Kingdom Atomic Energy Authority performed a few experiments to investigate two-phase CHF in an annulus.[33] Using an existing heat transfer loop experimental set-up, the investigators made a few easy modifications to allow for the detection of CHF in an annulus. Two sets of experiments were performed at different pressures, 500 and 1000 psia. For each of these pressures, the quality was varied while maintaining a two-phase velocity of roughly 0.56×10^6 lbm/ft^2-hr. No difficulties were found with this data set, so the entire 21 data points were added to the database.

3.20. United States Atomic Energy Commission Research

In 1963, the United States Atomic Energy Commission (now the Nuclear Regulatory Commission) published a report on annular CHF.[34] The purpose of the experiments was to determine the effect of non-uniform heat flux on CHF values. As is expected the vast majority of the data present in the report is for various non-uniform power profiles. However, a uniform profile was developed as a baseline and is usable for this database. The data set is limited in that a single test geometry was used and only a pressure of 1000 psia was considered. The mass flux and the two-phase quality of the fluid was varied. In total, 48 data points were added to the database from this report.

3.21. Database Compilation

Once all the data was gathered from these 18 sources, it was entered into a database in the originally reported units. This made it easy to perform a quality assurance check on the data to ensure that any inaccurate data entries could be found and corrected.

This compilation of raw data is not useful in the creation of a new predictive tool. There is a mixture of English and International System of Units (SI) in the various reports. Some authors report quality for two-phase flow, others report void fraction, while still others report only enthalpy. This raw data needed to be conditioned to create a standardized system of independent variables in a common unit system. Eleven independent variables where chosen to accurately show the test geometry and the fluid/vapor physical state. The variables chosen were pressure, quality, mass flux, hydraulic diameter, heated diameter, heated length, inlet subcooling enthalpy, latent heat of vaporization, density of liquid, density of vapor, and surface tension. The values of these quantities were either explicitly stated in the reports, implicitly determined from the reported information, or determined through the use of the American Society of Mechanical Engineering (ASME) Steam Tables. The common units were chosen to be the SI unit system. This resulted in a database of CHF with regards to the eleven independent variables in the SI unit system containing 1630 data points. This database is given in its entirety in the Appendix.

A couple items of note with regard to mass flux should be noted. Negative mass flux is considered to be down flow and positive mass flux is considered to be up flow. In addition, there exists no information for zero mass flux or pool boiling. Under pool boiling conditions there exists several well documented correlations that would provide estimates of CHF values. Groeneveld[9] used pool boiling correlations to complete the data in that look-up table for zero mass flux.

4. THE USE OF SHEPARD'S METHOD TO GENERATE AN ANNULAR GEOMETRY CRITICAL HEAT FLUX LOOKUP TABLE

4.1. Introduction

Now that a database has been created of annular geometry critical heat flux experimental values, a methodology of prediction needs to be decided upon. Examination of the trends in the database will give an indication of what technique will be best to use. Then a technique of prediction is used to create the new tool needed. Finally, a summary of the applicability and limitations of the new tool will be discussed.

4.2. Annular CHF Database Examination

Before starting to explore the techniques used to generate a new predictive tool for annular CHF, it is necessary to examine the database from which the result will be obtained. The database is composed of data from 18 publications and contains 11 independent variables. If CHF is plotted as a function of each of the independent variables, a mix of results is found. Some of the independent variables, such as quality, are nicely distributed over the range of CHF as shown in Figure 4.1. Other independent variables are segmented over the range of CHF, such as pressure as shown in Figure 4.2. The consequences of this unstructured data configuration limit the techniques that may be employed in the estimation of CHF. It was originally hoped that splines could be used to generate a geometrical representation of the CHF database to model the local fluctuations. However, since the data is highly segmented as a function of some of

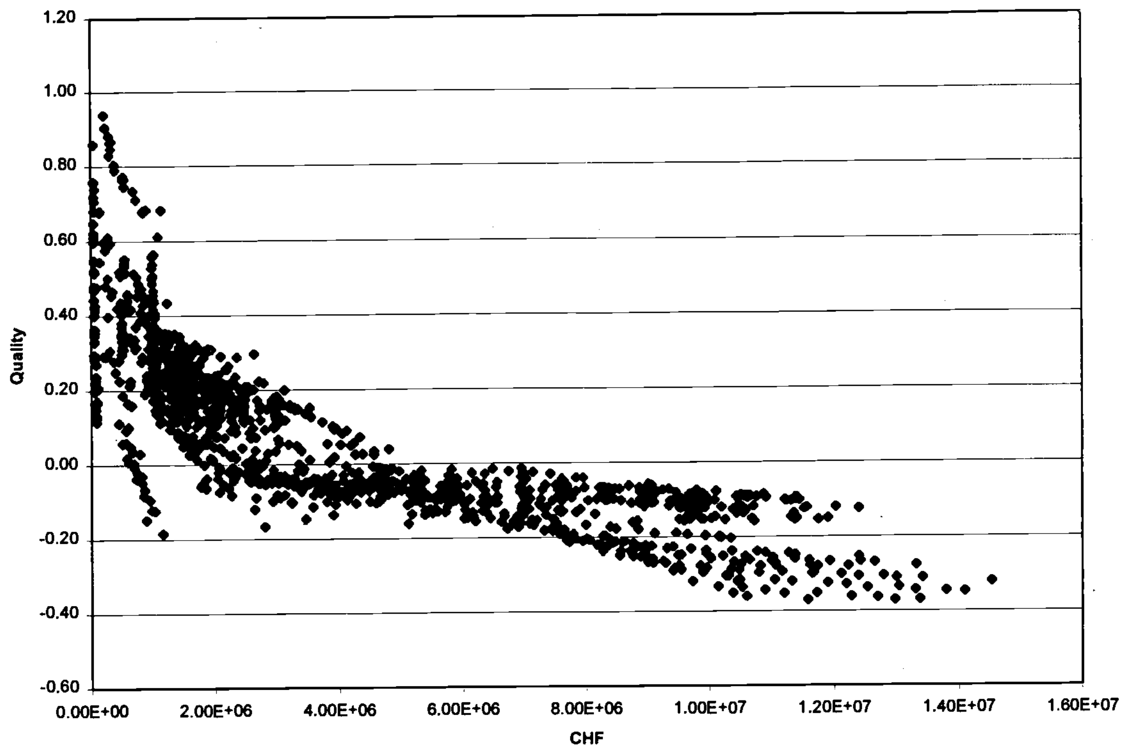

Figure 4.1 – Quality verses Critical Heat Flux

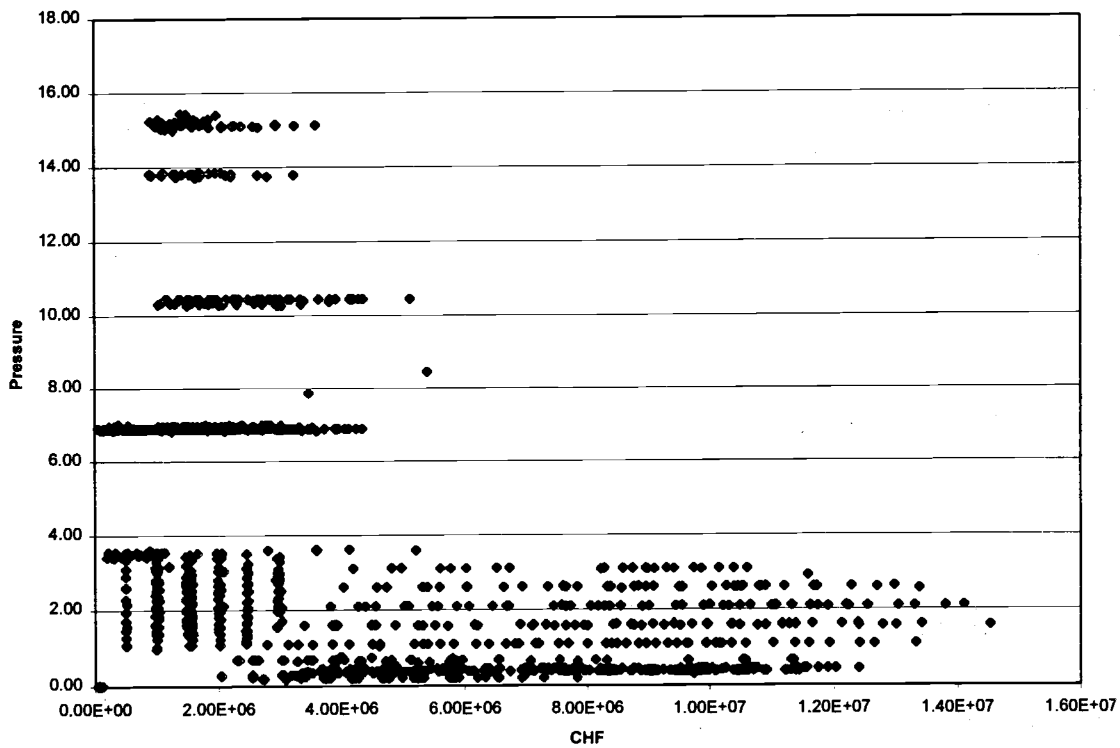

Figure 4.2 – Pressure verses Critical Heat Flux

the independent variables, it is impossible to generate a multidimensional spline. The reason for this is that there is too much distance between data points for the spline formulations to have a single solution, causing divergence.

One technique that is able to handle the segmented data is a look-up table. A look-up table can be considered to be a series of points in the three independent variables that were reported. This series of points can also be called a mesh of points. Two types of meshes can exist, either structured (i.e. equidistant) or unstructured (i.e. variable distances between data points). Structured meshes are easier for computer codes to work with due to their predictable nature. It would be possible to create an unstructured mesh of the current database, but it would significantly slow computation time due to the need to find the portion of the table which bounds the data point desired.

It is also possible to develop a new correlation from the data available, but this process is full of pitfalls. As we have previously discussed, it is possible to correlate the data given statistical techniques, but this provides little physical information or theoretical support. A look-up table has the advantage over correlations that the local information can be maintained in addition to the trends along constant variable lines.

4.3. Generation of Structured Mesh using Shepard's Method

4.3.1. Method Determination

To create a structured mesh from an unstructured group of data points, an interpolation routine needs to be used to generate the "missing information". What "missing" means is that the value in close proximity is known (or not so close proximity) from the experimental data, but the value at the exact location is not known. Therefore, interpolation between known points must occur to generate the "missing information".

Several techniques are available to be used to interpolate data; linear interpolation, radial interpolation, triangulations, etc. Which technique is best depends upon what the problem is and the geometry of the domain in question. The method that was chosen for this body of work was Shepard's Method. This method provides better accuracy than linear interpolation for non-linear functions (such as CHF predictions), but is not so geometrically complex that the lack of sufficient data causes solution problems.

Shepard's Method has been used as a predictive tool in other fields such as oil exploration, color film processing, and physics, but to date has not been used in the evaluation of CHF.[7] In fact, no geometric technique has been used to determine CHF in a general system. Previous look-up tables have been compiled using parametric and asymptotic trends of the variables in the local range.[9] It is believed that geometric theory can improve upon this interpolation by creating reproducibility and a reduction in the error.

Simply described, Shepard's Method is a point scheme where values are generated based upon inverse square weights of the distance between points. A complete description of this method can be found in Alfeld[7] and in Barnhill[8]. A multivariate form of Shepard's Method can be used to interpolate between the data points using as coarse (few mesh points between the domain limits) or as fine (many mesh points between the domain limits) a mesh as is desired.

4.3.2. Database Preparation for use with Shepard's Method

One other consideration must be taken into account before the analysis can be performed. The database has nine independent variables, which was very useful for the statistical analysis. However, for every variable the look-up table uses, that is one additional direction in the array that must be stored and the final neighboring values found during run time. For instance if a course mesh of 5 points between the domain limits is used, a nine variable look-up table would have approximately 2 million entries. A four variable look-up table with 5 points between the domain limits would have 625 entries by comparison. A rather large difference, especially since 5 mesh points do not provide much detail of a function in a particular direction. Previous look-up tables have used three values for their analysis[9]; pressure, quality, and mass flow. Then after the "base" value was calculated, correction factors were applied to account for problem specific geometry. With recent significant advances in computing power a fourth variable can be included in this analysis, hydraulic diameter.

Hydraulic diameter is an important parameter for annuli because it helps determine the shear stresses and their distribution between the surfaces, the distribution of the droplet deposition between the surfaces, and differences in entrainment rates from liquid films flowing along concave and convex surfaces. The presence of a second surface in the annulus dramatically changes the body forces acting on the fluid. With especially small hydraulic diameters, it is possible for heated boundary layers to interfere with one another (inside wall and outside wall) allowing CHF to occur at lower heat fluxes than for tubes.

4.3.3. Initial Results of Interpolation

Using Shepard's Method and the data of the four independent variables, various mesh sizes where calculated to determine trends in the analysis and to attempt to find an optimum result. Figures 4.3 thorough 4.12 show the results as the mesh is refined in each of the four variables. The nomenclature used in the graphs is to identify the number of mesh points in each of the four variables starting with flow rate, followed by pressure, quality, and hydraulic diameter. Therefore, a (5,5,10,5) designation would state that there are 5 mesh points in the flow rate, pressure, and hydraulic diameter variables and 10 mesh points in the quality variable.

As each of the variables is individually refined, it is possible to note how this refinement effects the final result. The initial 5-point mesh shows that the results are

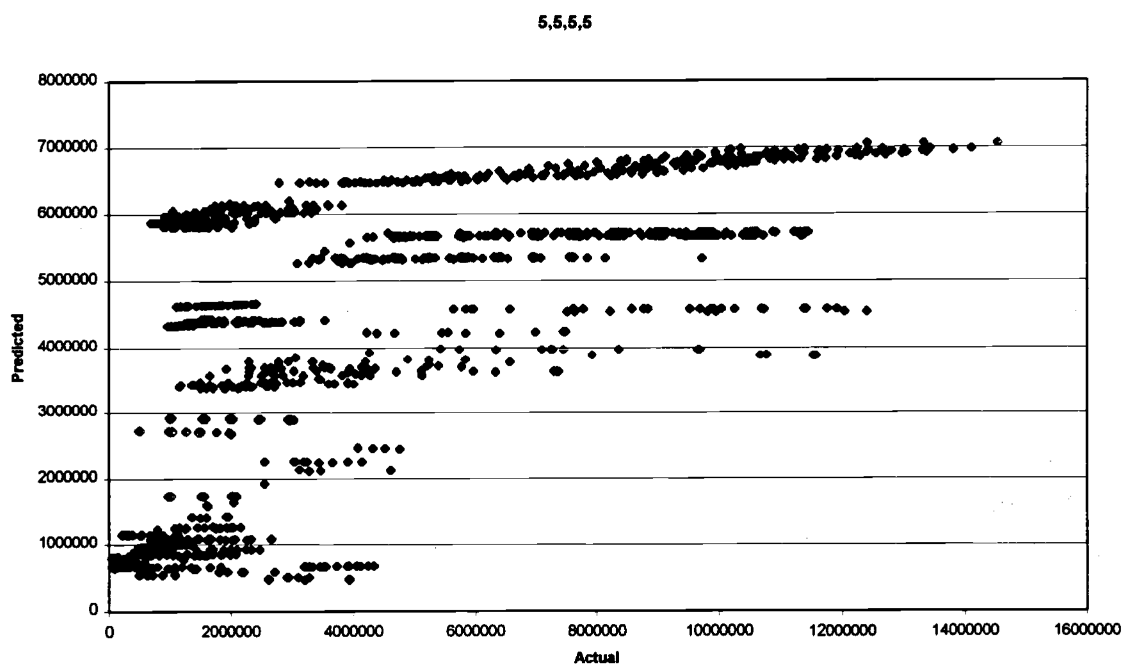

Figure 4.3 – Initial Shepard's Method Results (5,5,5,5)

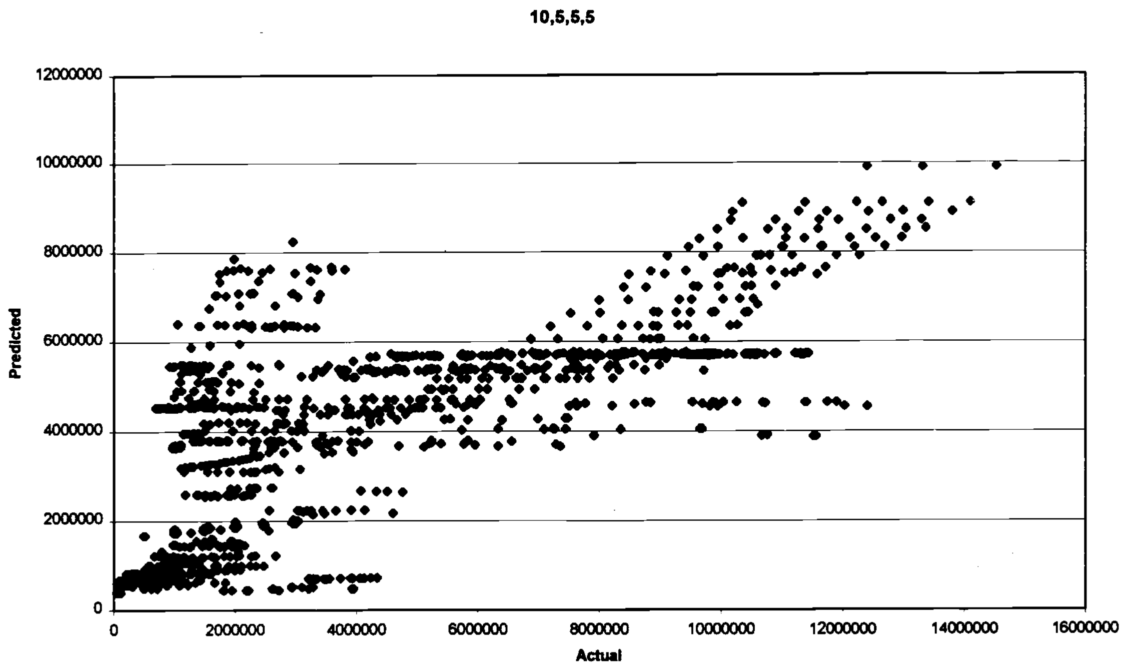

Figure 4.4 – Initial Shepard's Method Results (10,5,5,5)

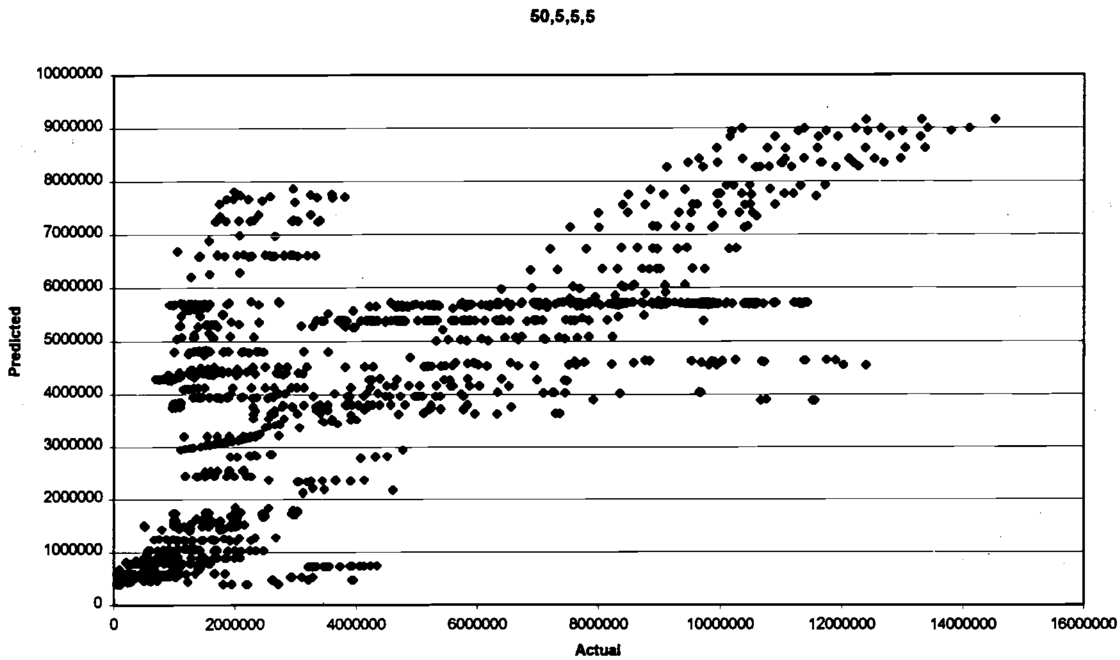

Figure 4.5 – Initial Shepard's Method Results (50,5,5,5)

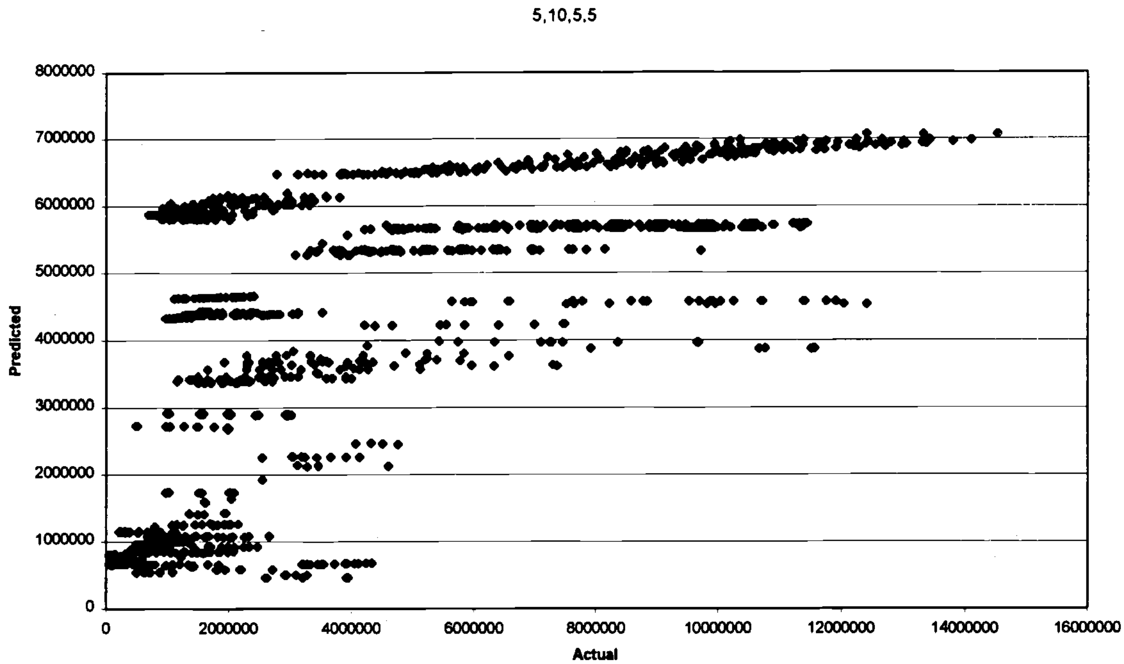

Figure 4.6 – Initial Shepard's Method Results (5,10,5,5)

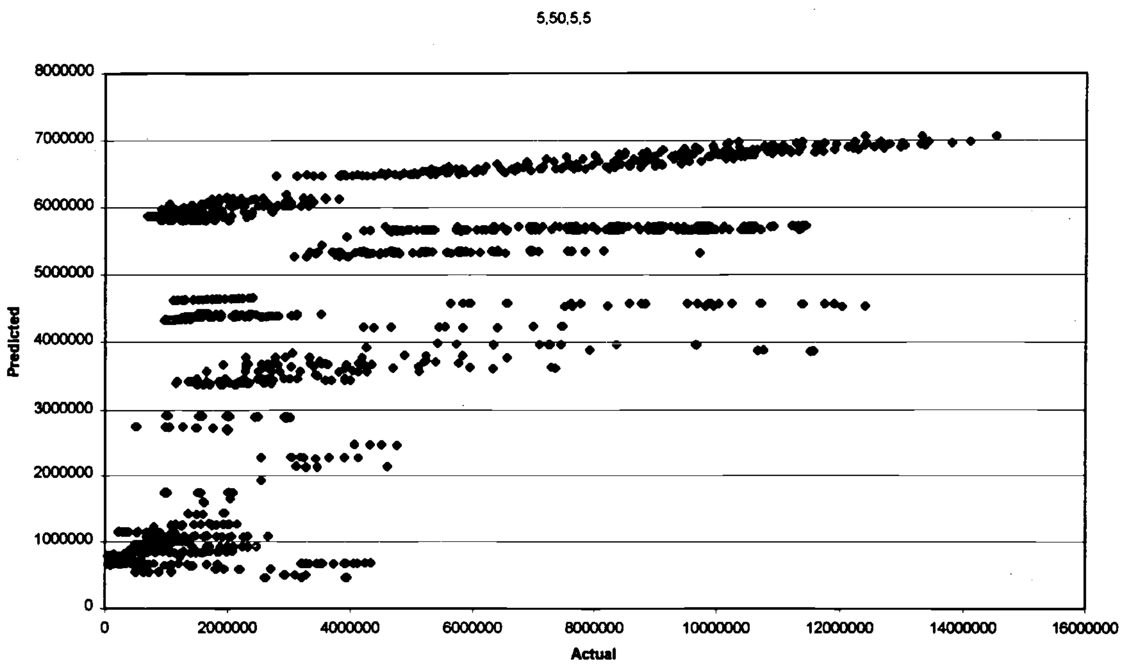

Figure 4.7 – Initial Shepard's Method Results (5,50,5,5)

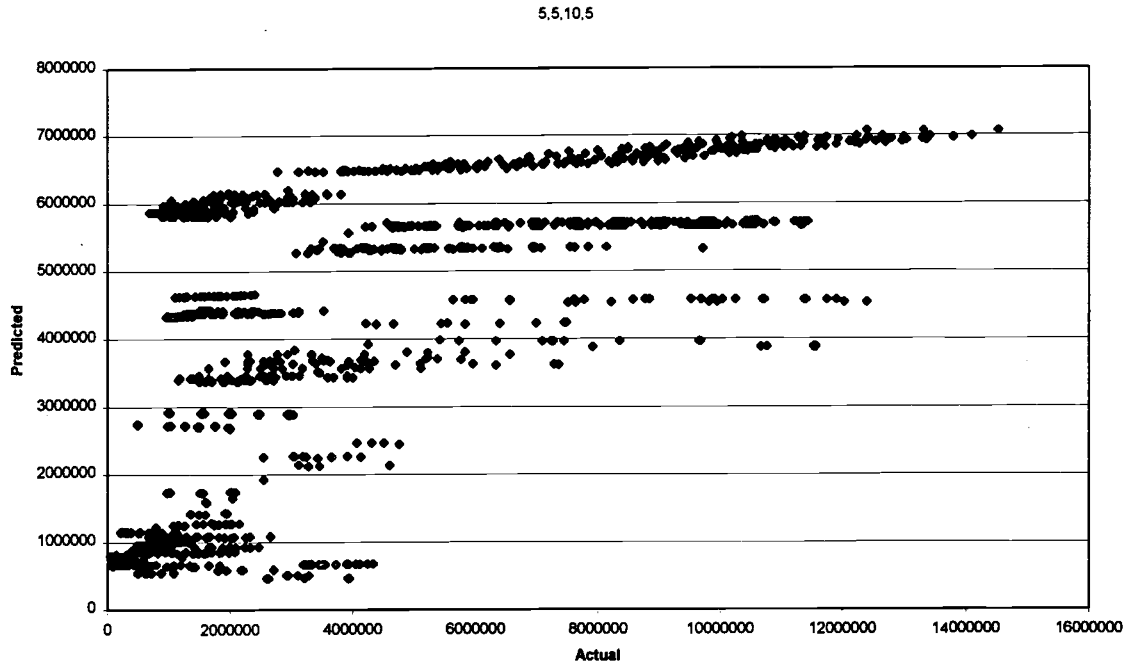

Figure 4.8 – Initial Shepard's Method Results (5,5,10,5)

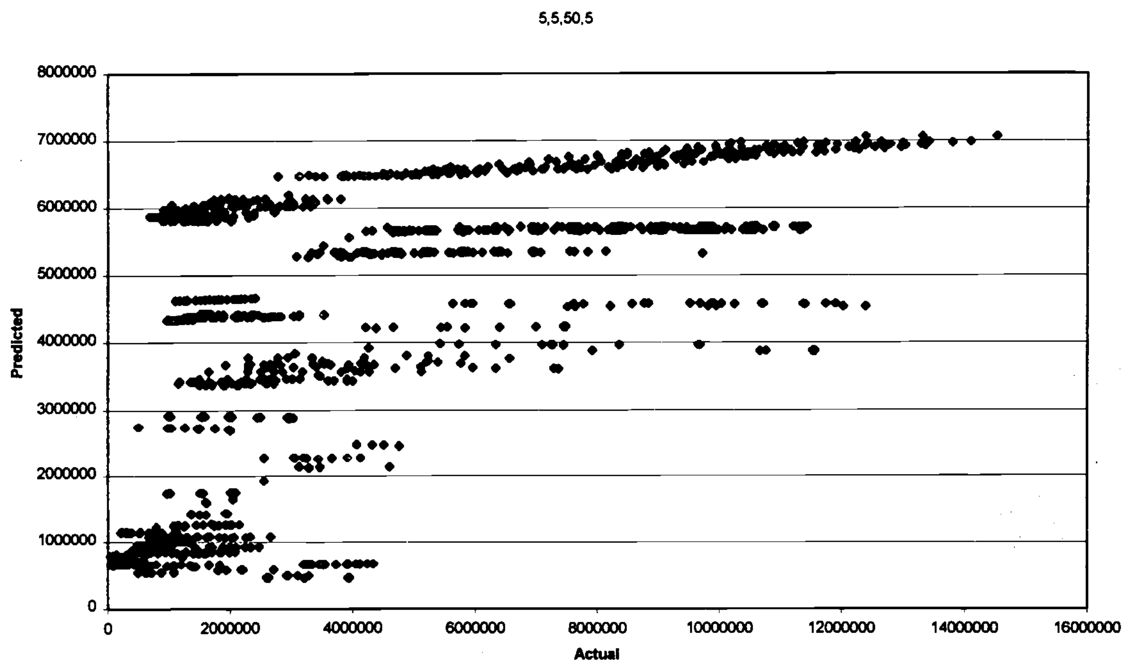

Figure 4.9 – Initial Shepard's Method Results (5,5,50,5)

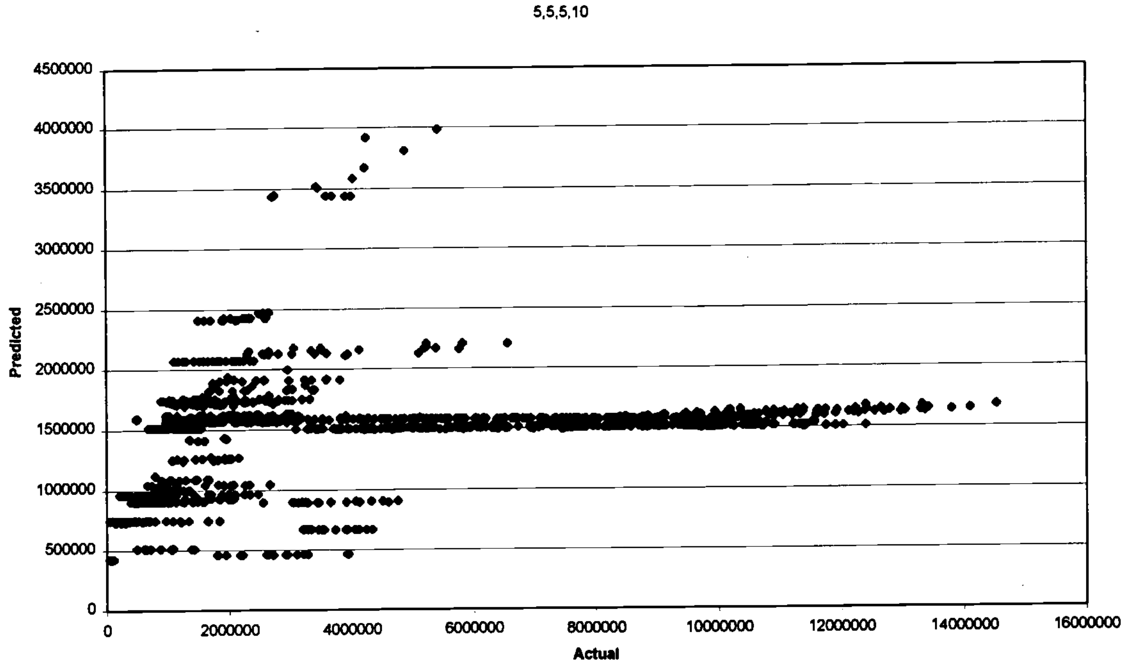

Figure 4.10 – Initial Shepard's Method Results (5,5,5,10)

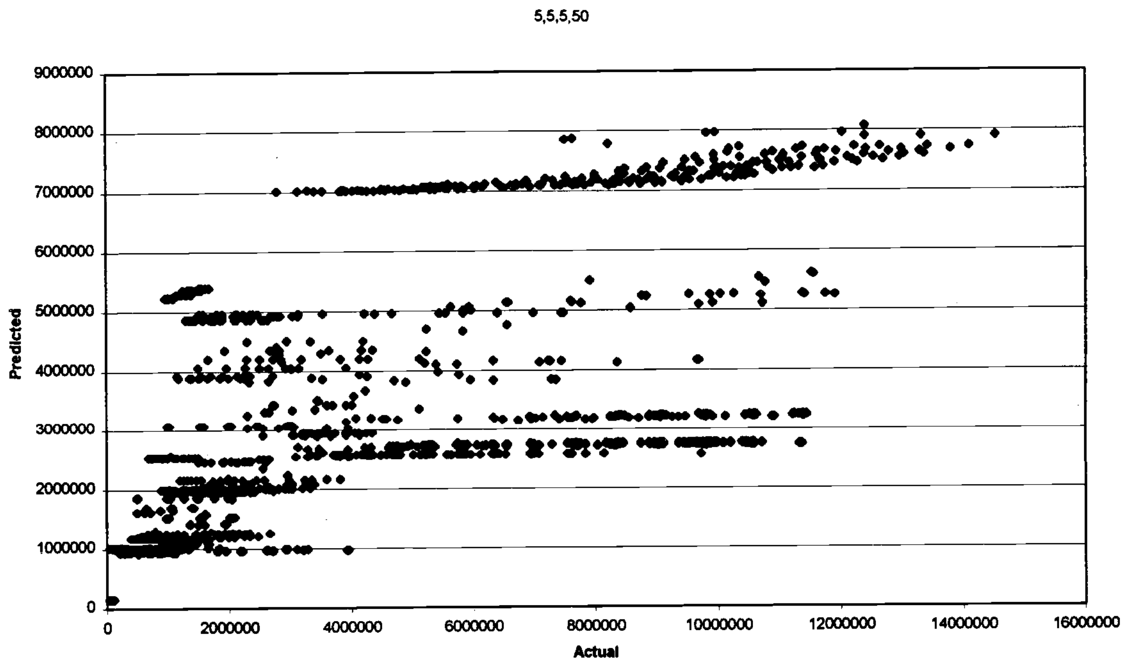

Figure 4.11 – Initial Shepard's Method Results (5,5,5,50)

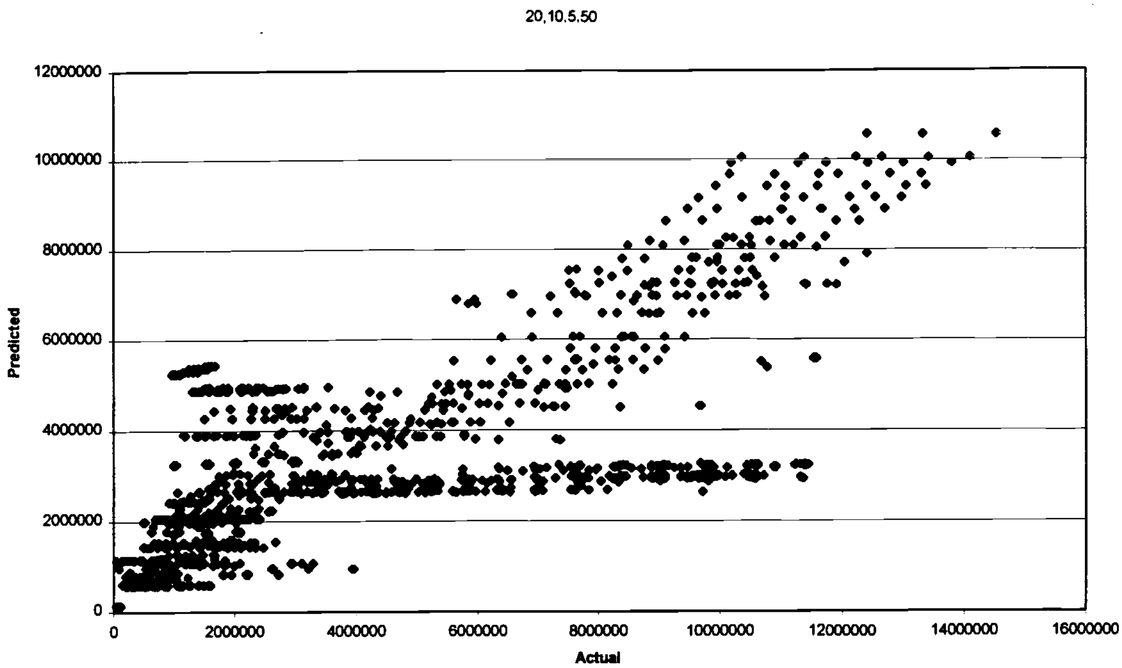

Figure 4.12 – Initial Shepard's Method Results (20,10,5,50)

highly segmented. In other words, it is possible to group the results into distinct sub-groups. As the flow rate variable is refined first to 10 points then to 50 points a major improvement is made. The data begins to collect along the diagonal (the true result line) and is no longer as distinctly grouped. This appears to be a variable where small mesh sizes are beneficial. The same is true for the hydraulic diameter variable. The original groups are broken up as the mesh becomes more refined in this direction.

Increasing resolution in the remaining two variables, pressure and quality, does not appreciably improve the accuracy of the predictions. Figures 4.6 through 4.9 are almost exact replicas of each other, which is very odd given the distribution of these two variables. Remembering the results of the database examination, quality was a distributed variable hydraulic diameter was segmented. It would be expected that an improvement in results should occur with a small mesh size for a distributed variable, as fewer data points would be contained in each increment. It would also be expected that for a segmented variable, leaps would only occur as the grouped data sets move from one increment to another. This however is not the case for these results. Figure 4.12 shows the "best" mesh for the initial results. (Here "best" is defined in a non-quantitative way, as achieving the lowest error while still maintaining a reasonable computational time.) This figure shows that the error in this calculation is quite large, especially in comparison to the correlations previously developed.

4.3.4. Exploration of Shepard's Method using a Known Function

4.3.4.1. Equal Variable Lengths

Given that the pervious results were very disappointing and counterintuitive, an exploration of the Shepard's Method is necessary. The effect of the independent variable mesh on the dependent variable must be explored, using known functions. The known function must have two properties to adequately test the method; non-linearity and data points whose distances from each other are not constant.

To make the investigation simple, a four variable function will be chosen that is the sum of the squares of the independent variables. In other words, $f(x,y,z,h) = x^2 + y^2 + z^2 + h^2$. Again to keep things simple, the values of the variables will be chosen such that they are all from the same set. In this case 10 points will be chosen (for 10,000 total database points) of increasing powers of 3 (i.e. $3^0, 3^1, 3^2, \ldots, 3^9$). Using the known database as the basis for Shepard's Method, the various mesh sizes for each of the four independent variables will then be calculated. The results should show that the changes due to mesh size are uniform as the mesh is increased in each of the four directions. It should also show that the result improves with an increasing number of mesh points. Figures 4.13 through 4.21 show the results of this calculation. The actual values represented on the graphs show the results of re-computing, using the known formula, the value at the mesh location determined through Shepard's Method.

The initial (5,5,5,5) result shows that the predicted results are higher than the actual values for the middle portion of the domain, while the ends (values less than 10^1 and greater than 10^9) are in line with the actual values. As the number of mesh points in each of the four variable directions is increased, the predicted values get pulled down toward

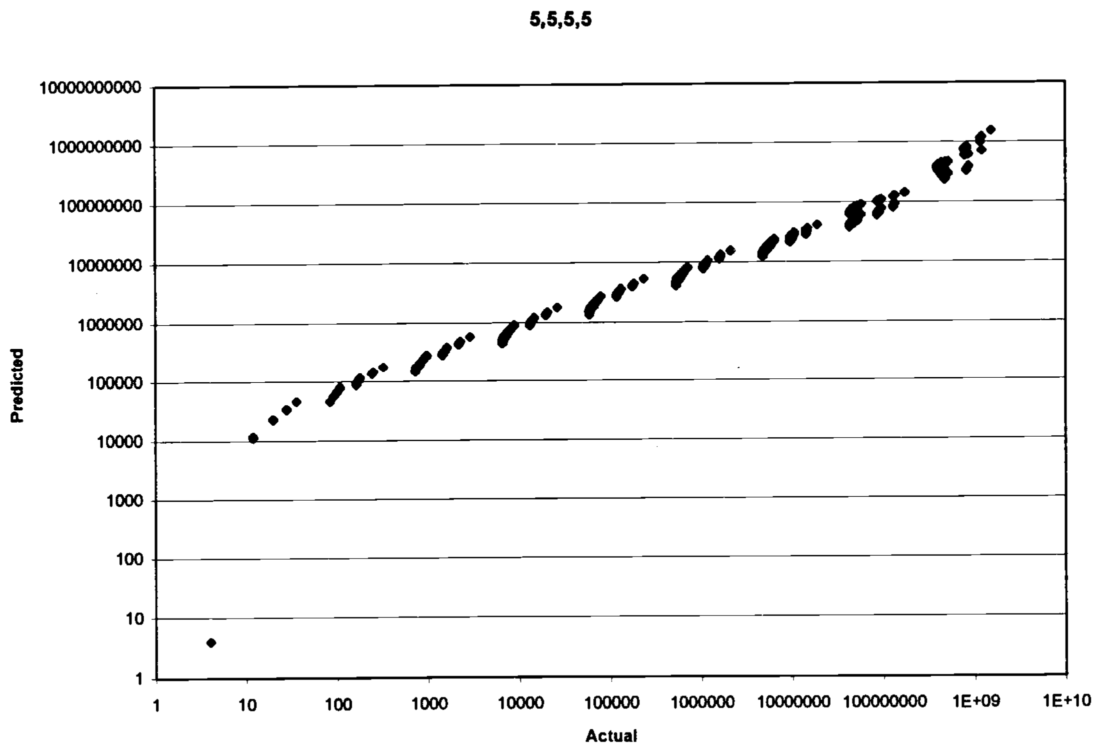

Figure 4.13 – Known Function Shepard's Method Result Equal Size (5,5,5,5)

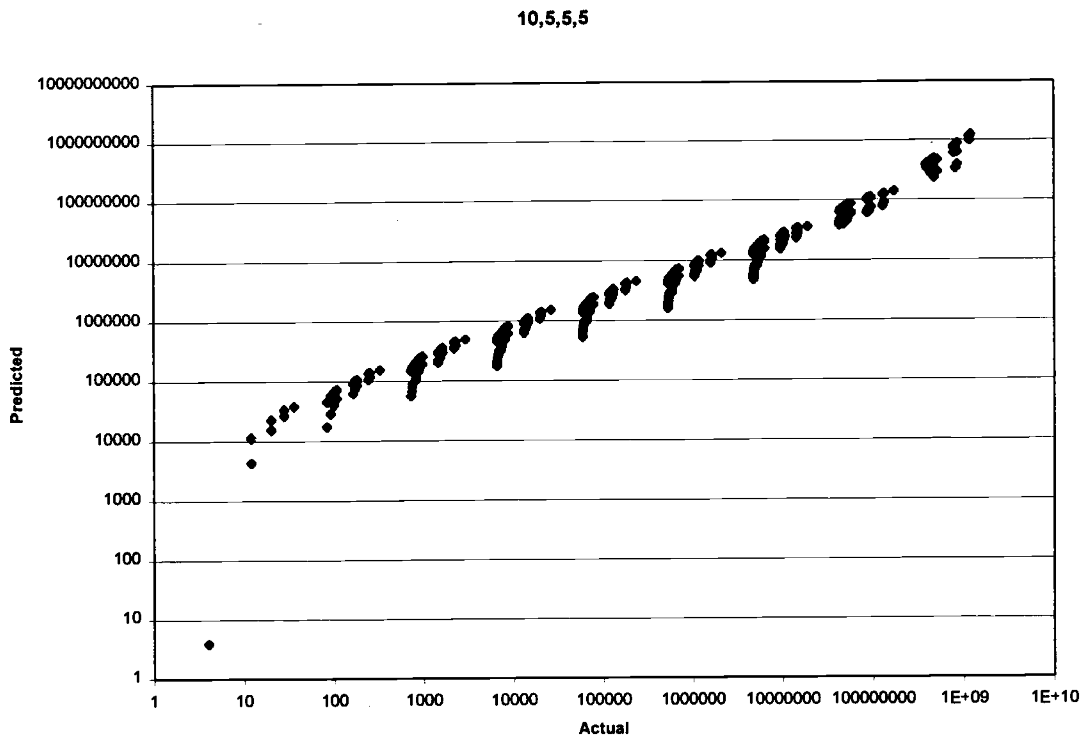

Figure 4.14 – Known Function Shepard's Method Result Equal Size (10,5,5,5)

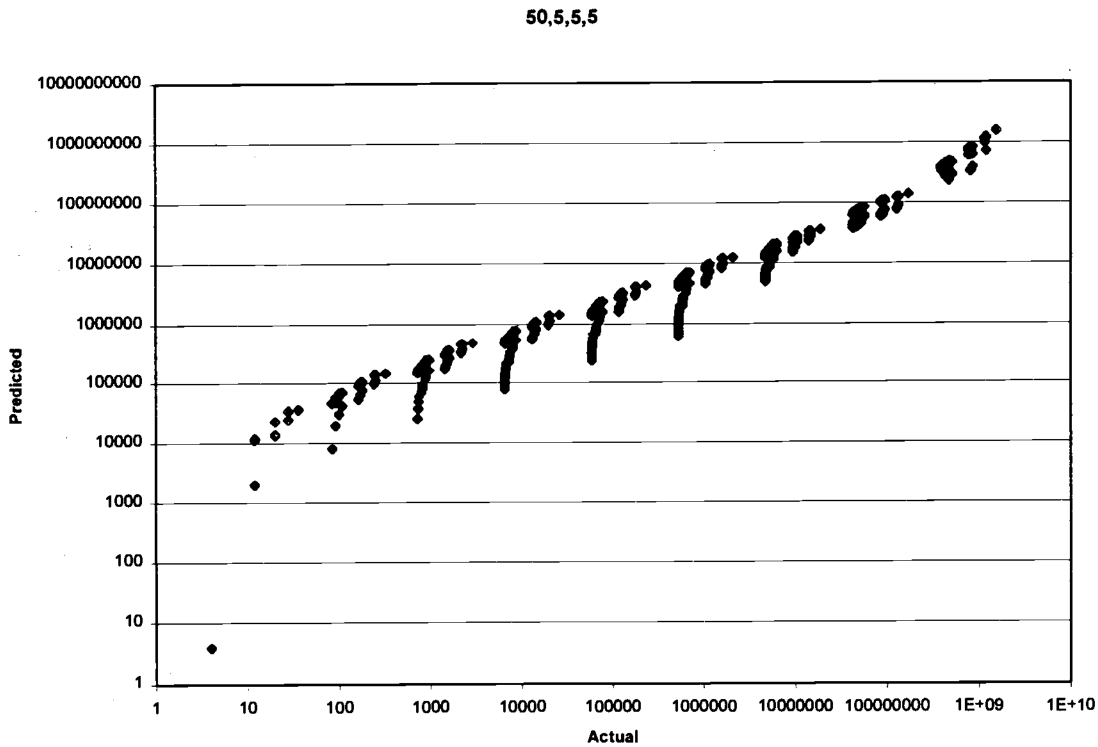

Figure 4.15 – Known Function Shepard's Method Result Equal Size (50,5,5,5)

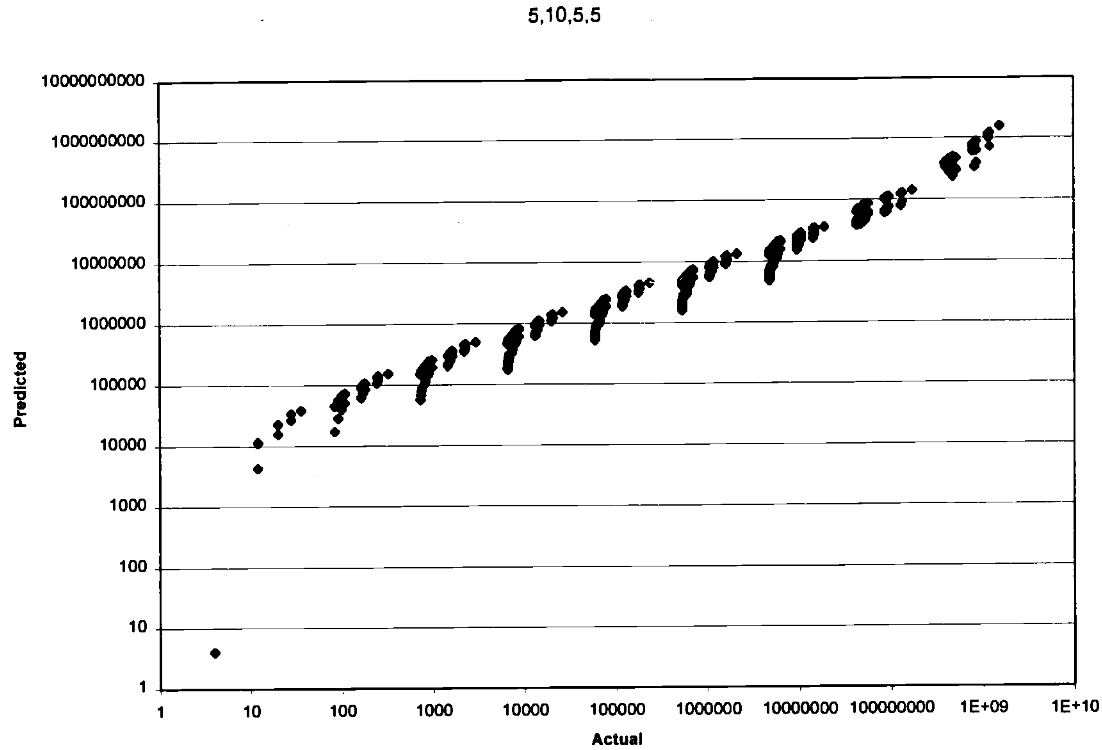

Figure 4.16 – Known Function Shepard's Method Result Equal Size (5,10,5,5)

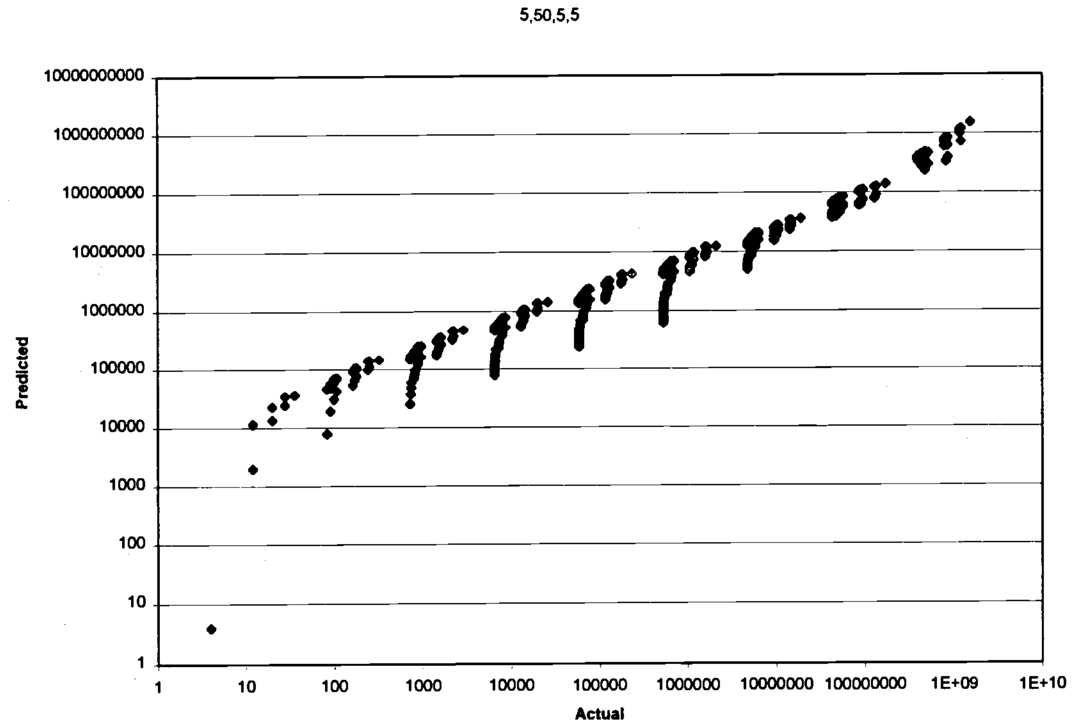

Figure 4.17 – Known Function Shepard's Method Result Equal Size (5,50,5,5)

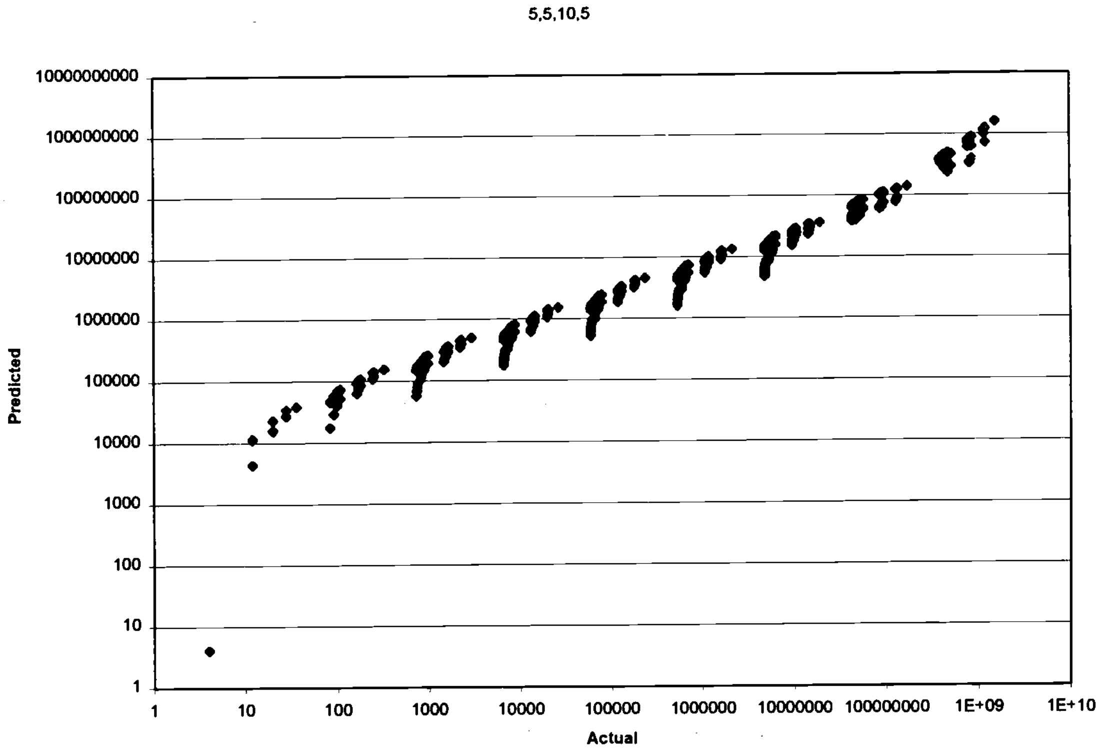

Figure 4.18 – Known Function Shepard's Method Result Equal Size (5,5,10,5)

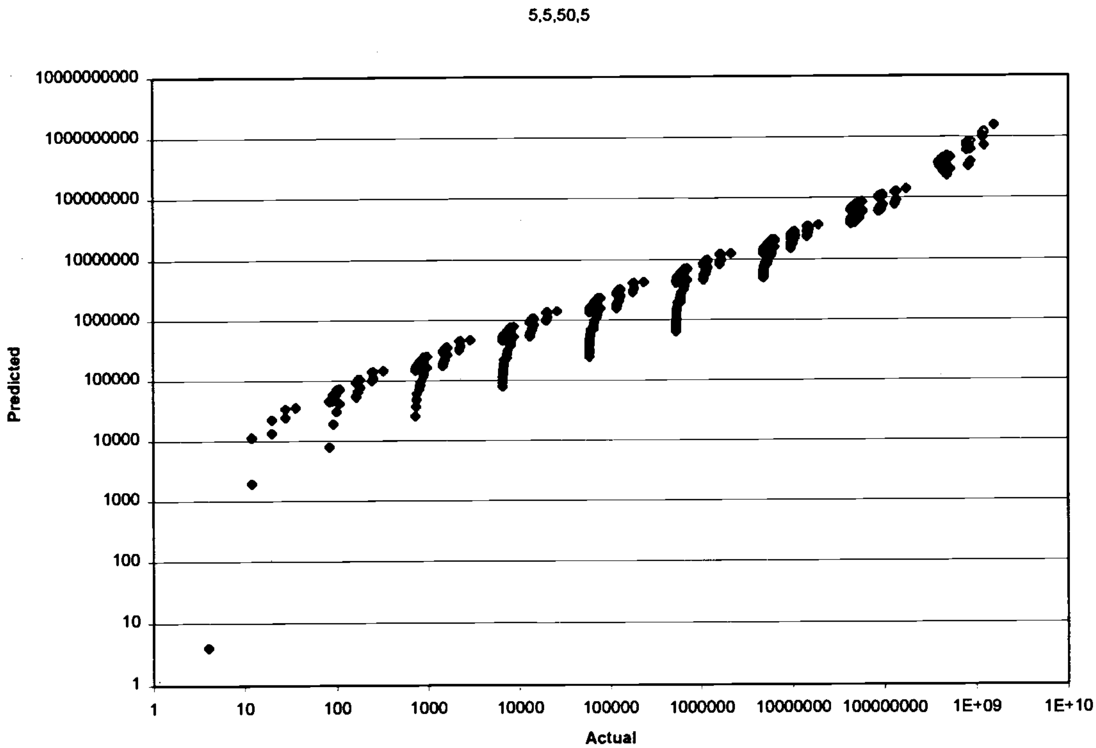

Figure 4.19 – Known Function Shepard's Method Result Equal Size (5,5,50,5)

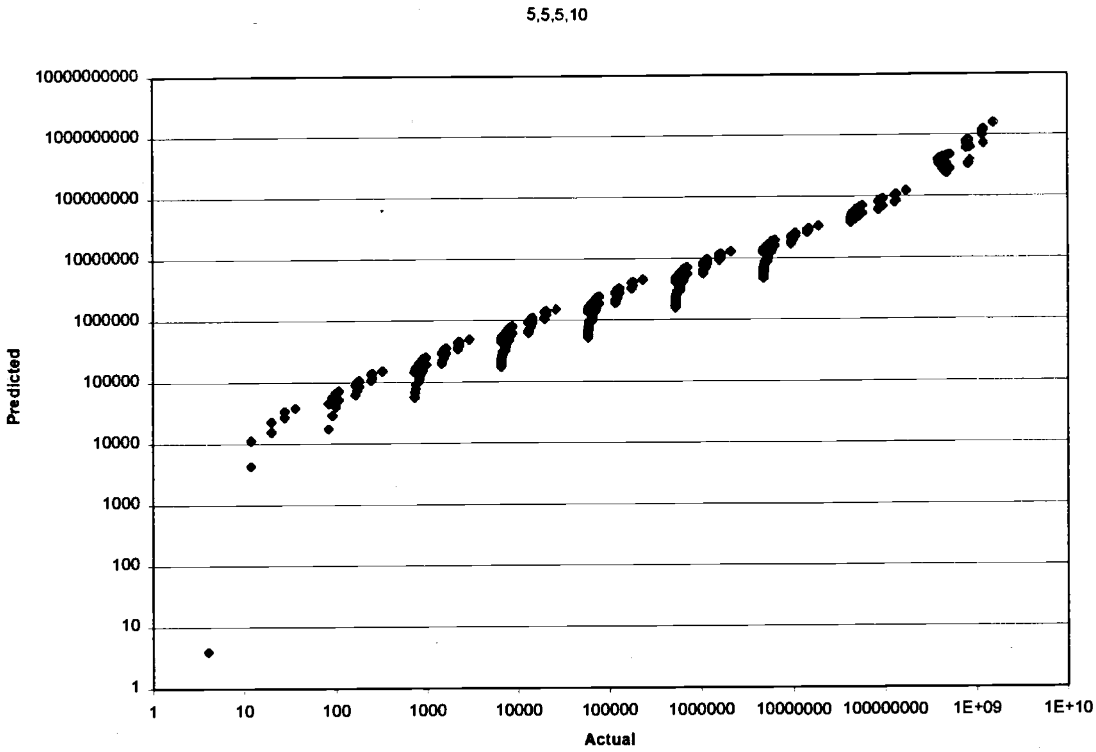

Figure 4.20 – Known Function Shepard's Method Result Equal Size (5,5,5,10)

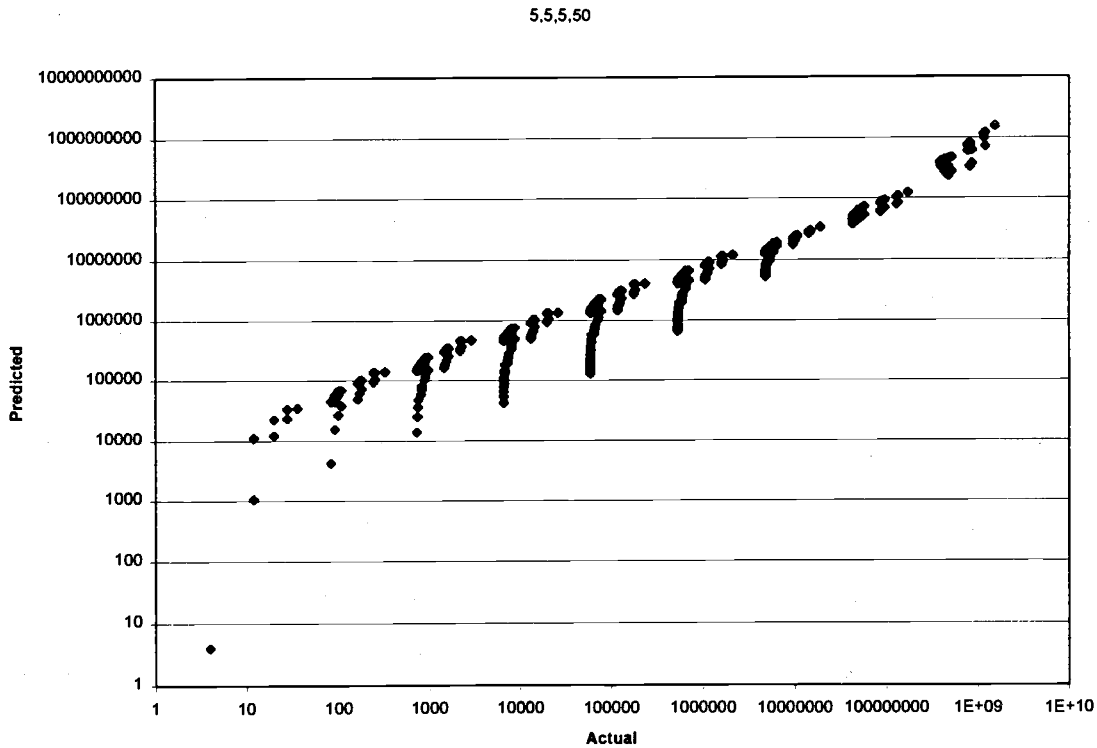

Figure 4.21 – Known Function Shepard's Method Result Equal Size (5,5,5,50)

the correct values. More importantly, each of the four variables has the exact same result. This is what would be expected to happen and gives confidence that the method is working correctly. However, this does not explain the insensitivity of the error to improved resolution in pressure and quality.

4.3.4.2. Differing Lengths

Next a formula where distance between values for the variables differs from one another will be explored. This is being explored because the method is based on an inverse square of the distances between points. The formula will remain essentially the same, $f(x,y,z,h) = (x^2 + y^2 + z^2 + h^2)/1000$, but the variable values will differ by four orders of magnitude. The first and the last two independent variables will maintain the same step size of powers of 3, but the second will be changed to ten equal sized steps between 0.1 and 1.0 (0.1, 0.2, 0.3 … 1.0). Figures 4.22 through 4.26 show the results of these calculations.

The results of the initial (5,5,5,5) mesh show very similar results to the equal length problem. The values for the ends ($<10^1$ and $>10^9$) are in fairly close agreement with the actual values. The results in the middle show that the method over predicts the function value. As the resolution of the first variable direction is increased, the result changes much as it did previously. The predicted values get drawn down toward the actual values, reducing the error in the results. When the resolution is increased in the second variable direction, no change in the results of the calculations is seen. The remaining two variables show behavior exactly the same as the first variable and are therefore not shown.

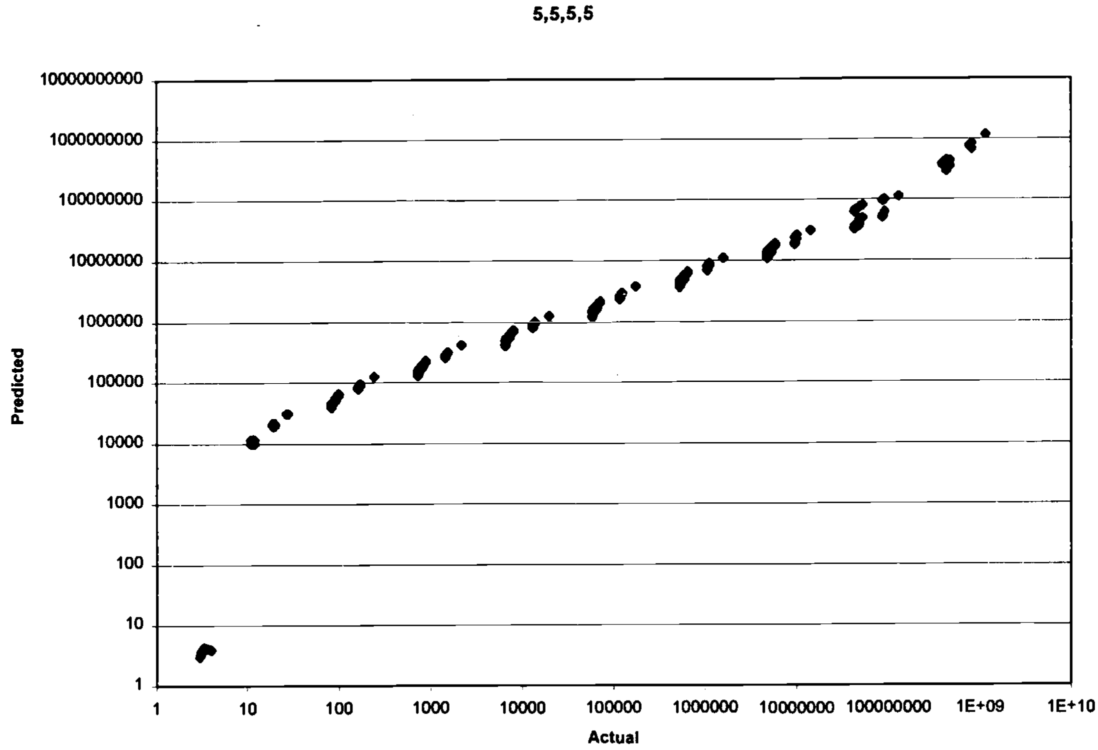

Figure 4.22 – Known Function Shepard's Method Result Differing Size (5,5,5,5)

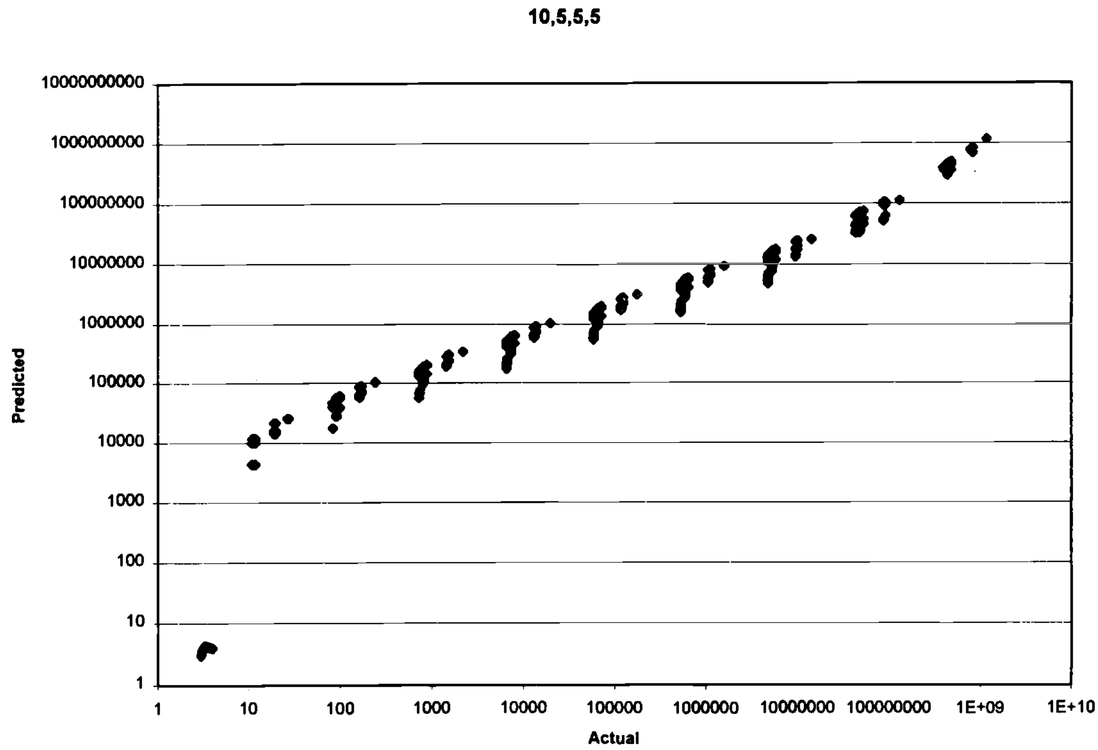

Figure 4.23 – Known Function Shepard's Method Result Differing Size (10,5,5,5)

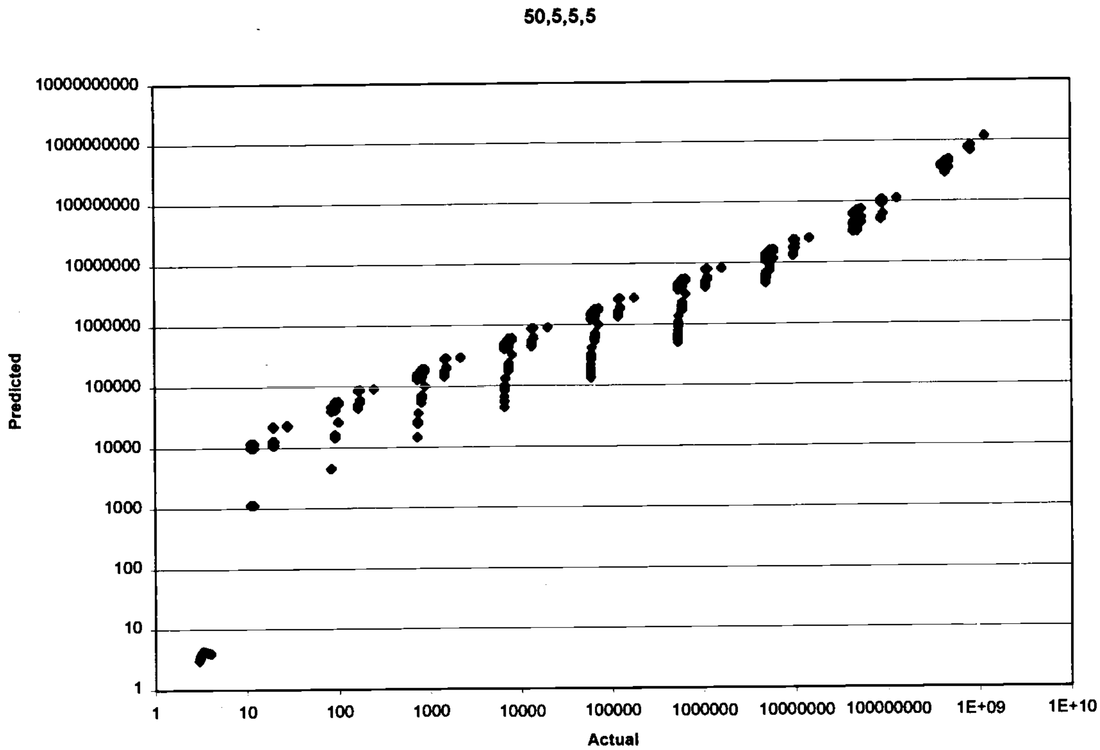

Figure 4.24 – Known Function Shepard's Method Result Differing Size (50,5,5,5)

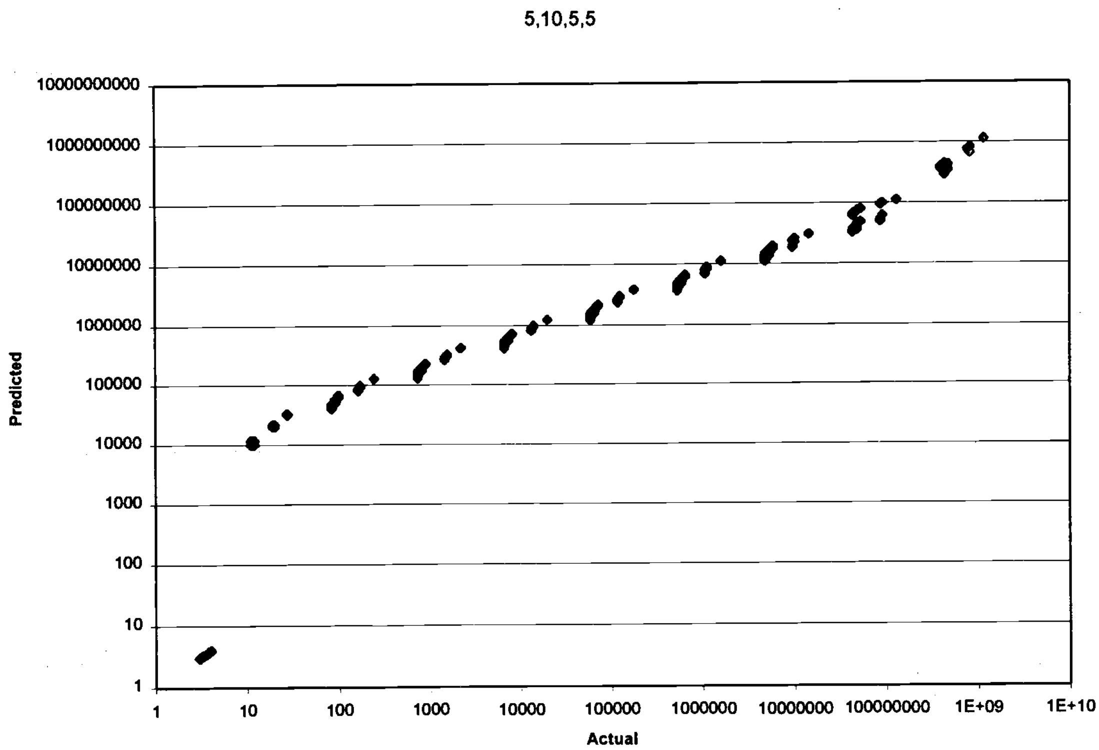

Figure 4.25 – Known Function Shepard's Method Result Differing Size (5,10,5,5)

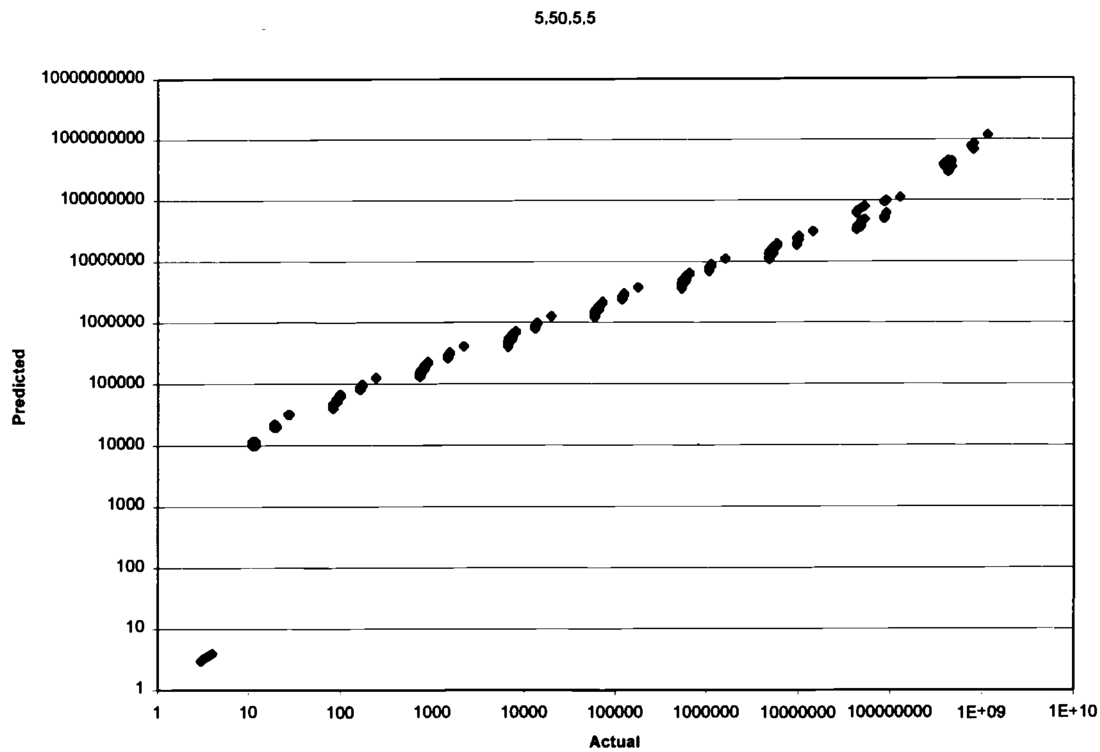

Figure 4.26 – Known Function Shepard's Method Result Differing Size (5,50,5,5)

This leads to the conclusion that even though the second variable is more regular in its distribution, making an equal spaced table more accurate, the fact that it is much smaller than the other three by several orders of magnitude reduces its weight in the formulation. Therefore, when using Shepard's Method for an unknown relation between the variables, it is best to have the ranges of each of the independent variables roughly the same "length" in relation to each other. In other words, it is desirable to see the inverse norm of the data range, $\frac{1}{\sum_{j=1}^{N}\|x_i - x_j\|^{-p}}$, roughly equal for each of the four data sets. So the initial Shepard results will be modified to account for this fact.

4.3.5. Equally Spaced Shepard's Results

In order to determine how to equally space the data sets, it is necessary to know the ranges for each of the independent variables. Table 4.1 shows the minimum and maximum values for each of the four variables. In examining the table the quality range is found to be quite small (as would be expected) and the mass flux range is quite large. However, the pressure values and hydraulic diameter values are roughly in a range of 0.0 to 20.0.

There are several ways to obtain a roughly equal data set range, but one of the easier methods is to apply a scalar to the look-up table and then modify the incoming and outgoing reportable results to make it appear that the table has not been modified. In other words a multiplier of 100 can be applied to the quality variable data set to generate

Independent Variable	Minimum Value	Maximum Value
Pressure (MPa)	2.59×10^{-3}	15.44
Quality	-0.37	0.937
Mass Flux (kg/m^2-s)	-13,653.45	6,781.2
Hydraulic Diameter (mm)	1.61	19.05

Table 4.1 – Annular CHF Database Variable Ranges

the look-up table, then multiply by 100 any data point that is desired and finally divide by 100 when the results are reported. In this way the necessary data range for Shepard's Method is achieved while not forcing the user to make an adjustment in data input.

The question naturally becomes, "What scalars should be applied to which variables?" Essentially trial and error is the method that was ultimately used to determine the "final" solution. Some general guidelines can be applied however, since the function is dependent upon inverse norms for the function weights. Extreme values, either too large or too small, are not desirous as the weights become very large numbers, for small distances, or very small numbers, for large distances. The spread of the range needs to be maintained as well. If data points become too close then the mesh will have difficulties capturing the changes in values. The final solution was to create a spread roughly in line with the two variables that already had a desirable range, 0.0 to 20.0. Due to the large range in the mass flux variable a little extra spread was allowed to ensure that data points for this variable were not forced into too narrow a range. Table 4.2 shows the modified data range for the variables with a scalar of 1/400 applied to the mass flux and 20 to the quality variable.

Independent Variable	Minimum Value	Maximum Value
Pressure (MPa)	2.59×10^{-3}	15.44
Quality	-7.4	18.74
Mass Flux (kg/m^2-s)	~ -34.13	16.953
Hydraulic Diameter (mm)	1.61	19.05

Table 4.2 – Modified Annular CHF Database Variable Ranges

Using these new data ranges, Shepard's Method was reapplied to the problem. Figures 4.27 through 4.35 show the results of increasing the mesh in each of the four variable directions. Unlike the initial Shepard's results, the variables behave similarly as they are increased in the number of mesh points. The only exception to this trend is the hydraulic diameter variable which shows a much more dramatic effect in the results as its mesh values are increased. This leads to two conclusions: first, that the changes to the data ranges for the variable achieved the desired result of allowing all variables to contribute to the improvement of the estimate, and second, that the hydraulic diameter variable has a stronger impact on the results than the other variables.

As the resolution in each of the four variables is increased, the prediction gets better. However, the disadvantage of larger meshes is longer computational time in obtaining the results of the look-up. In order to estimate the quality of the table the error reduction vs. resolution will be examined. A common metric for error is the sum of the squares (SS) of the error. This value is used to ultimately determine the root mean square of the error, which is an estimate of how far percentage-wise the results could commonly differ from the real value.

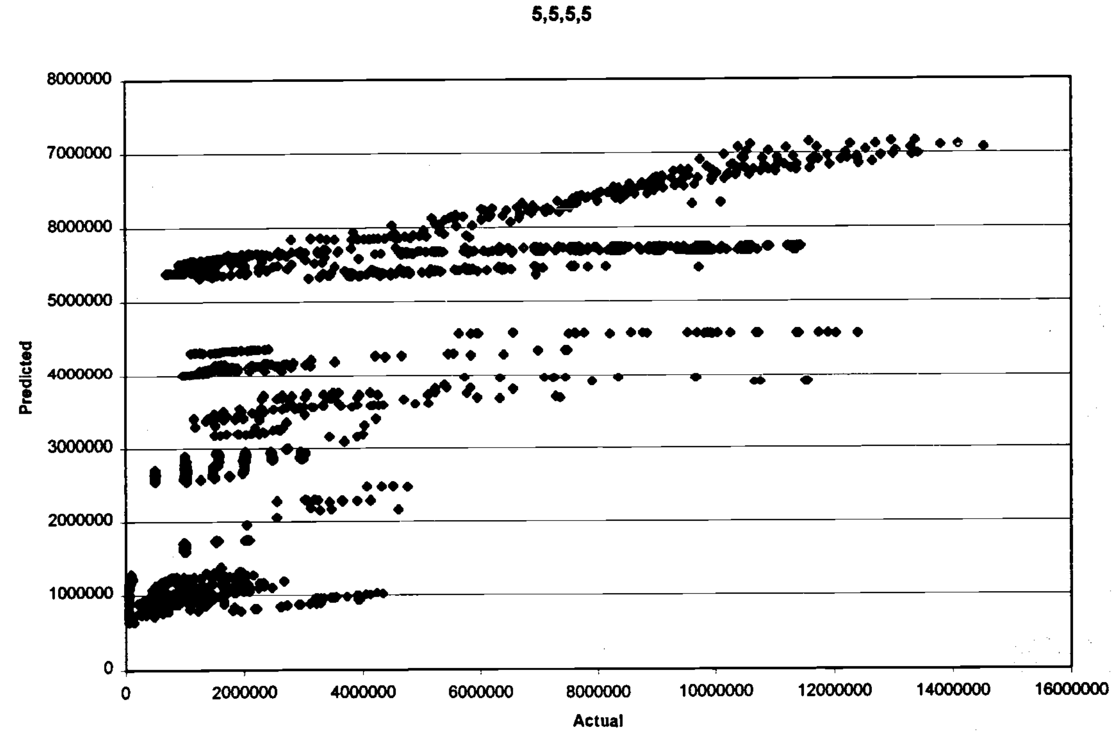

Figure 4.27 – Equally Spaced Shepard's Method Results (5,5,5,5)

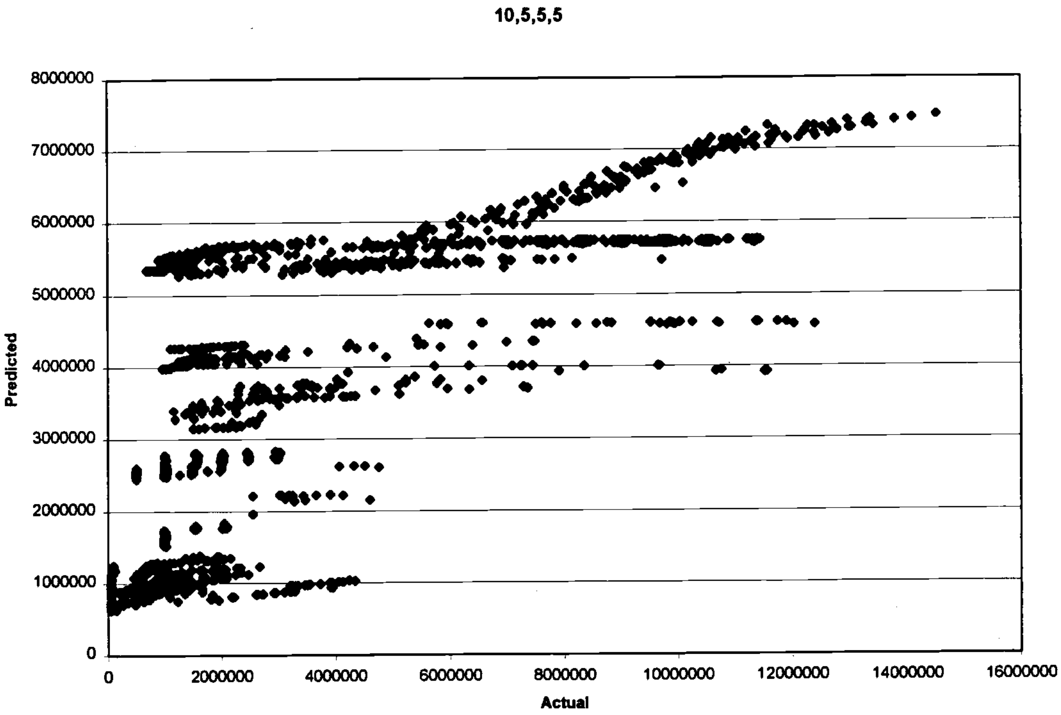

Figure 4.28 – Equally Spaced Shepard's Method Results (10,5,5,5)

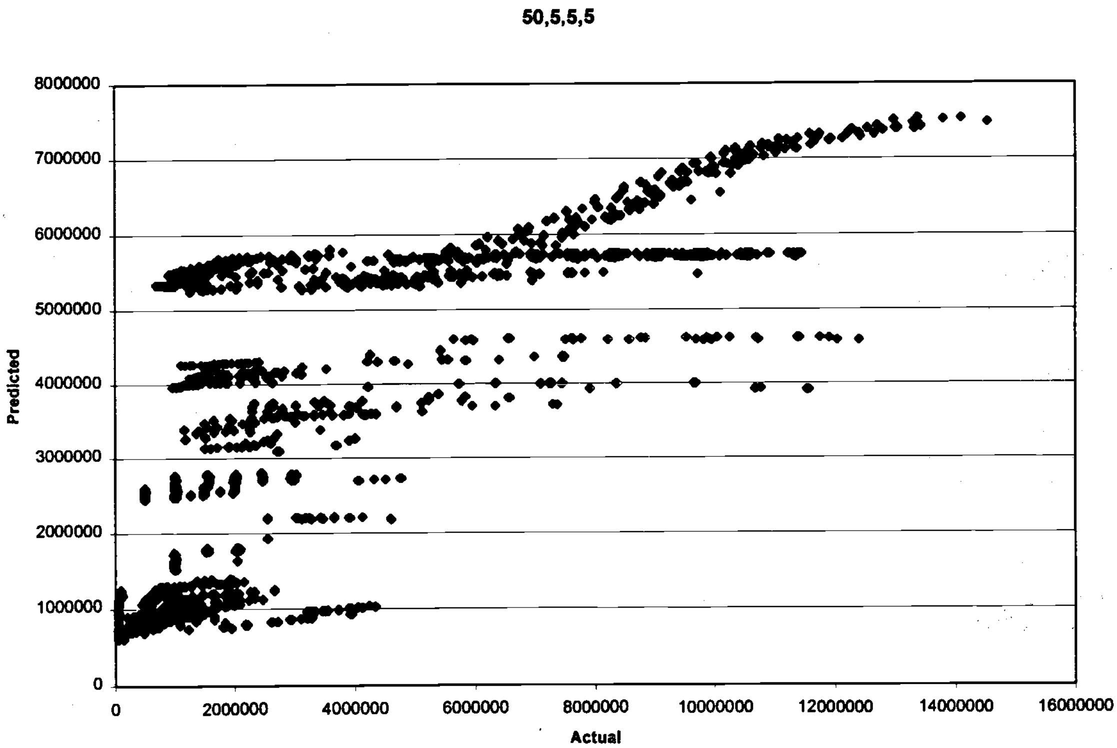

Figure 4.29 – Equally Spaced Shepard's Method Results (50,5,5,5)

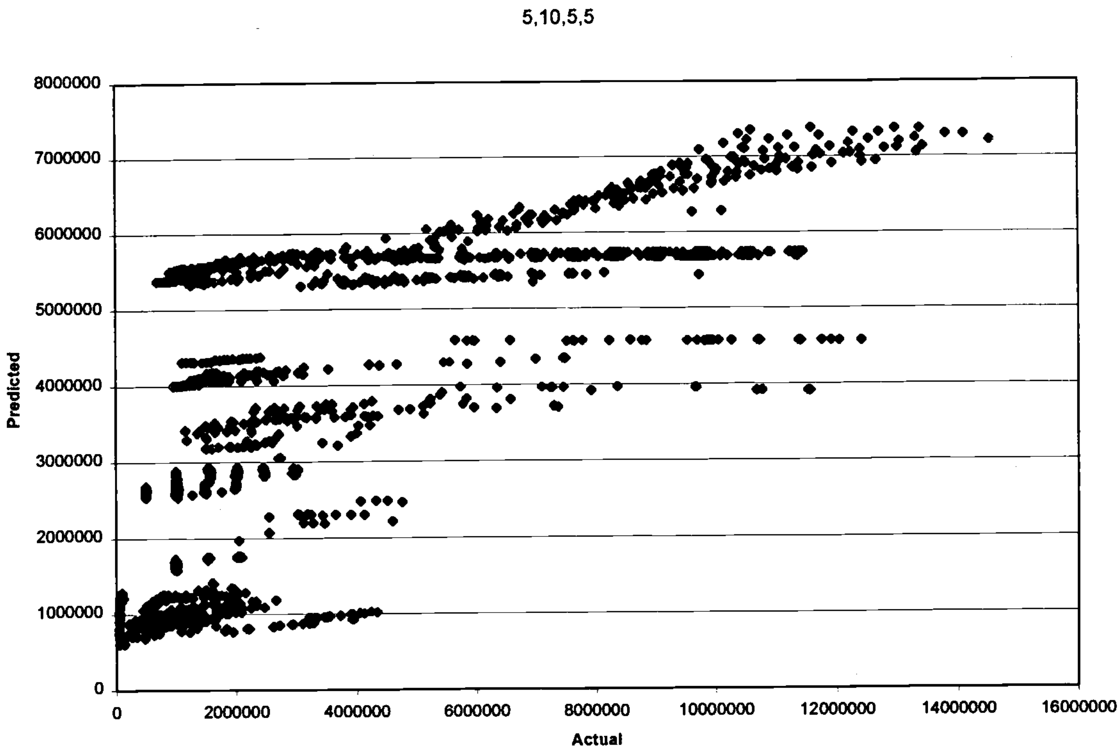

Figure 4.30 – Equally Spaced Shepard's Method Results (5,10,5,5)

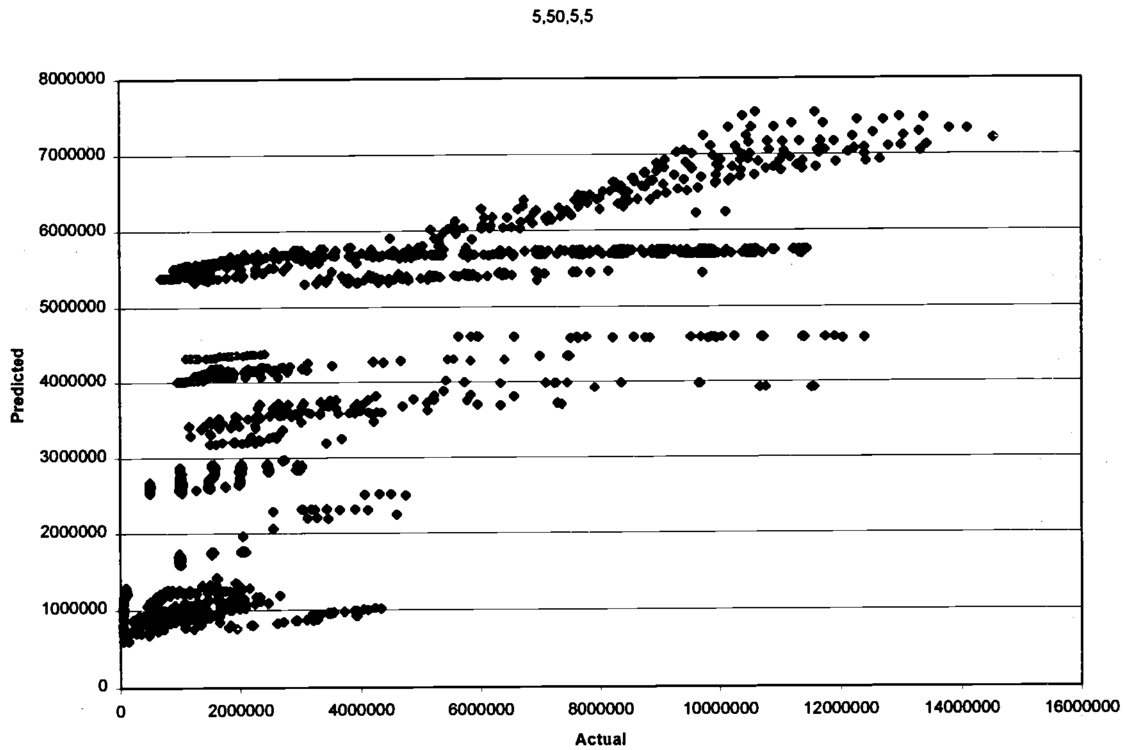

Figure 4.31 – Equally Spaced Shepard's Method Results (5,50,5,5)

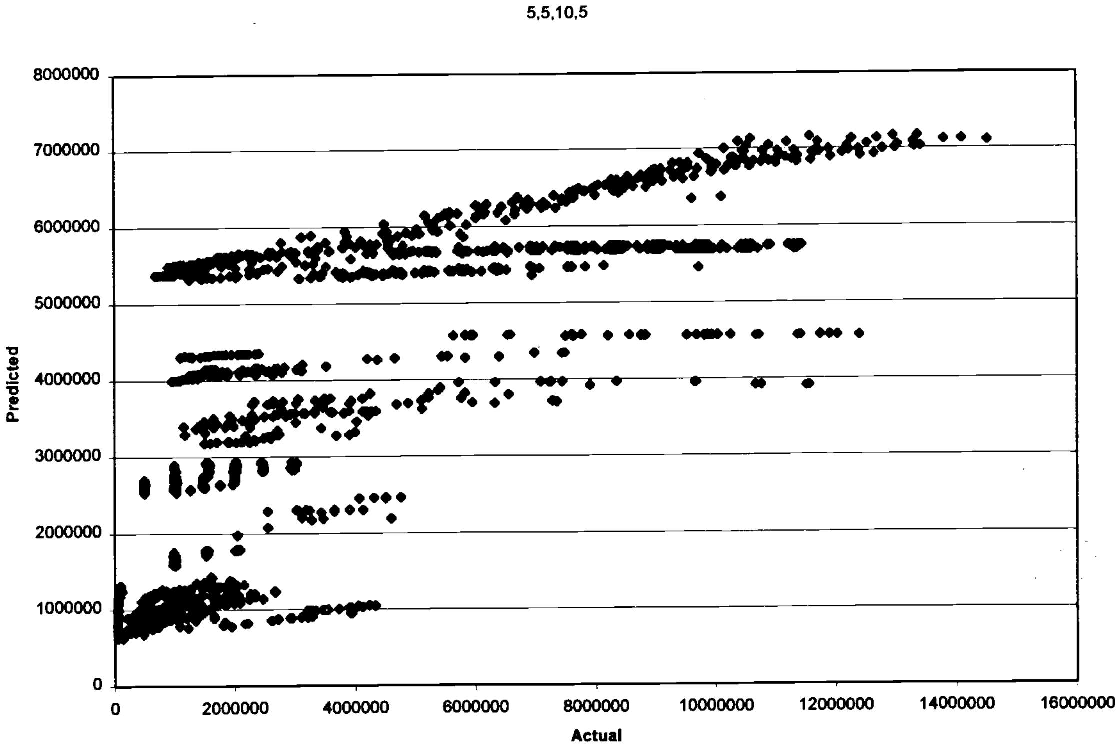

Figure 4.32 – Equally Spaced Shepard's Method Results (5,5,10,5)

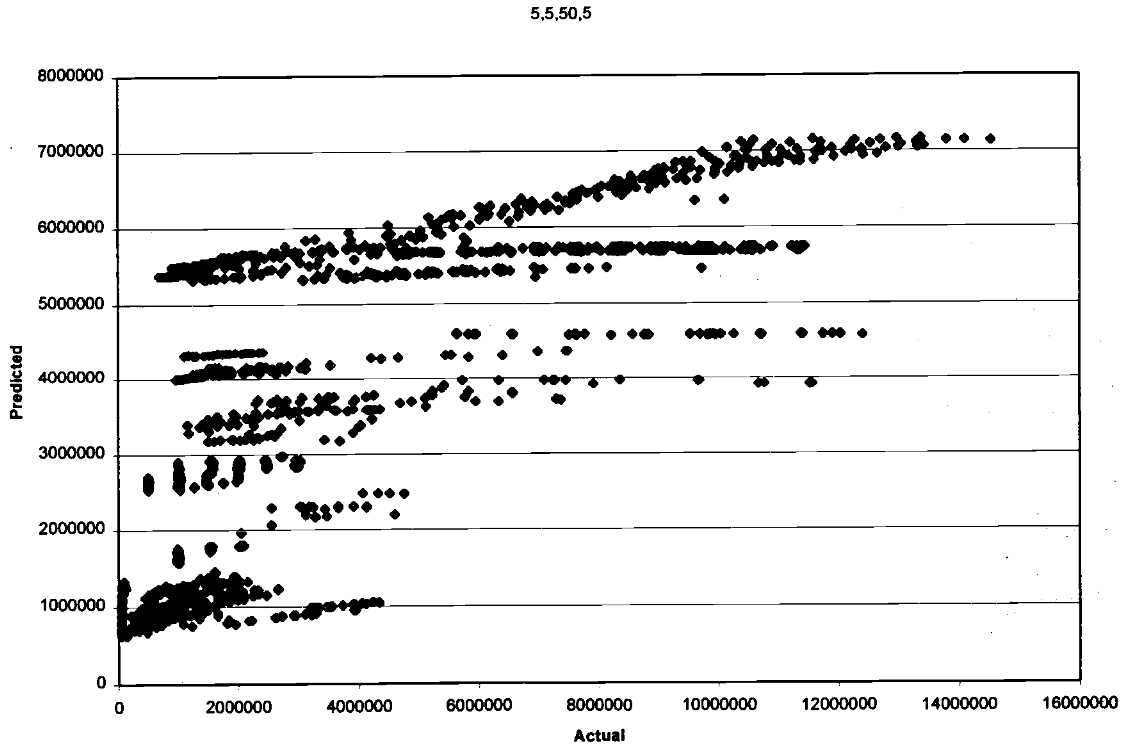

Figure 4.33 – Equally Spaced Shepard's Method Results (5,5,50,5)

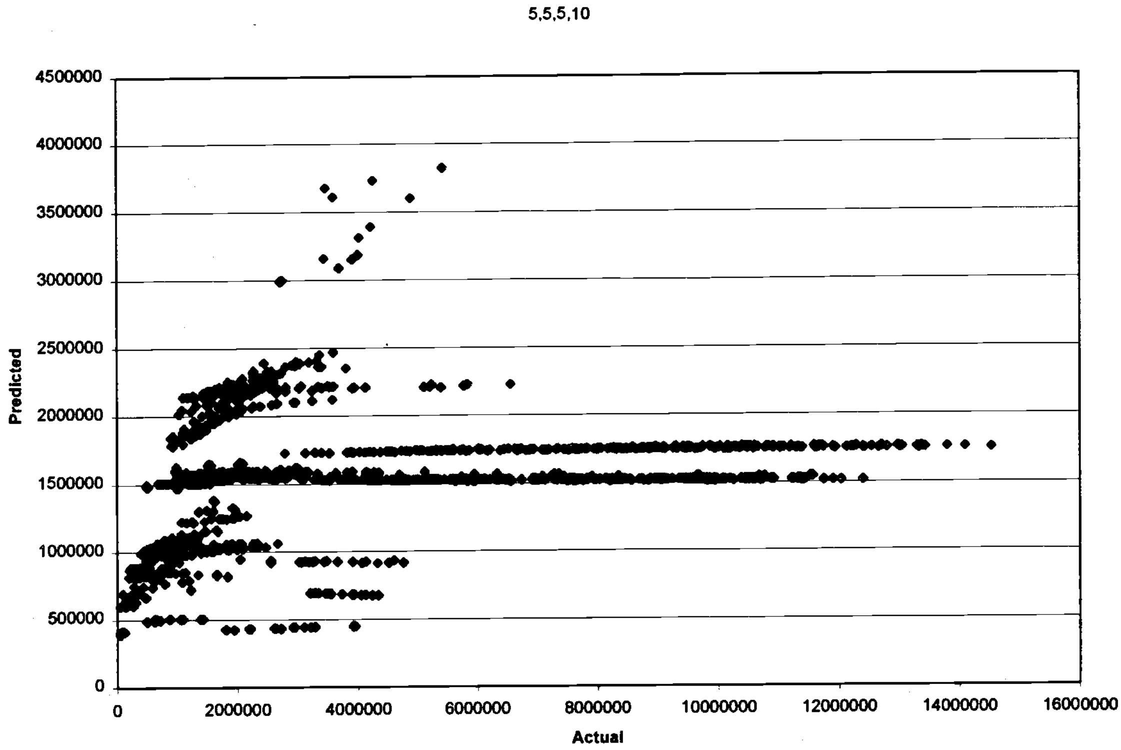

Figure 4.34 – Equally Spaced Shepard's Method Results (5,5,5,10)

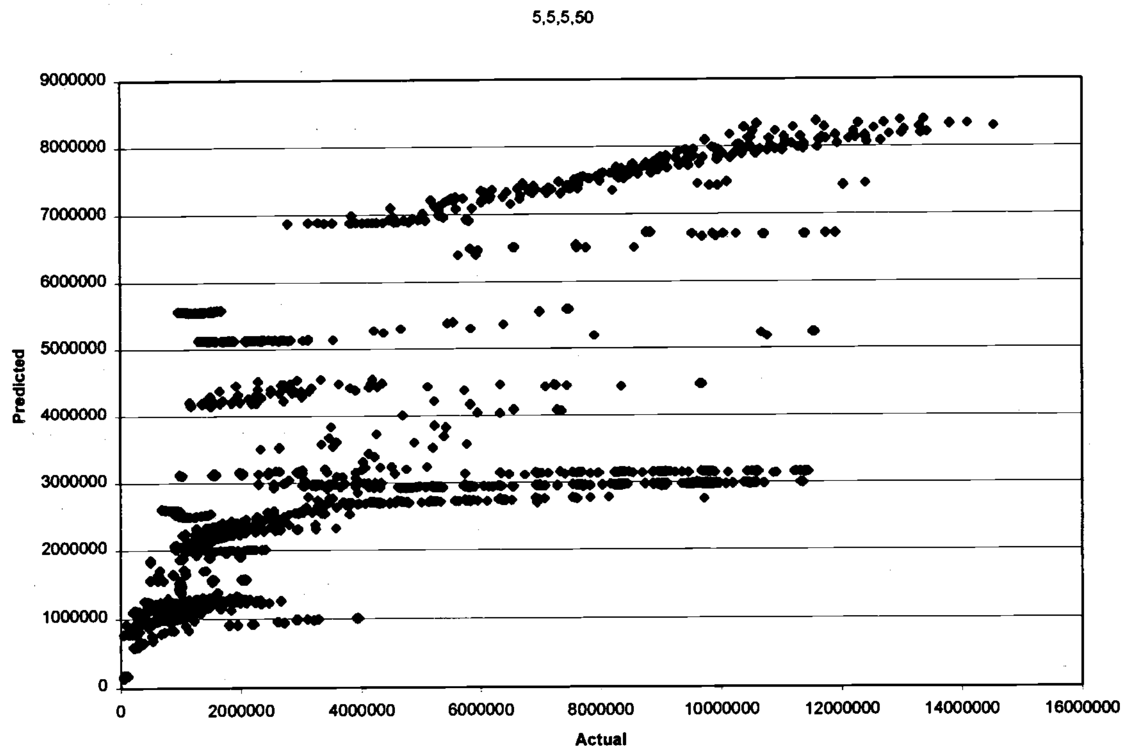

Figure 4.35 – Equally Spaced Shepard's Method Results (5,5,5,50)

Table 4.3 shows the sum of the square of the errors for various mesh sizes. As can be seen, increasing of the mesh size in the various directions reduces the SS of the errors in the predictions. There are, however, certain mesh structures that do not improve the SS of the error, but make it worse. This is due to how the mesh divisions contain the data for each of the variables. There are instances for the clustered data where the cluster can be separated by a mesh position creating great difficulty in predicting data near that division line. It is much better to contain the clustered data sets within one mesh sub-domain than spanning it across two. For instance if a set containing 1 and 3 is used, mesh locations of [0,2,4] would divide the set while locations [0,4,8] would contain the set in

Mesh Size	SS	Mesh Size	SS	Mesh Size	SS
5,5,5,5	14419.48	5,5,5,20	69893.18	20,10,10,50	1410.51
10,5,5,5	13133.69	5,5,5,50	1694.12	20,10,20,50	1342.723105
20,5,5,5	13159.92	5,100,5,5	14376.88	20,20,20,50	1383.394212
50,5,5,5	13097.59	5,200,5,5	14376.73	20,10,30,50	1326.967627
5,10,5,5	14380.70	5,5,100,5	14345.52	20,10,50,50	1313.413795
5,20,5,5	14382.61	20,5,5,50	1596.96	30,10,50,50	1293.60536
5,50,5,5	14377.17	20,10,5,50	1509.80	50,10,50,50	1172.361403
5,5,10,5	14369.58	20,5,20,50	1520.28	70,10,50,50	1157.975983
5,5,20,5	14348.00	20,20,5,50	1518.67	100,10,50,50	1144.175303
5,5,50,5	14345.95	5,5,5,100	2181.58	70,10,70,50	1149.928734
5,5,5,10	2513.21	5,5,5,200	2313.410269	100,10,100,50	1130.428555

Table 4.3 – Sum of Squares of Errors for Various Mesh Sizes

a sub domain. Table 4.3 also shows the importance of an accurate hydraulic diameter mesh, as the error can swing quite widely as the mesh structure is refined. Ultimately, a point is reached where increasing the mesh size in various directions does not significantly decrease the error while slowing the calculation. The last few mesh structures give a SS of the error between 1100 and 1200, showing the best result. Figure 4.36 shows graphically the results of the (100,10,100,50) mesh to give a feel for what kind of error this represents.

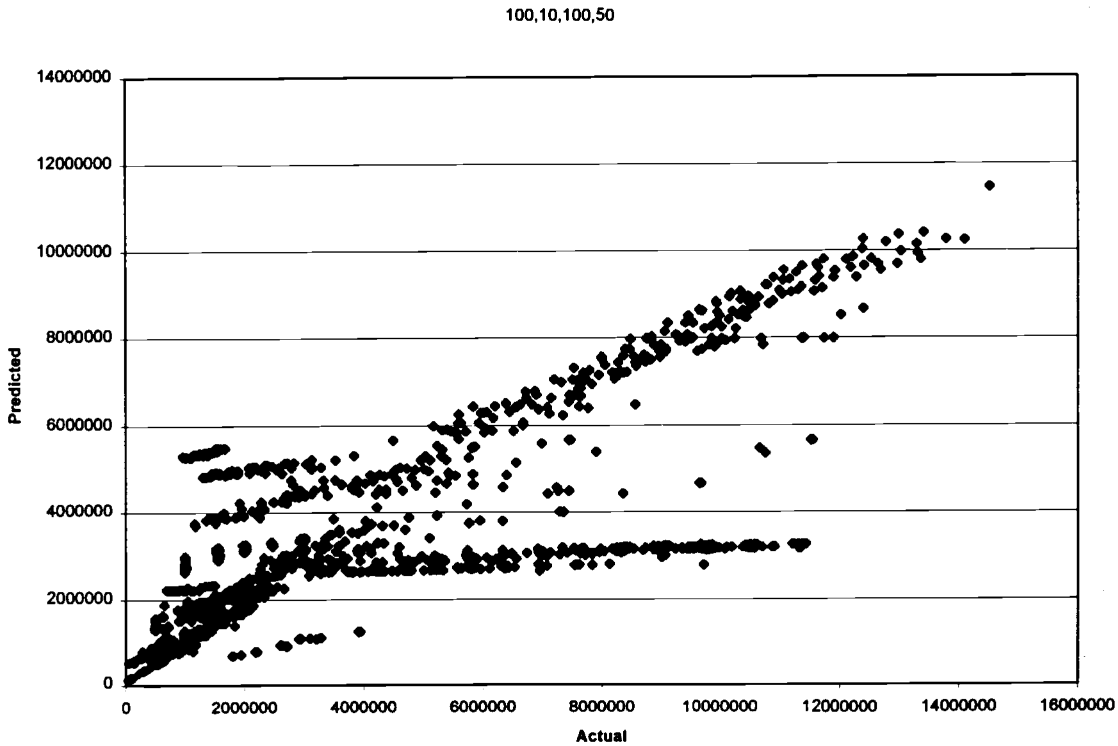

Figure 4.36 – Equally Spaced Shepard's Method Results (100,10,100,50)

4.3.6. Results of Shepard's Method Divided by Hydraulic Diameter

The results thus far have been a great improvement over the initial Shepard's Method, but the large swing in the sum of the squares (SS) of the error in the meshing of the hydraulic diameter is disconcerting. The reason behind the swing is quite easy to discern by reconsidering the CHF database. The hydraulic diameter values are discrete because each experiment series ran with a single hydraulic diameter value. In only one instance did two separate experimenters use the same hydraulic diameter. Therefore, as the hydraulic diameter domain is divided, the experiments are essentially divided up into regions. The interaction of these experiments (and their inherent errors) can cause sections of the mesh to have a difficult time accurately predicting values. It can be likened to approaching a singularity in a function. As the singularity is approached, the function will vary dramatically in a small range.

The best method to overcome this concern over the meshing of the hydraulic diameter is to "hard wire" the mesh in that direction to the known, discrete values of the hydraulic diameter. In this way the errors will be reduced because the known data locations are used as the mesh location points. Given the spread in this variable the number of mesh points can be reduced down from 50 to 25 without sacrificing the quality of the results. Therefore, the problem will be reanalyzed while fixing the hydraulic diameter variable to the known values. Figures 4.37 through 4.43 show the results of this analysis.

From the figures, it is apparent that an improvement is achieved as the meshes increase in size. No dramatic changes from variable to variable are shown, giving a well behaved result. The only difficulty is the scattering of data points that are being over-predicted significantly, by 5 or 6 times their actual value. It is unknown at the present

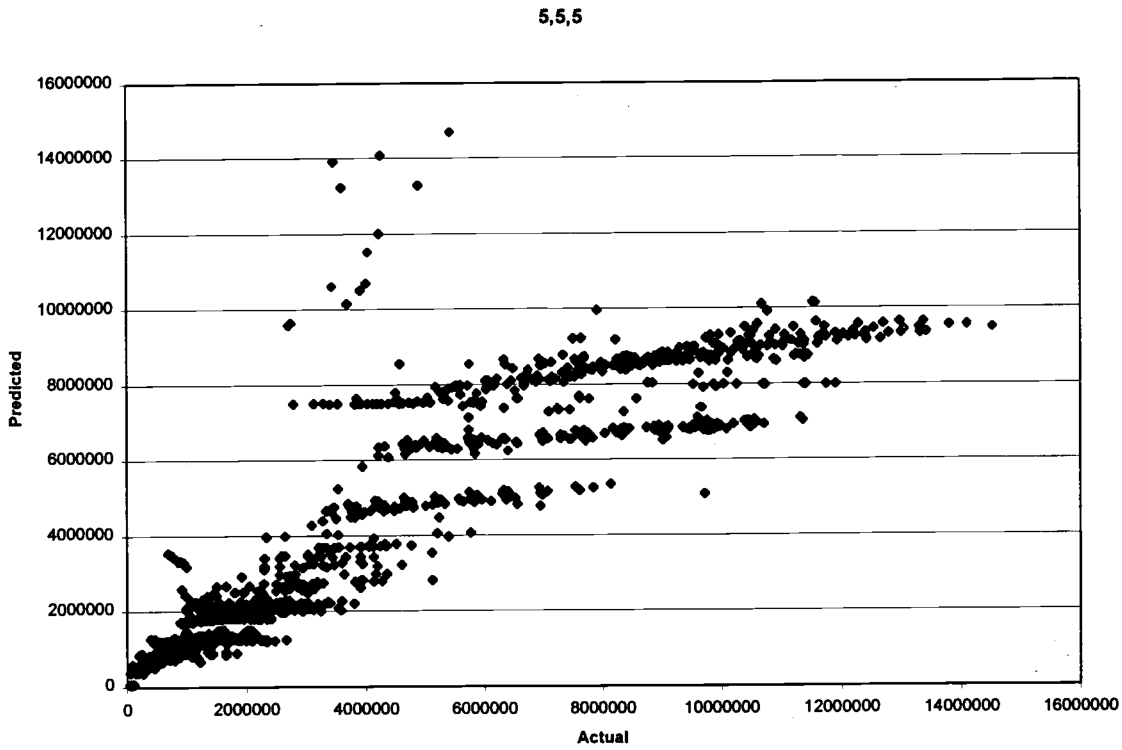

Figure 4.37 – Fixed Diameter Shepard's Method Results (5,5,5)

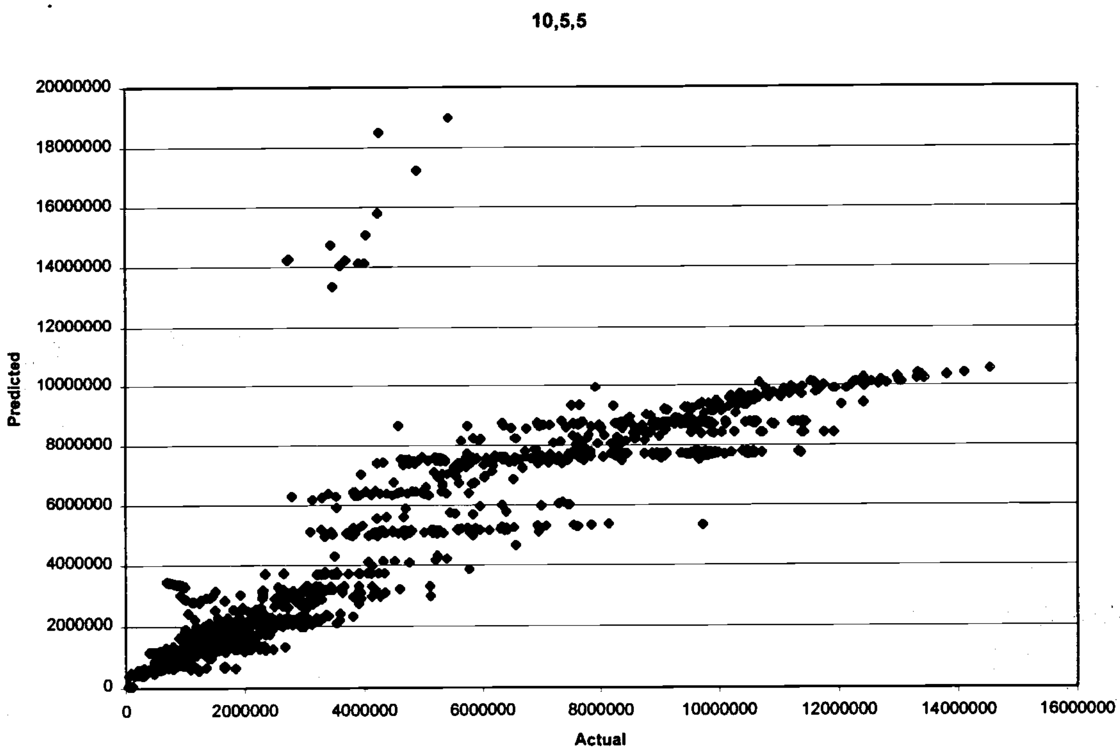

Figure 4.38 – Fixed Diameter Shepard's Method Results (10,5,5)

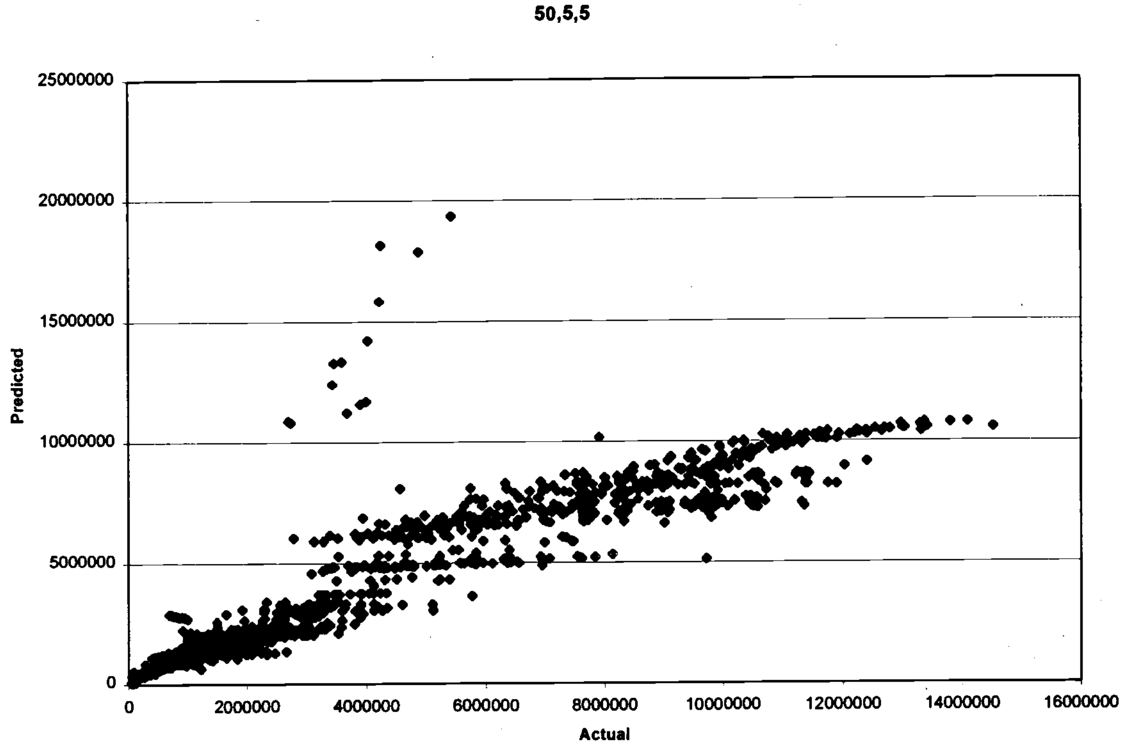

Figure 4.39 – Fixed Diameter Shepard's Method Results (50,5,5)

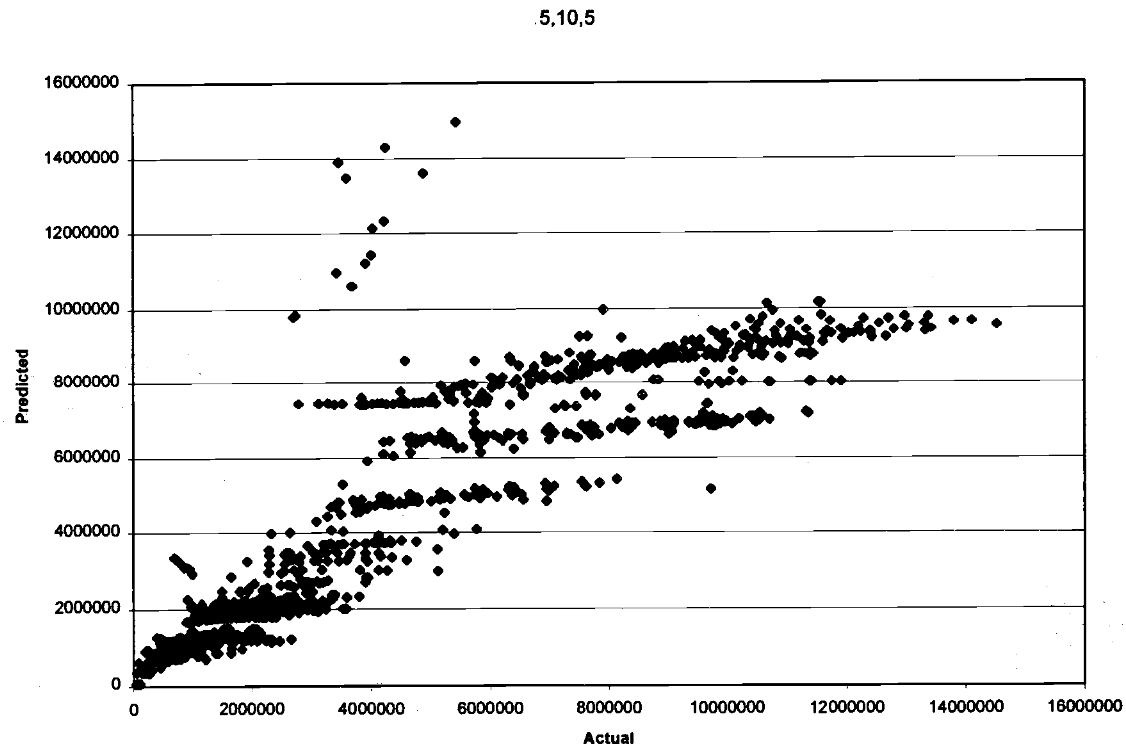

Figure 4.40 – Fixed Diameter Shepard's Method Results (5,10,5)

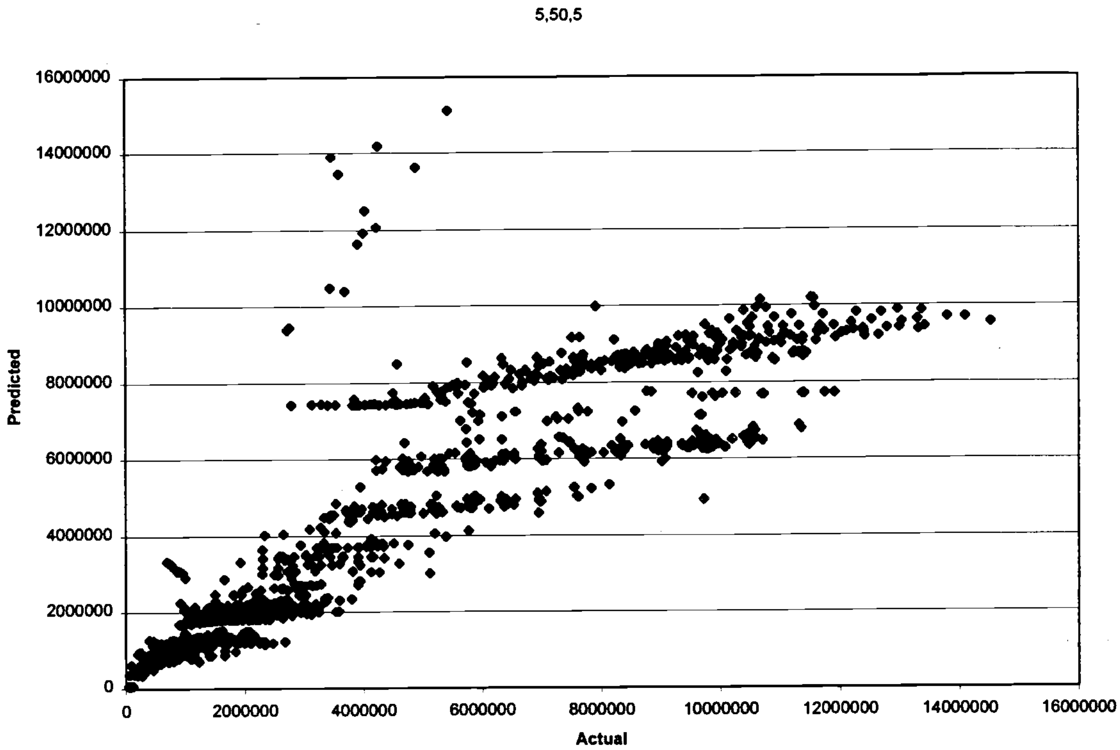

Figure 4.41 – Fixed Diameter Shepard's Method Results (5,50,5)

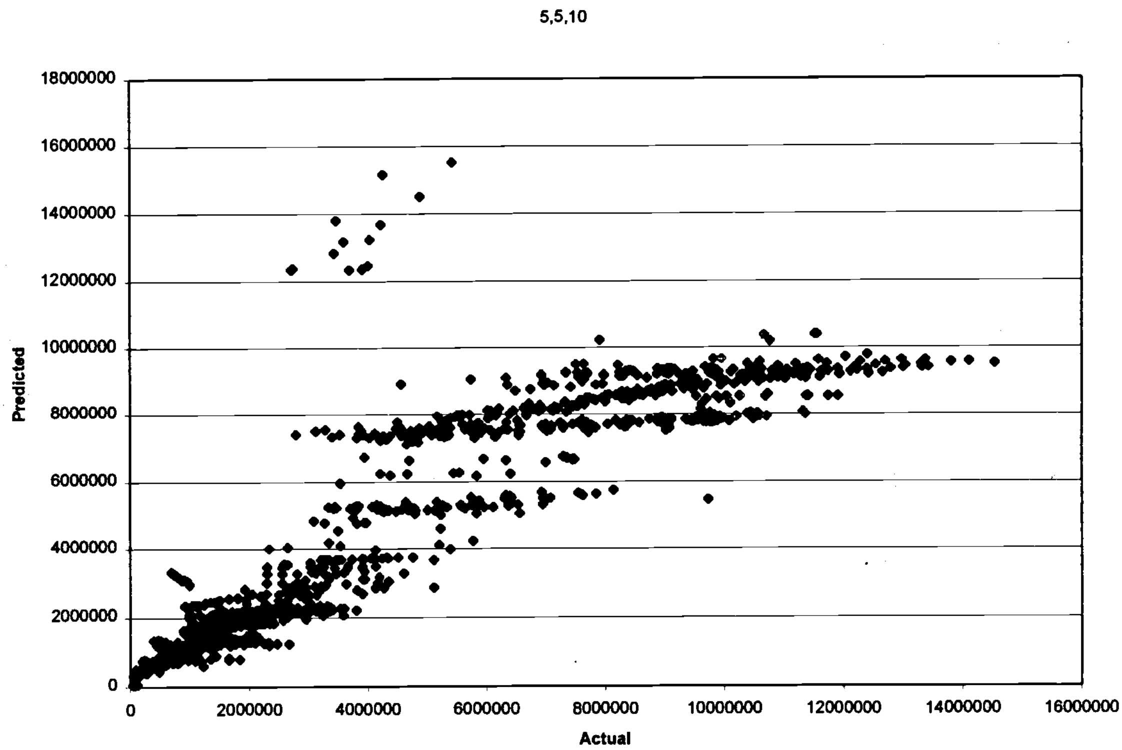

Figure 4.42 – Fixed Diameter Shepard's Method Results (5,5,10)

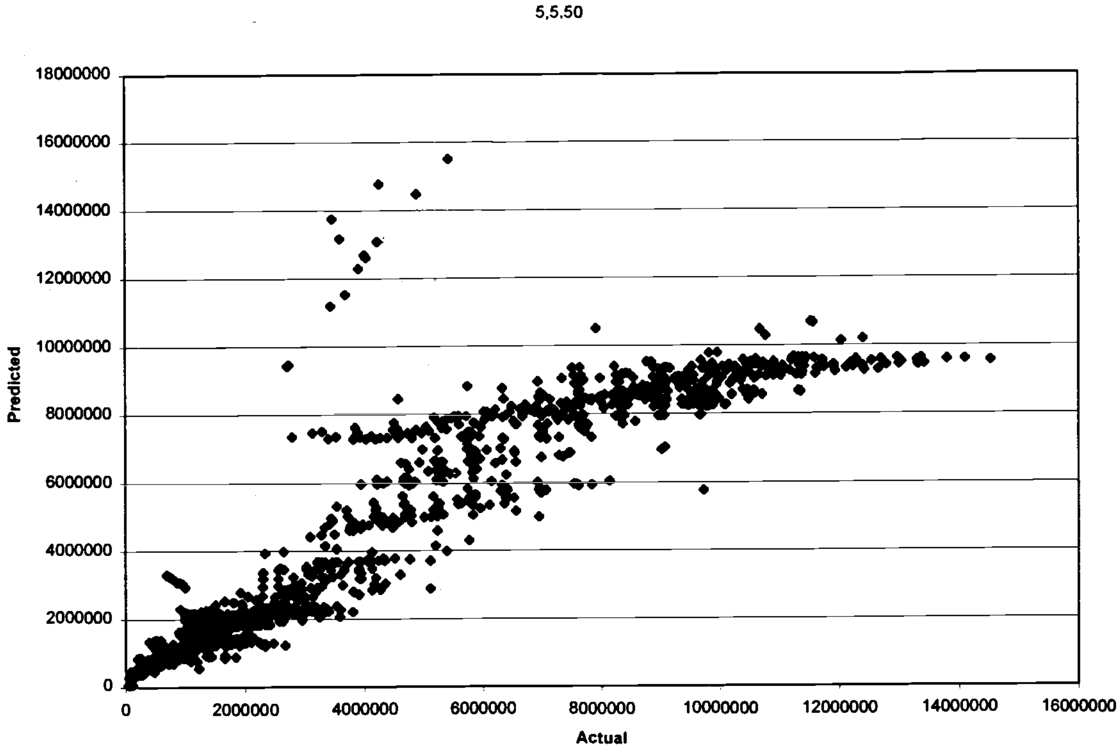

Figure 4.43 – Fixed Diameter Shepard's Method Results (5,5,50)

time why these data points are not as well behaved, though it could be due to experimental error.

Once again, by looking at the SS of the errors, it is possible to generate the lowest error while still being computationally reasonable. Table 4.4 shows the SS of the errors for the different mesh sizes. As the meshes are increased in each of the variable directions the pressure variable has the most impact and the quality variable has the least impact upon the results. Improvement is seen in the reduction of the error as the pressure and mass flux mesh sizes are increased over 100 points, but the SS of the error is roughly in the range of 150 to 100, an order of magnitude below the previous results. Figure 4.44 shows the (100,10,150) results for this case.

Mesh Size	SS	Mesh Size	SS	Mesh Size	SS
5,5,5	470.0099051	5,5,10	444.055667	50,10,50	155.193473
10,5,5	481.9787753	5,5,20	417.7710814	75,10,20	170.1524089
20,5,5	384.0295909	5,5,50	400.1911565	60,10,60	150.2377272
50,5,5	349.6612917	10,10,10	375.4345788	100,10,100	132.3207987
5,10,5	459.7864567	20,20,20	226.8497688	100,15,100	148.1188827
5,20,5	462.6214062	20,10,20	222.0145656	100,10,150	131.1605529
5,50,5	459.1237828	50,10,20	180.8205751		

Table 4.4 – Sum of Squares of Error for Fixed Diameter Results

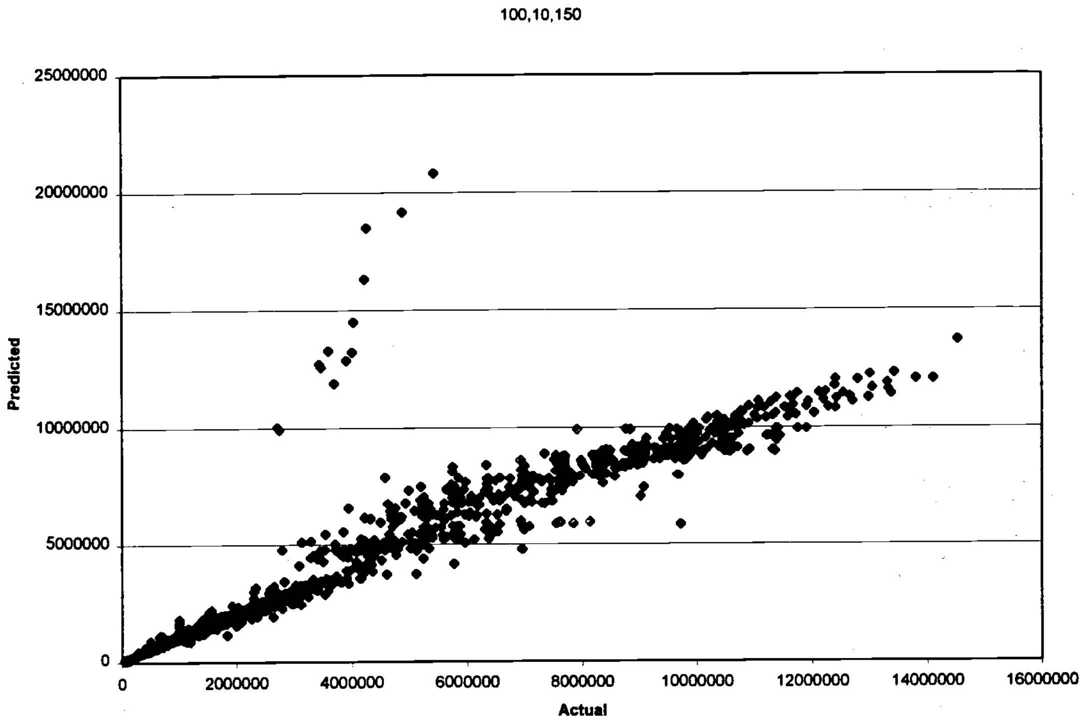

Figure 4.44 – Fixed Diameter Shepard's Method Results (100,10,150)

4.4. Summary

It was desired to create a tool to predict annular CHF that could be used in general purpose thermal-hydraulic codes. In examining the database it was noticed that the data consisted of both distributed and segmented data. This makes most techniques difficult (if not impossible) to use. One technique that works well with this type of data is the look-up table.

Using Shepard's Method as an interpolation routine, it was possible to generate a look-up table to estimate values at each of the mesh locations. Initial attempts were not very successful in generating an accurate table. Through investigation of Shepard's Method using a known function, it was discovered that the method is highly dependent upon the range of the variables. If one variable has a small range and another a large range, the method will not be able to show the impact of the small range variable as the weights of the large range variable will overshadow it. Therefore, a scaling of the variable ranges was completed to correct this defect.

The final Shepard's Method results showed much better agreement with the initial data than all pervious attempts to estimate the database. It was noticed that the meshing of the hydraulic diameter variable had a large impact upon the results. Though somewhat artificial, it was not unreasonable to manually divide the mesh for the hydraulic diameter into the known values. Then, re-applying Shepard's Method to the problem, the errors dropped once again, as would be expected. There did appear, however, some data points that were not improved by fixing the hydraulic diameter. It is unknown if these data points are data outliers or if they have an unknown error associated with them.

Shepard's Method, using the modified equal length data set gives a SS of the error of ~1293. If we take the square root of the average of the SS called the root mean square error (RMSE) we end up with a value of 0.8267. Using the fixed hydraulic diameter mesh and Shepard's Method it is possible to reduce the RMSE to 0.2816.

5. SUMMARY

5.1. The Journey Thus Far

The focus of this thesis has been on the point at which the wall temperature of a heated surface will dramatically increase due to a small increase of heat flux. This point is commonly referred to as Critical Heat Flux (CHF) and is an important parameter for thermal hydraulic analysis of nuclear reactors. The most commonly used tool to predict CHF for thermal hydraulic codes is the Groeneveld look-up table. This table is based primarily upon tube data with hydraulic diameters on average of 8.0 mm. When compared to annular correlations that were previously developed, the look-up table over-predicts the value of CHF. In regards to safety, this is undesirable, as the calculations will under-predict the temperature rise of the fuel leading to erroneous conclusions. Unfortunately, no correlation or other tool exists to replace the Groeneveld table.

To remedy this situation, a database of annular CHF data was developed in order to create a new predictive tool. Eighteen sources of annular CHF data were found in the open literature. These sources were carefully screened and any data that did not conform to an open flow channel, uniform axial heating, and unilateral inner wall heating was removed from the database. A total of 1630 data points were obtained and collected into a coherent set of usable data.

After examination of this data set, it was decided that a look-up table would be appropriate for capturing the cloud of data points that comprise the database. After reviewing some interpolation schemes, Shepard's Method was chosen. Direct application of the technique did not give desirable results due to the necessity of an equal range for the independent variables. After some adjustment, two tables were developed, one with a regular hydraulic diameter mesh and one with an irregular mesh. The root mean squares of these errors were 0.8267 and 0.2816 respectively.

There now exists a tool to predict CHF for annular geometries. Depending upon the application and the thermal hydraulic simulation software, either of the tools could be employed with differing degrees of confidence in the result.

5.2. The Path Ahead

Results of predictive tools have been improving as analysis has moved from generic locations to the specific locations of the data set. In other words, a technique that can use the data set "as is" and predict intermediary results would be ideal. A technique that can accomplish this is the use of convex hulls. The data points are used for the mesh points of the geometric construction and then convex hulls are determined between the spaces between the mesh points. This gives accurate CHF predictions near the known data points and bounds the values for those points between the known locations. The main difficulty with this method is what to do with the boundary, those locations beyond the range of the known space. This region can be excluded, constant values applied, or a general increasing or decreasing slope given. The technique is more computationally expensive in comparison to the work previously done, but might be applicable for work that can sacrifice time for precision.

Additionally, a non-dimensional analysis of the data set could provide insight to the trends of the data for various parameters. Non-dimensional analysis has the benefit of being applicable beyond the original range of the data set and could also be applicable for other fluids, such as liquid metals.

Ultimately, what is really needed is a better data set. Only by producing more and better data over a wider range can the precision be improved in general. In addition, a trend in industry from the macroscopic to microscopic has been occurring. Analysis is being performed using 10 million node models of reactor fuel assemblies. Previous experimental tests determined the point of CHF over large test sections with thermocouples spaced, in relation to the microscopic physics currently being done, a large distance apart.

The ultimate extension of this work would be to generate a new data set that accounts for the demands of the new thermal hydraulic programs and models being developed. No immediate plans are in place to perform this work, but it is hoped that eventually completion will be possible.

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APPENDIX

Annular Geometry Critical Heat Flux Database:

Nomenclature:

q_{cr}	critical heat flux, W/m^2
P	pressure, MPa
x	quality (vapor weight fraction)
G	mass flux, kg/m^2-s
D_{hy}	hydraulic equivalent diameter, mm
D_{he}	heated equivalent diameter, mm
L_{he}	heated length, m
Δh	inlet subcooling enthalpy, J/kg
h_{fg}	latent heat of evaporation, J/kg
ρ_f	liquid density, kg/m^3
ρ_g	vapor density, kg/m^3
σ	surface tension, N/m

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
1	2257977.19	10.44	0.14	678.12	7.87	60.71	0.58
2	1992332.83	10.44	0.15	678.12	7.87	60.71	0.58
3	1401274.10	10.44	0.16	678.12	7.87	60.71	0.58
4	1859510.62	10.44	0.17	678.12	7.87	60.71	0.58
5	1660277.35	10.44	0.18	678.12	7.87	60.71	0.58
6	1364747.99	10.44	0.20	678.12	7.87	60.71	0.58
7	2267938.87	10.44	0.18	678.12	7.87	60.71	1.17
8	1510852.40	10.44	0.27	678.12	7.87	60.71	1.17
9	1520814.05	10.44	0.31	678.12	7.87	60.71	1.17
10	1182117.47	10.44	0.34	678.12	7.87	60.71	1.17
11	2188245.55	7.00	0.25	678.12	7.87	60.71	0.58
12	2319891.72	10.44	-0.01	1356.23	7.87	60.71	0.58
13	2346179.43	10.44	0.02	1356.23	7.87	60.71	0.58
14	2139163.60	10.44	0.04	1356.23	7.87	60.71	0.58
15	1905860.06	10.44	0.08	1356.23	7.87	60.71	0.58
16	1708702.12	10.44	0.10	1356.23	7.87	60.71	0.58
17	2250886.44	10.44	0.02	1356.23	7.87	60.71	1.17
18	1544403.82	10.44	0.10	1356.23	7.87	60.71	1.17
19	1159945.84	10.44	0.15	1356.23	7.87	60.71	1.17
20	2717493.54	7.00	0.15	1356.23	7.87	60.71	0.58
21	3013230.44	10.44	-0.08	2712.46	7.87	60.71	0.58
22	2924509.37	10.44	-0.05	2712.46	7.87	60.71	0.58
23	2645202.31	10.44	-0.02	2712.46	7.87	60.71	0.58
24	2267316.26	10.44	0.02	2712.46	7.87	60.71	0.58
25	3910298.95	10.44	-0.13	2712.46	7.87	60.71	1.17
26	3138097.15	10.44	-0.08	2712.46	7.87	60.71	1.17
27	2497333.86	10.44	-0.02	2712.46	7.87	60.71	1.17
28	1961721.46	10.44	0.02	2712.46	7.87	60.71	1.17
29	1501686.29	10.44	0.08	2712.46	7.87	60.71	1.17

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
30	3023088.34	7.00	0.07	2712.46	7.87	60.71	0.58
31	4134090.56	10.44	-0.09	4068.69	7.87	60.71	0.58
32	3818637.86	10.44	-0.06	4068.69	7.87	60.71	0.58
33	2855677.05	10.44	-0.04	4068.69	7.87	60.71	0.58
34	2719534.29	10.44	-0.04	4068.69	7.87	60.71	0.58
35	2503698.25	10.44	0.00	4068.69	7.87	60.71	0.58
36	5123615.83	10.44	-0.16	4068.69	7.87	60.71	1.17
37	4276874.54	10.44	-0.10	4068.69	7.87	60.71	1.17
38	3181091.56	10.44	-0.05	4068.69	7.87	60.71	1.17
39	2291182.75	10.44	-0.01	4068.69	7.87	60.71	1.17
40	1656956.80	10.44	0.05	4068.69	7.87	60.71	1.17
41	2858997.60	7.00	0.03	4068.69	7.87	60.71	0.58
42	4356567.67	10.44	-0.08	5424.92	7.87	60.71	0.58
43	3636007.47	10.44	-0.05	5424.92	7.87	60.71	0.58
44	2822471.49	10.44	-0.05	5424.92	7.87	60.71	0.58
45	2726175.43	10.44	-0.01	5424.92	7.87	60.71	0.58
46	4167296.06	10.44	-0.06	5424.92	7.87	60.71	1.17
47	2673046.53	10.44	0.00	5424.92	7.87	60.71	1.17
48	1929242.29	10.44	0.02	5424.92	7.87	60.71	1.17
49	2825792.04	7.00	0.01	5424.92	7.87	60.71	0.58
50	4195025.29	10.44	-0.05	6781.15	7.87	60.71	0.58
51	3332898.12	10.44	-0.06	6781.15	7.87	60.71	0.58
52	2943124.11	10.44	-0.01	6781.15	7.87	60.71	0.58
53	3339504.33	10.44	-0.02	6781.15	7.87	60.71	1.17
54	2295702.87	10.44	0.03	6781.15	7.87	60.71	1.17
55	2777965.63	7.00	0.00	6781.15	7.87	60.71	0.58
56	80300.00	0.02	0.21	23.00	5.51	20.45	0.86
57	80300.00	0.02	0.23	23.00	5.51	20.45	0.86
58	80300.00	0.02	0.24	21.20	5.51	20.45	0.86
59	94400.00	0.00	0.13	29.20	5.51	20.45	0.86
60	93600.00	0.00	0.13	29.70	5.51	20.45	0.86
61	93400.00	0.00	0.12	31.20	5.51	20.45	0.86
62	93600.00	0.01	0.13	32.10	5.51	20.45	0.86
65	65700.00	0.00	0.42	10.10	5.51	20.45	0.86
66	51400.00	0.01	0.60	6.30	5.51	20.45	0.86
67	59500.00	0.01	0.35	11.30	5.51	20.45	0.86
68	50100.00	0.01	0.60	6.10	5.51	20.45	0.86
69	48800.00	0.01	0.60	5.99	5.51	20.45	0.86
70	66000.00	0.00	0.43	10.00	5.51	20.45	0.86
71	64700.00	0.00	0.74	6.30	5.51	20.45	0.86
74	57900.00	0.01	0.71	6.10	5.51	20.45	0.86
75	58900.00	0.01	0.36	11.10	5.51	20.45	0.86
76	58200.00	0.01	0.33	10.90	5.51	20.45	0.86
77	57900.00	0.01	0.36	10.40	5.51	20.45	0.86
78	54000.00	0.01	0.30	9.20	5.51	20.45	0.86
79	49800.00	0.01	0.44	7.80	5.51	20.45	0.86

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
80	48200.00	0.01	0.62	5.70	5.51	20.45	0.86
81	88900.00	0.00	0.27	18.50	5.51	20.45	0.86
82	94900.00	0.00	0.13	30.60	5.51	20.45	0.86
83	121000.00	0.01	0.21	33.60	5.51	20.45	0.86
84	50600.00	0.00	0.72	5.00	5.51	20.45	0.86
85	58200.00	0.00	0.52	7.50	5.51	20.45	0.86
86	67000.00	0.00	0.22	16.20	5.51	20.45	0.86
87	58400.00	0.00	0.29	11.90	5.51	20.45	0.86
88	73000.00	0.00	0.21	18.10	5.51	20.45	0.86
89	84000.00	0.01	0.15	26.20	5.51	20.45	0.86
90	105600.00	0.02	0.17	35.70	5.51	20.45	0.86
91	51100.00	0.02	0.86	4.60	5.51	20.45	0.86
93	54200.00	0.01	0.55	7.20	5.51	20.45	0.86
94	61600.00	0.01	0.28	14.00	5.51	20.45	0.86
95	66800.00	0.01	0.17	22.20	5.51	20.45	0.86
96	67000.00	0.01	0.20	20.10	5.51	20.45	0.86
97	117600.00	0.02	0.21	35.30	5.51	20.45	0.86
99	49300.00	0.02	0.76	5.00	5.51	20.45	0.86
100	54000.00	0.02	0.47	8.30	5.51	20.45	0.86
101	61600.00	0.02	0.33	12.50	5.51	20.45	0.86
102	69100.00	0.01	0.23	18.70	5.51	20.45	0.86
103	103000.00	0.02	0.17	35.80	5.51	20.45	0.86
104	57900.00	0.00	0.36	9.80	5.51	20.45	0.86
105	57400.00	0.00	0.42	8.60	5.51	20.45	0.86
106	55800.00	0.00	0.48	7.70	5.51	20.45	0.86
107	54200.00	0.00	0.55	6.70	5.51	20.45	0.86
108	51600.00	0.00	0.61	5.90	5.51	20.45	0.86
109	48800.00	0.00	0.76	4.60	5.51	20.45	0.86
112	51600.00	0.00	0.65	5.60	5.51	20.45	0.86
113	52900.00	0.00	0.52	6.90	5.51	20.45	0.86
114	52900.00	0.01	0.40	8.60	5.51	20.45	0.86
115	9703324.96	0.38	-0.10	-8855.52	9.53	12.70	0.61
116	9078728.62	0.38	-0.10	-8785.49	9.53	12.70	0.61
117	7637109.80	0.39	-0.08	-8691.23	9.53	12.70	0.61
118	5854802.06	0.38	-0.06	-8595.98	9.53	12.70	0.61
119	5883192.80	0.38	-0.06	-8606.94	9.53	12.70	0.61
120	5258596.46	0.37	-0.04	-8551.48	9.53	12.70	0.61
121	4700245.19	0.39	-0.03	-8450.62	9.53	12.70	0.61
122	5826411.31	0.21	-0.04	-8574.26	9.53	12.70	0.61
123	5293296.26	0.22	-0.03	-8516.81	9.53	12.70	0.61
124	4763335.73	0.20	-0.01	-8470.38	9.53	12.70	0.61
125	5835874.90	0.21	-0.09	-4350.67	9.53	12.70	0.61
126	5160806.12	0.21	-0.08	-4430.66	9.53	12.70	0.61
127	4772799.31	0.20	-0.08	-4326.64	9.53	12.70	0.61
128	4274384.04	0.22	-0.07	-4282.55	9.53	12.70	0.61
129	3816977.63	0.21	-0.06	-4338.32	9.53	12.70	0.61

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
130	3419507.24	0.24	-0.02	-4126.01	9.53	12.70	0.61
131	9738024.76	0.39	-0.11	-8847.69	9.53	12.70	0.61
132	9040874.30	0.38	-0.10	-8823.48	9.53	12.70	0.61
133	7842154.05	0.64	-0.13	-4449.11	9.53	12.70	0.61
134	7075603.99	0.65	-0.12	-4355.96	9.53	12.70	0.61
135	5883192.80	0.65	-0.10	-4356.94	9.53	12.70	0.61
136	4712863.29	0.65	-0.07	-4193.14	9.53	12.70	0.61
137	4274384.04	0.65	-0.06	-4009.80	9.53	12.70	0.61
138	4302774.79	0.65	-0.04	-4015.68	9.53	12.70	0.61
139	5570894.63	0.38	-0.10	-4310.09	9.53	12.70	0.61
140	4242838.78	0.39	-0.07	-4214.58	9.53	12.70	0.61
141	3798050.47	0.38	-0.06	-4323.20	9.53	12.70	0.61
142	9845278.67	0.39	-0.12	-8917.59	9.53	12.70	0.61
143	9823196.99	0.41	-0.11	-8895.17	9.53	12.70	0.61
144	8999865.45	0.39	-0.10	-8860.31	9.53	12.70	0.61
145	7681273.17	0.39	-0.08	-8799.61	9.53	12.70	0.61
146	5835874.90	0.39	-0.05	-8694.01	9.53	12.70	0.61
147	5324841.53	0.40	-0.04	-8656.43	9.53	12.70	0.61
148	4757026.67	0.39	-0.02	-8526.69	9.53	12.70	0.61
149	5804329.63	0.72	-0.06	-8161.12	9.53	12.70	0.61
150	6211263.60	0.20	-0.05	-8704.39	9.53	12.70	0.61
151	5842183.95	0.20	-0.04	-8792.52	9.53	12.70	0.61
152	5331150.58	0.20	-0.02	-8707.78	9.53	12.70	0.61
153	9801115.30	0.38	-0.07	-13134.51	9.53	12.70	0.61
154	9062955.99	0.38	-0.07	-13121.97	9.53	12.70	0.61
155	7842154.05	0.37	-0.04	-12807.33	9.53	12.70	0.61
156	6741224.14	0.37	-0.02	-12719.59	9.53	12.70	0.61
157	10085022.70	0.38	-0.10	-8900.51	9.53	12.70	0.61
158	9482508.07	0.38	-0.10	-8877.09	9.53	12.70	0.61
159	7835844.99	0.20	-0.07	-8843.86	9.53	12.70	0.61
160	7290111.83	0.20	-0.07	-8829.74	9.53	12.70	0.61
161	6558261.57	0.20	-0.05	-8761.55	9.53	12.70	0.61
162	10873654.50	0.39	-0.08	-13214.91	9.53	12.70	0.61
163	10113413.50	0.38	-0.08	-13168.77	9.53	12.70	0.61
164	9356326.99	0.38	-0.07	-13127.82	9.53	12.70	0.61
165	8873684.37	0.39	-0.07	-13143.48	9.53	12.70	0.61
166	9249073.08	0.40	-0.07	-13124.66	9.53	12.70	0.61
167	7955717.02	0.38	-0.04	-12876.53	9.53	12.70	0.61
168	8703339.91	0.39	-0.06	-13002.91	9.53	12.70	0.61
169	7416292.91	0.39	-0.03	-12797.88	9.53	12.70	0.61
170	6116627.80	0.38	-0.09	-4291.84	9.53	12.70	0.61
171	5586667.26	0.39	-0.09	-4338.12	9.53	12.70	0.61
172	5012543.36	0.39	-0.07	-4239.90	9.53	12.70	0.61
173	4577218.63	0.39	-0.06	-4216.59	9.53	12.70	0.61
174	4072494.32	0.39	-0.04	-4283.07	9.53	12.70	0.61
175	3441588.92	0.39	-0.01	-4126.54	9.53	12.70	0.61

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
176	9980923.33	0.38	-0.11	-9003.45	9.53	12.70	0.61
177	9438344.70	0.38	-0.10	-8909.46	9.53	12.70	0.61
178	8141834.11	0.67	-0.14	-4544.20	9.53	12.70	0.61
179	7545628.51	0.67	-0.13	-4502.51	9.53	12.70	0.61
180	5962055.97	0.68	-0.08	-4301.98	9.53	12.70	0.61
181	5132415.38	0.68	-0.07	-4100.54	9.53	12.70	0.61
182	4479428.30	0.74	-0.05	-3913.61	9.53	12.70	0.61
183	10198585.70	0.41	-0.12	-8977.27	9.53	12.70	0.61
184	9469889.97	0.39	-0.11	-8845.78	9.53	12.70	0.61
185	8886302.48	0.39	-0.10	-8799.37	9.53	12.70	0.61
186	8290096.88	0.39	-0.09	-8742.36	9.53	12.70	0.61
187	7744363.71	0.39	-0.08	-8719.56	9.53	12.70	0.61
188	7081913.05	0.39	-0.07	-8677.16	9.53	12.70	0.61
189	6302744.89	0.39	-0.06	-8789.89	9.53	12.70	0.61
190	6063000.84	0.38	-0.06	-8708.90	9.53	12.70	0.61
191	5324841.53	0.39	-0.05	-8665.94	9.53	12.70	0.61
192	4662390.86	0.38	-0.01	-8151.15	9.53	12.70	0.61
193	10914663.30	0.39	-0.09	-13152.10	9.53	12.70	0.61
194	9902060.16	0.39	-0.08	-13169.32	9.53	12.70	0.61
195	9466735.44	0.39	-0.08	-13208.58	9.53	12.70	0.61
196	8545613.56	0.39	-0.07	-13061.22	9.53	12.70	0.61
197	7977798.71	0.39	-0.07	-13073.48	9.53	12.70	0.61
198	7028286.09	0.39	-0.04	-12994.89	9.53	12.70	0.61
199	6529870.83	0.38	-0.11	-4187.99	9.53	12.70	0.61
200	5643448.75	0.39	-0.10	-4118.06	9.53	12.70	0.61
201	4798035.52	0.39	-0.08	-4076.04	9.53	12.70	0.61
202	4485737.35	0.39	-0.07	-4209.50	9.53	12.70	0.61
203	3782277.84	0.39	-0.04	-4002.60	9.53	12.70	0.61
204	9782188.14	0.38	-0.12	-8914.14	9.53	12.70	0.61
205	9356326.99	0.39	-0.11	-8919.15	9.53	12.70	0.61
206	8744348.76	0.39	-0.11	-8895.67	9.53	12.70	0.61
207	8040889.25	0.39	-0.10	-8634.24	9.53	12.70	0.61
208	7649727.90	0.39	-0.09	-8602.97	9.53	12.70	0.61
209	7018822.51	0.39	-0.08	-8474.31	9.53	12.70	0.61
210	6359526.37	0.40	-0.07	-8634.76	9.53	12.70	0.61
211	5775938.88	0.38	-0.06	-8598.80	9.53	12.70	0.61
212	9788497.19	0.39	-0.11	-8842.32	9.53	12.70	0.61
213	9012483.55	0.38	-0.09	-8867.91	9.53	12.70	0.61
214	8334260.26	0.38	-0.09	-8613.29	9.53	12.70	0.61
215	7715972.97	0.38	-0.08	-8416.43	9.53	12.70	0.61
216	9703324.96	0.41	-0.11	-8855.20	9.53	12.70	0.61
217	8999865.45	0.40	-0.10	-8873.13	9.53	12.70	0.61
218	8261706.14	0.40	-0.09	-8837.33	9.53	12.70	0.61
219	7630800.74	0.41	-0.09	-8808.30	9.53	12.70	0.61
220	9794806.24	0.41	-0.11	-8926.63	9.53	12.70	0.61
221	9062955.99	0.40	-0.11	-8881.91	9.53	12.70	0.61

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
222	8359496.47	0.41	-0.10	-8850.89	9.53	12.70	0.61
223	7693891.28	0.39	-0.09	-8818.20	9.53	12.70	0.61
224	9807424.35	0.40	-0.10	-8833.98	9.53	12.70	0.61
225	9062955.99	0.40	-0.09	-8878.19	9.53	12.70	0.61
226	8387887.21	0.40	-0.09	-8830.13	9.53	12.70	0.61
227	7738054.66	0.40	-0.08	-8788.57	9.53	12.70	0.61
228	9772724.55	0.41	-0.11	-8893.41	9.53	12.70	0.61
229	9738024.76	0.40	-0.11	-8892.01	9.53	12.70	0.61
230	9772724.55	0.40	-0.10	-8773.99	9.53	12.70	0.61
231	9050337.88	0.41	-0.10	-8816.80	9.53	12.70	0.61
232	8331105.73	0.40	-0.09	-8831.74	9.53	12.70	0.61
233	7706509.39	0.40	-0.08	-8795.34	9.53	12.70	0.61
234	9794806.24	0.41	-0.11	-8948.57	9.53	12.70	0.61
235	8334260.26	0.41	-0.09	-8879.18	9.53	12.70	0.61
236	9829506.04	0.40	-0.11	-8921.70	9.53	12.70	0.61
237	9845278.67	0.41	-0.11	-8978.66	9.53	12.70	0.61
238	9107119.36	0.41	-0.11	-8971.26	9.53	12.70	0.61
239	8454132.28	0.40	-0.10	-8941.34	9.53	12.70	0.61
240	7750672.77	0.41	-0.08	-8894.18	9.53	12.70	0.61
241	9873669.42	0.41	-0.11	-9001.74	9.53	12.70	0.61
242	8409968.90	0.41	-0.10	-8930.03	9.53	12.70	0.61
243	9794806.24	0.39	-0.11	-8913.47	9.53	12.70	0.61
244	9028256.19	0.39	-0.10	-8882.47	9.53	12.70	0.61
245	8359496.47	0.39	-0.09	-8847.90	9.53	12.70	0.61
246	7659191.48	0.39	-0.08	-8809.28	9.53	12.70	0.61
247	6403689.75	0.38	-0.11	-4643.52	9.53	12.70	0.61
248	5883192.80	0.38	-0.10	-4546.31	9.53	12.70	0.61
249	5274369.09	0.39	-0.09	-4380.08	9.53	12.70	0.61
250	4785417.41	0.39	-0.08	-4364.25	9.53	12.70	0.61
251	9810578.88	0.39	-0.11	-8675.01	9.53	12.70	0.61
252	10510883.90	0.39	-0.09	-13516.65	9.53	12.70	0.61
253	11378378.80	0.40	-0.10	-13554.22	9.53	12.70	0.61
254	9810578.88	0.39	-0.08	-13487.46	9.53	12.70	0.61
255	9085037.67	0.39	-0.08	-13465.62	9.53	12.70	0.61
256	8416277.96	0.40	-0.07	-13439.43	9.53	12.70	0.61
257	7700200.33	0.39	-0.06	-13392.03	9.53	12.70	0.61
258	9867360.36	0.39	-0.12	-8886.55	9.53	12.70	0.61
259	9788497.19	0.39	-0.12	-8879.48	9.53	12.70	0.61
260	8331105.73	0.39	-0.10	-8812.82	9.53	12.70	0.61
261	5832720.37	0.38	-0.06	-8724.07	9.53	12.70	0.61
262	9753797.39	0.38	-0.11	-8857.15	9.53	12.70	0.61
263	9085037.67	0.38	-0.10	-8838.75	9.53	12.70	0.61
264	8359496.47	0.38	-0.09	-8804.89	9.53	12.70	0.61
265	7649727.90	0.38	-0.08	-8764.65	9.53	12.70	0.61
266	9810578.88	0.38	-0.11	-8869.96	9.53	12.70	0.61
267	11384687.80	0.39	-0.10	-13328.97	9.53	12.70	0.61

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
268	10596056.10	0.39	-0.09	-13278.29	9.53	12.70	0.61
269	9823196.99	0.38	-0.08	-13423.45	9.53	12.70	0.61
270	9085037.67	0.38	-0.08	-13424.83	9.53	12.70	0.61
271	8473059.44	0.39	-0.07	-13365.45	9.53	12.70	0.61
272	7687582.23	0.38	-0.06	-13287.54	9.53	12.70	0.61
273	9810578.88	0.38	-0.11	-8902.29	9.53	12.70	0.61
274	9526671.45	0.39	-0.11	-8885.20	9.53	12.70	0.61
275	9050337.88	0.39	-0.10	-8848.41	9.53	12.70	0.61
276	8362651.00	0.38	-0.09	-8844.51	9.53	12.70	0.61
277	7681273.17	0.39	-0.08	-8831.33	9.53	12.70	0.61
278	11406769.50	0.39	-0.09	-13534.30	9.53	12.70	0.61
279	10583438.00	0.39	-0.09	-13519.71	9.53	12.70	0.61
280	9816887.93	0.39	-0.08	-13481.26	9.53	12.70	0.61
281	9056646.93	0.39	-0.08	-13413.74	9.53	12.70	0.61
282	8375269.11	0.39	-0.07	-13375.95	9.53	12.70	0.61
283	7340584.26	0.39	-0.06	-13472.06	9.53	12.70	0.61
284	9864205.84	0.38	-0.12	-8855.47	9.53	12.70	0.61
285	9107119.36	0.39	-0.11	-8820.74	9.53	12.70	0.61
286	5804329.63	0.38	-0.06	-8708.06	9.53	12.70	0.61
287	5286987.20	0.39	-0.05	-8662.76	9.53	12.70	0.61
288	4769644.78	0.38	-0.02	-8463.23	9.53	12.70	0.61
289	9794806.24	0.38	-0.11	-8992.92	9.53	12.70	0.61
290	4804344.58	0.69	-0.06	-4033.32	9.53	12.70	0.61
291	9760106.45	0.39	-0.14	-8977.02	9.53	12.70	0.61
292	9829506.04	0.39	-0.11	-9030.98	9.53	12.70	0.61
293	9078728.62	0.39	-0.06	-8856.55	9.53	12.70	0.61
294	8362651.00	0.39	-0.10	-8973.91	9.53	12.70	0.61
295	7687582.23	0.39	-0.09	-8941.18	9.53	12.70	0.61
296	9835815.09	0.39	-0.11	-9038.99	9.53	12.70	0.61
297	11441469.30	0.39	-0.10	-13503.54	9.53	12.70	0.61
298	10618137.80	0.39	-0.09	-13456.14	9.53	12.70	0.61
299	9867360.36	0.39	-0.09	-13414.83	9.53	12.70	0.61
300	9157591.80	0.39	-0.08	-13365.98	9.53	12.70	0.61
301	8346878.36	0.39	-0.07	-13389.40	9.53	12.70	0.61
302	7671809.59	0.39	-0.06	-13342.36	9.53	12.70	0.61
303	9845278.67	0.38	-0.12	-8938.16	9.53	12.70	0.61
304	9526671.45	0.39	-0.12	-8935.26	9.53	12.70	0.61
305	4757026.67	0.35	-0.02	-8271.39	9.53	12.70	0.61
306	4217602.56	0.21	-0.07	-4524.43	9.53	12.70	0.61
307	3753887.09	0.20	-0.06	-3850.24	9.53	12.70	0.61
308	3337489.53	0.20	-0.05	-4369.70	9.53	12.70	0.61
309	9545598.61	0.38	-0.12	-8892.83	9.53	12.70	0.61
310	4757026.67	0.45	-0.07	-4279.18	9.53	12.70	0.61
311	4315392.90	0.66	-0.07	-4110.00	9.53	12.70	0.61
312	3848522.90	0.68	-0.05	-4275.55	9.53	12.70	0.61
313	9835815.09	0.38	-0.13	-8908.72	9.53	12.70	0.61

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
314	9753797.39	0.38	-0.11	-8974.59	9.53	12.70	0.61
315	9056646.93	0.38	-0.10	-8969.77	9.53	12.70	0.61
316	8375269.11	0.38	-0.09	-8941.98	9.53	12.70	0.61
317	7681273.17	0.38	-0.08	-8902.79	9.53	12.70	0.61
318	11384687.80	0.39	-0.09	-13535.68	9.53	12.70	0.61
319	10618137.80	0.39	-0.09	-13482.69	9.53	12.70	0.61
320	9772724.55	0.39	-0.08	-13458.25	9.53	12.70	0.61
321	9107119.36	0.39	-0.08	-13420.27	9.53	12.70	0.61
322	8334260.26	0.39	-0.07	-13280.48	9.53	12.70	0.61
323	9810578.88	0.39	-0.11	-8920.88	9.53	12.70	0.61
324	9810578.88	0.38	-0.12	-8924.32	9.53	12.70	0.61
325	9753797.39	0.38	-0.11	-8991.19	9.53	12.70	0.61
326	6422616.91	0.38	-0.11	-4543.49	9.53	12.70	0.61
327	5813793.21	0.38	-0.10	-4500.48	9.53	12.70	0.61
328	5268060.04	0.38	-0.09	-4405.28	9.53	12.70	0.61
329	4747563.09	0.38	-0.07	-4356.79	9.53	12.70	0.61
330	4242838.78	0.38	-0.06	-4334.15	9.53	12.70	0.61
331	3798050.47	0.38	-0.05	-4373.15	9.53	12.70	0.61
332	9760106.45	0.38	-0.12	-8869.49	9.53	12.70	0.61
333	9583452.94	0.39	-0.11	-8938.34	9.53	12.70	0.61
334	8873684.37	0.39	-0.11	-8950.98	9.53	12.70	0.61
335	8176533.91	0.39	-0.10	-8962.47	9.53	12.70	0.61
336	7545628.51	0.39	-0.09	-8950.85	9.53	12.70	0.61
337	9652852.53	0.66	-0.12	-8826.45	9.53	12.70	0.61
338	8318487.62	0.66	-0.10	-8736.79	9.53	12.70	0.61
339	6302744.89	0.38	-0.11	-4523.70	9.53	12.70	0.61
340	5757011.72	0.38	-0.10	-4289.75	9.53	12.70	0.61
341	5211278.56	0.39	-0.08	-4362.83	9.53	12.70	0.61
342	9681243.27	0.39	-0.09	-13653.45	9.53	12.70	0.61
343	8879993.42	0.39	-0.08	-13425.92	9.53	12.70	0.61
344	7592946.42	0.40	-0.13	-4487.71	9.53	12.70	0.61
345	6949422.92	0.38	-0.01	-4236.40	9.53	12.70	0.61
346	6353217.32	0.38	-0.11	-4404.39	9.53	12.70	0.61
347	5769629.83	0.39	-0.10	-4379.84	9.53	12.70	0.61
348	9652852.53	0.38	-0.12	-8900.97	9.53	12.70	0.61
349	10482493.10	0.39	-0.11	-8892.39	9.53	12.70	0.61
350	9750642.87	0.39	-0.11	-8863.05	9.53	12.70	0.61
351	8965165.65	0.39	-0.09	-8827.05	9.53	12.70	0.61
352	8239624.45	0.39	-0.09	-8790.81	9.53	12.70	0.61
353	7637109.80	0.39	-0.08	-8764.76	9.53	12.70	0.61
354	6971504.60	0.39	-0.07	-8724.62	9.53	12.70	0.61
355	6971504.60	0.38	-0.11	-4434.28	9.53	12.70	0.61
356	6428925.97	0.38	-0.10	-4396.82	9.53	12.70	0.61
357	5791711.52	0.38	-0.09	-4392.10	9.53	12.70	0.61
358	5239669.30	0.39	-0.09	-4350.02	9.53	12.70	0.61
359	10532965.60	0.39	-0.12	-8907.39	9.53	12.70	0.61

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
360	9725406.65	0.38	-0.11	-8879.42	9.53	12.70	0.61
361	10555047.20	0.39	-0.09	-13363.21	9.53	12.70	0.61
362	9750642.87	0.39	-0.08	-13342.27	9.53	12.70	0.61
363	8993556.39	0.39	-0.07	-13264.27	9.53	12.70	0.61
364	8290096.88	0.39	-0.07	-13198.55	9.53	12.70	0.61
365	10539274.60	0.66	-0.13	-8823.27	9.53	12.70	0.61
366	11356297.10	0.66	-0.14	-8814.86	9.53	12.70	0.61
367	10583438.00	0.66	-0.13	-8803.15	9.53	12.70	0.61
368	7621337.16	0.38	-0.13	-4439.65	9.53	12.70	0.61
369	6949422.92	0.38	-0.12	-4401.99	9.53	12.70	0.61
370	9725406.65	0.39	-0.12	-8901.04	9.53	12.70	0.61
371	6971504.60	0.44	-0.05	-12944.73	9.53	12.70	0.61
372	6971504.60	0.26	-0.02	-13097.48	9.53	12.70	0.61
373	4753872.14	0.39	-0.04	-8663.20	9.53	12.70	0.61
374	10384702.80	0.39	-0.13	-9058.14	9.53	12.70	0.61
375	9693861.38	0.38	-0.11	-9017.44	9.53	12.70	0.61
376	8965165.65	0.39	-0.10	-8981.14	9.53	12.70	0.61
377	8245933.50	0.38	-0.09	-8825.26	9.53	12.70	0.61
378	7615028.11	0.39	-0.08	-8886.56	9.53	12.70	0.61
379	6949422.92	0.38	-0.07	-8846.54	9.53	12.70	0.61
380	6387917.12	0.38	-0.10	-4377.22	9.53	12.70	0.61
381	5804329.63	0.38	-0.09	-4356.86	9.53	12.70	0.61
382	5258596.46	0.38	-0.08	-4458.47	9.53	12.70	0.61
383	4706554.24	0.39	-0.07	-4466.02	9.53	12.70	0.61
384	10447793.30	0.38	-0.12	-8917.68	9.53	12.70	0.61
385	11214343.40	0.39	-0.10	-13463.22	9.53	12.70	0.61
386	10435175.20	0.39	-0.09	-13392.73	9.53	12.70	0.61
387	9715943.07	0.39	-0.08	-13415.63	9.53	12.70	0.61
388	8965165.65	0.39	-0.08	-13348.10	9.53	12.70	0.61
389	8249088.03	0.39	-0.07	-13270.80	9.53	12.70	0.61
390	11315288.20	0.66	-0.15	-8880.07	9.53	12.70	0.61
391	10548738.20	0.66	-0.14	-8884.95	9.53	12.70	0.61
392	9715943.07	0.39	-0.12	-8831.98	9.53	12.70	0.61
393	11312133.70	0.39	-0.10	-13521.68	9.53	12.70	0.61
394	6968350.08	0.40	-0.03	-12985.76	9.53	12.70	0.61
395	5779093.41	0.38	-0.06	-8686.15	9.53	12.70	0.61
396	5211278.56	0.38	-0.05	-8599.43	9.53	12.70	0.61
397	4690781.61	0.38	-0.02	-8431.85	9.53	12.70	0.61
398	3769659.73	0.39	-0.04	-4229.42	9.53	12.70	0.61
399	7659191.48	0.39	-0.07	-13235.49	9.53	12.70	0.61
400	6927341.23	0.39	-0.06	-13263.57	9.53	12.70	0.61
401	6353217.32	0.39	-0.03	-12995.84	9.53	12.70	0.61
402	5245978.35	0.38	-0.06	-8690.66	9.53	12.70	0.61
403	4927371.13	0.39	-0.05	-8628.15	9.53	12.70	0.61
404	4621382.01	0.39	-0.05	-8630.69	9.53	12.70	0.61
405	4217602.56	0.36	-0.02	-8358.20	9.53	12.70	0.61

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
406	4186057.29	0.39	-0.07	-4319.91	9.53	12.70	0.61
407	3760196.15	0.38	-0.05	-4195.08	9.53	12.70	0.61
408	10463566.00	0.38	-0.12	-9014.00	9.53	12.70	0.61
409	9624461.79	0.38	-0.11	-9012.30	9.53	12.70	0.61
410	9368945.10	0.38	-0.10	-8984.52	9.53	12.70	0.61
411	9551907.67	0.38	-0.10	-8982.89	9.53	12.70	0.61
412	10469875.00	0.38	-0.13	-9064.98	9.53	12.70	0.61
413	5182887.81	0.38	-0.05	-8748.96	9.53	12.70	0.61
414	4684472.55	0.38	-0.02	-8651.08	9.53	12.70	0.61
415	11236425.10	0.39	-0.10	-13564.34	9.53	12.70	0.61
416	7551937.57	0.38	-0.06	-13107.27	9.53	12.70	0.61
417	6943113.86	0.38	-0.04	-12910.09	9.53	12.70	0.61
418	9879978.47	0.40	-0.10	-8895.96	9.53	12.70	0.61
419	4321701.95	0.37	-0.02	-8419.70	9.53	12.70	0.61
420	9829506.04	0.38	-0.10	-8873.95	9.53	12.70	0.61
421	9829506.04	0.38	-0.10	-8861.05	9.53	12.70	0.61
422	5081942.95	0.38	-0.04	-8540.42	9.53	12.70	0.61
423	4813808.16	0.35	-0.02	-8444.44	9.53	12.70	0.61
424	9920987.32	0.38	-0.11	-8915.47	9.53	12.70	0.61
425	9034565.24	0.39	-0.10	-8894.31	9.53	12.70	0.61
426	5321687.00	0.39	-0.04	-8677.54	9.53	12.70	0.61
427	4839044.37	0.37	-0.02	-8514.35	9.53	12.70	0.61
428	9810578.88	0.39	-0.11	-8942.42	9.53	12.70	0.61
429	6485707.45	0.33	-0.01	-12813.96	9.53	12.70	0.61
430	7138694.53	0.37	-0.02	-13129.38	9.53	12.70	0.61
431	5372159.43	0.38	-0.04	-8503.30	9.53	12.70	0.61
432	4854817.01	0.34	-0.01	-8282.60	9.53	12.70	0.61
433	4359556.27	0.38	-0.06	-4187.93	9.53	12.70	0.61
434	10709619.10	0.39	-0.12	-8964.40	9.53	12.70	0.61
435	9965150.70	0.38	-0.11	-8939.96	9.53	12.70	0.61
436	5359541.32	0.38	-0.04	-8612.74	9.53	12.70	0.61
437	9943069.01	0.39	-0.11	-8942.95	9.53	12.70	0.61
438	5337459.63	0.38	-0.07	-4391.02	9.53	12.70	0.61
439	9930450.90	0.40	-0.12	-8987.27	9.53	12.70	0.61
440	6542488.94	0.68	-0.06	-8326.48	9.53	12.70	0.61
441	6536179.88	0.21	-0.06	-8730.27	9.53	12.70	0.61
442	5905274.49	0.21	-0.04	-8789.86	9.53	12.70	0.61
443	5280678.15	0.21	-0.03	-8823.26	9.53	12.70	0.61
444	10573974.40	0.39	-0.13	-9033.04	9.53	12.70	0.61
445	9779033.61	0.40	-0.12	-9009.73	9.53	12.70	0.61
446	6933650.28	0.21	-0.08	-8910.85	9.53	12.70	0.61
447	6337444.68	0.21	-0.07	-8793.54	9.53	12.70	0.61
448	5750702.67	0.21	-0.06	-8803.50	9.53	12.70	0.61
449	5217587.61	0.21	-0.03	-8606.20	9.53	12.70	0.61
450	9744333.81	0.31	-0.10	-8996.46	9.53	12.70	0.61
451	5785402.46	0.21	-0.09	-4550.90	9.53	12.70	0.61

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
452	5236514.77	0.21	-0.08	-4533.00	9.53	12.70	0.61
453	4684472.55	0.21	-0.07	-4516.30	9.53	12.70	0.61
454	4223911.61	0.21	-0.06	-4448.01	9.53	12.70	0.61
455	4258611.41	0.39	-0.07	-4316.85	9.53	12.70	0.61
456	9722252.12	0.39	-0.13	-4223.09	9.53	12.70	0.61
457	6996740.82	0.40	-0.09	-8807.23	9.53	12.70	0.61
458	5775938.88	0.40	-0.07	-8723.72	9.53	12.70	0.61
459	5236514.77	0.39	-0.06	-8656.34	9.53	12.70	0.61
460	4734944.98	0.40	-0.03	-8472.98	9.53	12.70	0.61
461	4734944.98	0.23	-0.02	-8547.24	9.53	12.70	0.61
462	4980998.09	0.21	-0.06	-8829.13	9.53	12.70	0.61
463	10460411.40	0.39	-0.13	-9037.06	9.53	12.70	0.61
464	9646543.48	0.40	-0.12	-8918.05	9.53	12.70	0.61
465	8949393.02	0.40	-0.12	-8904.20	9.53	12.70	0.61
466	10441484.30	0.40	-0.14	-8959.44	9.53	12.70	0.61
467	5734930.03	0.40	-0.06	-8754.15	9.53	12.70	0.61
468	5211278.56	0.39	-0.05	-8722.22	9.53	12.70	0.61
469	4678163.50	0.38	-0.03	-8547.29	9.53	12.70	0.61
470	6927341.23	0.40	-0.14	-4509.17	9.53	12.70	0.61
471	6324826.58	0.39	-0.13	-4470.31	9.53	12.70	0.61
472	5747548.14	0.39	-0.12	-4476.78	9.53	12.70	0.61
473	5167115.18	0.39	-0.10	-4454.22	9.53	12.70	0.61
474	4668699.92	0.40	-0.09	-4347.35	9.53	12.70	0.61
475	4208138.98	0.40	-0.08	-4436.61	9.53	12.70	0.61
476	9652852.53	0.40	-0.12	-8913.18	9.53	12.70	0.61
477	7539319.46	0.40	-0.07	-13266.64	9.53	12.70	0.61
478	6921032.17	0.40	-0.06	-13258.06	9.53	12.70	0.61
479	6331135.63	0.39	-0.05	-13214.87	9.53	12.70	0.61
480	4570909.58	0.39	-0.03	-13018.31	9.53	12.70	0.61
481	5747548.14	0.56	-0.06	-12980.09	9.53	12.70	0.61
482	4684472.55	0.40	-0.09	-4404.03	9.53	12.70	0.61
483	4189211.82	0.40	-0.08	-4354.71	9.53	12.70	0.61
484	3725496.35	0.39	-0.07	-4306.65	9.53	12.70	0.61
485	4668699.92	0.21	-0.09	-4408.57	9.53	12.70	0.61
486	4157666.55	0.19	-0.07	-4390.50	9.53	12.70	0.61
487	3719187.30	0.21	-0.07	-4392.42	9.53	12.70	0.61
488	9652852.53	0.40	-0.14	-8988.06	9.53	12.70	0.61
489	5722311.92	0.40	-0.07	-8756.00	9.53	12.70	0.61
490	5195505.92	0.40	-0.07	-8725.68	9.53	12.70	0.61
491	4678163.50	0.34	-0.02	-8541.35	9.53	12.70	0.61
492	4643463.70	0.21	-0.10	-4515.23	9.53	12.70	0.61
493	4157666.55	0.21	-0.09	-4494.03	9.53	12.70	0.61
494	3703414.66	0.21	-0.08	-4428.57	9.53	12.70	0.61
495	9602380.10	0.40	-0.16	-8961.23	9.53	12.70	0.61
496	9652852.53	0.40	-0.11	-9007.74	9.53	12.70	0.61
497	8958856.60	0.40	-0.10	-8951.56	9.53	12.70	0.61

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
498	7608719.05	0.39	-0.04	-13086.87	9.53	12.70	0.61
499	8245933.50	0.40	-0.06	-13199.73	9.53	12.70	0.61
500	9687552.33	0.39	-0.11	-8902.60	9.53	12.70	0.61
501	5747548.14	0.38	-0.05	-8693.82	9.53	12.70	0.61
502	5211278.56	0.39	-0.04	-8606.95	9.53	12.70	0.61
503	4712863.29	0.36	-0.02	-8552.33	9.53	12.70	0.61
504	9674934.22	0.39	-0.11	-8951.55	9.53	12.70	0.61
505	6962041.02	0.39	-0.12	-4506.69	9.53	12.70	0.61
506	6372144.48	0.40	-0.09	-4356.04	9.53	12.70	0.61
507	4684472.55	0.41	-0.07	-4243.17	9.53	12.70	0.61
508	9738024.76	0.40	-0.11	-8837.76	9.53	12.70	0.61
509	9021947.14	0.40	-0.06	-8684.97	9.53	12.70	0.61
510	5779093.41	0.40	-0.05	-8627.07	9.53	12.70	0.61
511	5252287.41	0.39	-0.04	-8581.48	9.53	12.70	0.61
512	7637109.80	0.41	-0.05	-13096.58	9.53	12.70	0.61
513	9725406.65	0.39	-0.11	-8846.94	9.53	12.70	0.61
514	6990431.77	0.40	-0.11	-4410.17	9.53	12.70	0.61
515	5223896.66	0.40	-0.08	-4291.69	9.53	12.70	0.61
516	10577128.90	0.40	-0.09	-13324.03	9.53	12.70	0.61
517	9028256.19	0.40	-0.07	-13228.77	9.53	12.70	0.61
518	8302714.99	0.40	-0.06	-13203.51	9.53	12.70	0.61
519	7615028.11	0.39	-0.05	-13000.24	9.53	12.70	0.61
520	6968350.08	0.40	-0.04	-12909.99	9.53	12.70	0.61
521	5779093.41	0.38	-0.05	-8702.11	9.53	12.70	0.61
522	5252287.41	0.40	-0.04	-8681.61	9.53	12.70	0.61
523	6148173.07	0.38	-0.02	-8569.76	9.53	12.70	0.61
524	5236514.77	0.40	-0.08	-4377.60	9.53	12.70	0.61
525	4712863.29	0.40	-0.07	-4278.23	9.53	12.70	0.61
526	9766415.50	0.40	-0.12	-8932.83	9.53	12.70	0.61
527	7239639.40	0.45	-0.11	-8854.83	7.82	19.05	0.61
528	9526671.45	0.45	-0.15	-8935.93	8.43	53.98	0.61
529	10037704.80	0.45	-0.15	-8945.43	8.43	53.98	0.61
530	7772754.46	0.45	-0.09	-8722.82	8.43	53.98	0.61
531	10255367.20	0.45	-0.15	-8941.26	8.43	53.98	0.61
532	7608719.05	0.45	-0.10	-8787.77	8.43	53.98	0.61
533	9867360.36	0.45	-0.15	-8930.55	8.43	53.98	0.61
534	6551952.52	0.45	-0.09	-8741.48	8.43	53.98	0.61
535	6570879.68	0.45	-0.09	-8741.48	8.43	53.98	0.61
536	8842139.10	0.45	-0.16	-8898.84	8.43	53.98	0.61
537	8766430.45	0.45	-0.16	-8924.11	8.43	53.98	0.61
538	11406769.50	0.45	-0.15	-8930.55	8.43	53.98	0.61
539	7621337.16	0.45	-0.09	-8754.91	8.43	53.98	0.61
540	11372069.70	0.45	-0.15	-8941.26	8.43	53.98	0.61
542	9816887.93	0.45	-0.09	-13104.93	8.43	53.98	0.61
543	9952532.59	0.45	-0.09	-13115.03	8.43	53.98	0.61
544	11902030.30	0.45	-0.15	-8930.55	8.43	53.98	0.61

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
545	5637139.70	0.45	-0.06	-8643.00	8.43	53.98	0.61
546	8217542.76	0.45	-0.07	-12819.56	8.43	53.98	0.61
547	5451022.60	0.45	-0.09	-4323.48	8.43	53.98	0.61
548	4214448.03	0.45	-0.05	-4334.86	8.43	53.98	0.61
549	5548812.94	0.45	-0.09	-4381.39	8.43	53.98	0.61
550	4668699.92	0.45	-0.06	-4320.06	8.43	53.98	0.61
551	5939974.29	0.45	-0.06	-8643.00	8.43	53.98	0.61
552	7637109.80	0.45	-0.06	-12968.23	8.43	53.98	0.61
553	7507774.19	0.45	-0.06	-12946.31	8.43	53.98	0.61
554	11747458.40	0.45	-0.15	-8941.26	8.43	53.98	0.61
555	12031365.90	0.45	-0.12	-13099.93	8.43	53.98	0.61
556	12400445.50	0.45	-0.12	-13277.19	8.43	53.98	0.61
557	7450992.70	0.45	-0.15	-4448.91	8.43	53.98	0.61
558	6990431.77	0.45	-0.14	-4393.80	8.43	53.98	0.61
559	7482537.97	0.45	-0.15	-4463.79	8.43	53.98	0.61
560	10690691.90	0.45	-0.15	-8897.82	8.43	53.98	0.61
561	4384792.49	0.45	-0.05	-4173.77	8.43	53.98	0.61
562	5842183.95	0.45	-0.07	-4207.37	8.43	53.98	0.61
563	6400535.22	0.45	-0.09	-4247.63	8.43	53.98	0.61
564	9693861.38	0.45	-0.15	-8676.87	8.43	53.98	0.61
565	9914678.27	0.45	-0.15	-8715.58	8.43	53.98	0.61
566	8574004.31	0.45	-0.10	-8596.93	8.43	53.98	0.61
567	10725391.70	0.45	-0.16	-8701.20	8.43	53.98	0.61
568	5968365.03	0.45	-0.09	-8545.52	8.43	53.98	0.61
569	5842183.95	0.45	-0.10	-8550.12	8.43	53.98	0.61
570	9659161.58	0.45	-0.12	-8865.53	7.82	19.05	0.61
571	11520332.50	0.45	-0.12	-13417.71	7.82	19.05	0.61
572	11561341.30	0.45	-0.12	-13398.51	7.82	19.05	0.61
573	7290111.83	0.45	-0.12	-4571.40	7.82	19.05	0.61
574	7359511.42	0.45	-0.12	-4376.39	7.82	19.05	0.61
575	9681243.27	0.45	-0.12	-8878.03	7.82	19.05	0.61
576	7450992.70	0.45	-0.10	-8825.17	7.82	19.05	0.61
577	7091376.63	0.45	-0.09	-8783.33	7.82	19.05	0.61
578	6331135.63	0.45	-0.09	-4393.94	7.82	19.05	0.61
579	6337444.68	0.45	-0.11	-8868.99	7.82	19.05	0.61
580	7268030.14	0.45	-0.10	-8832.45	7.82	19.05	0.61
581	7914708.17	0.45	-0.12	-13105.42	7.82	19.05	0.61
582	10766400.60	0.45	-0.09	-12952.84	7.82	19.05	0.61
583	10668610.20	0.45	-0.09	-13250.00	7.82	19.05	0.61
584	8359496.47	0.45	-0.09	-8767.27	7.82	19.05	0.61
585	5955746.92	0.45	-0.09	-4523.54	7.82	19.05	0.61
586	4700245.19	0.45	-0.06	-4425.87	7.82	19.05	0.61
587	5734930.03	0.45	-0.05	-8697.43	7.82	19.05	0.61
588	2555166.85	0.30	-0.04	-2894.35	6.35	12.70	0.61
589	3028345.89	0.29	-0.05	-5858.49	6.35	12.70	0.61
590	3186072.24	0.29	-0.05	-5861.10	6.35	12.70	0.61

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
591	3249162.78	0.28	-0.04	-5785.26	6.35	12.70	0.61
592	2555166.85	0.23	-0.01	-5801.36	6.35	12.70	0.61
593	3659251.29	0.37	-0.07	-5810.98	6.35	12.70	0.61
594	3911613.44	0.43	-0.08	-5814.60	6.35	12.70	0.61
595	3659251.29	0.43	-0.04	-5712.19	6.35	12.70	0.61
596	4132430.33	0.45	-0.08	-5776.40	6.35	12.70	0.61
597	3059891.16	0.29	-0.03	-5851.63	6.35	12.70	0.61
598	4510973.57	0.34	-0.04	-9660.78	6.35	12.70	0.61
599	4321701.95	0.34	-0.04	-9631.28	6.35	12.70	0.61
600	4069339.79	0.34	-0.03	-9597.64	6.35	12.70	0.61
601	2050442.53	0.28	-0.04	-1562.44	6.35	12.70	0.61
602	4763335.73	0.34	-0.06	-9942.77	6.35	12.70	0.61
603	3469979.67	0.37	-0.05	-4322.43	6.35	12.70	0.61
604	4605609.38	1.05	-0.10	-4345.80	6.35	12.70	0.61
605	3122981.70	0.21	-0.05	-4478.89	6.35	12.70	0.61
606	3280708.05	0.64	-0.05	-4238.08	6.35	12.70	0.61
607	3280708.05	0.66	-0.06	-4255.96	6.35	12.70	0.61
608	3438434.40	0.69	-0.05	-5654.82	6.35	12.70	0.61
609	5741239.09	0.61	-0.07	-9052.99	9.53	12.70	0.61
610	3943158.71	0.34	-0.05	-7213.93	9.53	12.70	0.61
611	3533070.21	0.34	-0.05	-5712.18	9.53	12.70	0.61
612	3469979.67	0.35	-0.06	-4344.56	9.53	12.70	0.61
613	3816977.63	0.45	-0.07	-3473.92	9.53	12.70	0.61
614	3974703.98	0.76	-0.08	-3421.99	9.53	12.70	0.61
615	3091436.43	0.17	-0.04	-3525.08	9.53	12.70	0.61
616	3943158.71	0.69	-0.07	-3411.19	9.53	12.70	0.61
617	3280708.05	0.28	-0.06	-3501.12	9.53	12.70	0.61
618	5236514.77	0.61	-0.06	-6899.69	12.70	12.70	0.61
619	5236514.77	0.43	-0.05	-9801.65	12.70	12.70	0.61
620	3911613.44	0.45	-0.07	-3762.06	12.70	12.70	0.61
621	5835874.90	0.45	-0.07	-9993.68	12.70	12.70	0.61
622	3406889.13	0.37	-0.05	-4335.85	12.70	12.70	0.61
623	4132430.33	3.61	-0.07	-5900.10	12.70	12.70	0.61
624	5204969.50	3.59	-0.10	-6400.41	12.70	12.70	0.61
625	3596160.75	3.62	-0.11	-2738.40	12.70	12.70	0.61
626	2807529.00	3.59	-0.05	-2774.61	12.70	12.70	0.61
627	5394241.12	8.42	-0.14	-6326.25	12.70	12.70	0.61
628	3533070.21	0.69	-0.05	-5677.04	12.70	12.70	0.61
629	2334349.96	0.69	-0.03	-5568.31	12.70	12.70	0.61
630	3343798.59	0.34	-0.06	-5745.70	12.70	12.70	0.61
631	3028345.89	0.69	-0.05	-4316.70	12.70	12.70	0.61
632	2586712.12	0.69	-0.05	-4222.90	12.70	12.70	0.61
633	2649802.66	0.69	-0.04	-4218.29	12.70	12.70	0.61
634	2302804.69	0.69	-0.03	-4057.31	12.70	12.70	0.61
635	2649802.66	0.69	-0.04	-5608.86	12.70	12.70	0.61
636	5772784.36	0.69	-0.10	-5878.39	12.70	12.70	0.61

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
637	3059891.16	0.69	-0.09	-1435.32	12.70	12.70	0.61
638	3059891.16	0.69	-0.09	-1433.24	12.70	12.70	0.61
639	2555166.85	0.69	-0.04	-2810.65	12.70	12.70	0.61
640	2555166.85	0.69	-0.04	-2809.10	12.70	12.70	0.61
641	5110333.69	0.69	-0.11	-4342.28	12.70	12.70	0.61
642	3501524.94	0.69	-0.05	-6824.04	12.70	12.70	0.61
643	3943158.71	0.69	-0.11	-2893.54	12.70	12.70	0.61
644	2302804.69	0.69	-0.04	-2810.65	12.70	12.70	0.61
645	6561416.10	0.69	-0.10	-8061.95	12.70	12.70	0.61
646	4258611.41	0.43	-0.07	-6154.58	19.05	12.70	0.61
647	5425786.39	0.62	-0.08	-6500.26	19.05	12.70	0.61
648	3690796.56	0.45	-0.07	-3471.72	19.05	12.70	0.61
649	2744438.46	0.19	-0.05	-3494.63	19.05	12.70	0.61
650	4006249.25	0.76	-0.09	-3370.68	19.05	12.70	0.61
651	2712893.19	0.19	-0.05	-3464.38	19.05	12.70	0.61
652	3911613.44	0.70	-0.08	-3377.64	19.05	12.70	0.61
653	3596160.75	3.59	-0.08	-3420.40	19.05	12.70	0.61
654	3469979.67	7.87	-0.15	-2071.51	19.05	12.70	0.61
655	4037794.52	0.69	-0.07	-4276.37	19.05	12.70	0.61
656	3438434.40	0.36	-0.06	-3919.14	19.05	12.70	0.61
657	4227066.14	0.41	-0.07	-4757.97	19.05	12.70	0.61
658	4889516.80	0.52	-0.08	-5539.87	19.05	12.70	0.61
987	1008000.00	3.55	0.38	81.30	7.50	9.92	0.61
988	1008000.00	2.99	0.38	82.40	7.50	9.92	0.61
989	1008000.00	2.70	0.34	88.00	7.50	9.92	0.61
990	1004000.00	2.11	0.33	89.50	7.50	9.92	0.61
991	1005000.00	1.55	0.28	101.50	7.50	9.92	0.61
992	1009000.00	1.23	0.26	110.80	7.50	9.92	0.61
993	1005000.00	1.03	0.23	118.20	7.50	9.92	0.61
994	997000.00	3.43	0.36	79.30	7.50	9.92	0.61
995	1000000.00	3.50	0.44	71.90	7.50	9.92	0.61
996	995000.00	2.50	0.36	81.80	7.50	9.92	0.61
997	999000.00	1.57	0.29	96.00	7.50	9.92	0.61
998	999000.00	0.98	0.23	112.70	7.50	9.92	0.61
999	1008000.00	3.43	0.37	78.00	7.50	9.92	0.61
1000	1010000.00	2.22	0.34	84.90	7.50	9.92	0.61
1001	1033000.00	1.84	0.31	89.80	7.50	9.92	0.61
1002	1001000.00	1.47	0.25	102.80	7.50	9.92	0.61
1003	1000000.00	2.40	0.37	80.00	7.50	9.92	0.61
1004	1560000.00	3.43	0.30	130.60	7.50	9.92	0.61
1005	1571000.00	3.38	0.31	130.60	7.50	9.92	0.61
1006	1568000.00	2.94	0.29	136.30	7.50	9.92	0.61
1007	1567000.00	2.70	0.27	142.00	7.50	9.92	0.61
1008	1569000.00	2.50	0.25	146.20	7.50	9.92	0.61
1009	1573000.00	2.21	0.24	152.30	7.50	9.92	0.61
1010	1581000.00	1.86	0.23	160.50	7.50	9.92	0.61

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
1011	1574000.00	1.67	0.19	172.80	7.50	9.92	0.61
1012	1573000.00	1.57	0.17	176.00	7.50	9.92	0.61
1013	1578000.00	1.42	0.19	178.50	7.50	9.92	0.61
1014	1565000.00	3.33	0.29	133.70	7.50	9.92	0.61
1015	1560000.00	3.06	0.28	136.20	7.50	9.92	0.61
1016	1559000.00	2.84	0.27	140.00	7.50	9.92	0.61
1017	1588000.00	2.70	0.26	142.50	7.50	9.92	0.61
1018	1568000.00	2.52	0.27	143.00	7.50	9.92	0.61
1019	1568000.00	2.35	0.25	149.30	7.50	9.92	0.61
1020	1573000.00	2.16	0.24	154.40	7.50	9.92	0.61
1021	1571000.00	1.96	0.23	159.20	7.50	9.92	0.61
1022	1573000.00	1.79	0.20	167.20	7.50	9.92	0.61
1023	1581000.00	1.57	0.20	172.80	7.50	9.92	0.61
1024	1595000.00	1.37	0.20	179.70	7.50	9.92	0.61
1025	1583000.00	1.23	0.17	192.70	7.50	9.92	0.61
1026	1567000.00	1.08	0.15	205.00	7.50	9.92	0.61
1027	1544000.00	1.52	0.19	172.20	7.50	9.92	0.61
1028	1530000.00	1.32	0.18	179.00	7.50	9.92	0.61
1029	1530000.00	1.08	0.16	194.50	7.50	9.92	0.61
1030	1979000.00	3.53	0.21	194.00	7.50	9.92	0.61
1031	2008000.00	3.16	0.24	191.50	7.50	9.92	0.61
1032	1994000.00	2.79	0.22	198.00	7.50	9.92	0.61
1033	1994000.00	2.65	0.22	201.50	7.50	9.92	0.61
1034	2000000.00	2.50	0.21	206.30	7.50	9.92	0.61
1035	1999000.00	2.30	0.20	210.50	7.50	9.92	0.61
1036	1999000.00	2.06	0.20	217.00	7.50	9.92	0.61
1037	2031000.00	3.35	0.23	195.00	7.50	9.92	0.61
1038	2034000.00	3.04	0.23	198.00	7.50	9.92	0.61
1039	2033000.00	2.70	0.22	210.00	7.50	9.92	0.61
1040	2029000.00	2.40	0.20	215.50	7.50	9.92	0.61
1041	2035000.00	2.16	0.19	221.80	7.50	9.92	0.61
1042	2019000.00	2.04	0.19	224.20	7.50	9.92	0.61
1043	2015000.00	1.81	0.19	229.50	7.50	9.92	0.61
1044	2008000.00	1.64	0.17	239.00	7.50	9.92	0.61
1045	2008000.00	1.44	0.16	255.00	7.50	9.92	0.61
1046	2038000.00	1.96	0.18	231.00	7.50	9.92	0.61
1047	2042000.00	1.76	0.16	245.50	7.50	9.92	0.61
1048	2041000.00	2.03	0.18	230.50	7.50	9.92	0.61
1049	2034000.00	1.76	0.17	242.00	7.50	9.92	0.61
1050	2030000.00	1.54	0.16	252.00	7.50	9.92	0.61
1051	2027000.00	1.37	0.15	261.00	7.50	9.92	0.61
1052	2027000.00	1.23	0.14	277.00	7.50	9.92	0.61
1053	2027000.00	1.08	0.13	286.00	7.50	9.92	0.61
1054	2487000.00	3.23	0.21	259.00	7.50	9.92	0.61
1055	2490000.00	2.99	0.21	261.50	7.50	9.92	0.61
1056	2492000.00	2.70	0.20	271.00	7.50	9.92	0.61

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
1057	2495000.00	2.50	0.19	276.50	7.50	9.92	0.61
1058	2489000.00	2.25	0.17	288.00	7.50	9.92	0.61
1059	2479000.00	2.06	0.17	292.50	7.50	9.92	0.61
1060	2479000.00	1.81	0.16	310.50	7.50	9.92	0.61
1061	2464000.00	3.50	0.20	248.00	7.50	9.92	0.61
1062	2464000.00	3.11	0.19	257.00	7.50	9.92	0.61
1063	2471000.00	2.86	0.20	261.00	7.50	9.92	0.61
1064	2471000.00	2.67	0.19	269.50	7.50	9.92	0.61
1065	2471000.00	2.47	0.18	276.50	7.50	9.92	0.61
1066	2471000.00	2.21	0.18	281.50	7.50	9.92	0.61
1067	2472000.00	2.01	0.17	294.50	7.50	9.92	0.61
1068	2474000.00	1.83	0.16	307.00	7.50	9.92	0.61
1069	2470000.00	1.67	0.15	314.00	7.50	9.92	0.61
1070	2472000.00	1.47	0.14	332.00	7.50	9.92	0.61
1071	2472000.00	1.29	0.13	350.50	7.50	9.92	0.61
1072	2457000.00	1.13	0.12	372.00	7.50	9.92	0.61
1073	2464000.00	1.86	0.16	308.00	7.50	9.92	0.61
1074	2462000.00	1.64	0.15	321.50	7.50	9.92	0.61
1075	2448000.00	1.47	0.14	339.50	7.50	9.92	0.61
1076	2470000.00	1.35	0.14	347.00	7.50	9.92	0.61
1077	2462000.00	1.27	0.13	354.00	7.50	9.92	0.61
1078	2454000.00	1.18	0.12	371.00	7.50	9.92	0.61
1079	3000000.00	3.28	0.18	336.50	7.50	9.92	0.61
1080	2999000.00	2.81	0.17	355.50	7.50	9.92	0.61
1081	2999000.00	3.43	0.18	332.00	7.50	9.92	0.61
1082	2999000.00	2.96	0.16	353.00	7.50	9.92	0.61
1083	2974000.00	2.98	0.18	340.50	7.50	9.92	0.61
1084	2931000.00	2.79	0.17	350.00	7.50	9.92	0.61
1085	2988000.00	2.55	0.16	357.00	7.50	9.92	0.61
1086	2979000.00	2.32	0.15	371.50	7.50	9.92	0.61
1087	2979000.00	2.11	0.15	385.00	7.50	9.92	0.61
1088	2999000.00	1.96	0.14	406.00	7.50	9.92	0.61
1089	2954000.00	3.38	0.18	333.50	7.50	9.92	0.61
1090	2970000.00	2.99	0.18	344.00	7.50	9.92	0.61
1091	2970000.00	2.89	0.17	351.50	7.50	9.92	0.61
1092	2974000.00	2.70	0.16	359.00	7.50	9.92	0.61
1093	2977000.00	2.50	0.16	368.00	7.50	9.92	0.61
1094	2960000.00	2.23	0.15	382.00	7.50	9.92	0.61
1095	2965000.00	1.96	0.14	406.00	7.50	9.92	0.61
1096	2979000.00	3.09	0.13	375.50	7.50	9.92	0.61
1097	2990000.00	2.74	0.12	392.50	7.50	9.92	0.61
1098	2990000.00	2.84	0.13	383.00	7.50	9.92	0.61
1099	2974000.00	2.06	0.10	445.00	7.50	9.92	0.61
1100	2979000.00	2.06	0.13	419.00	7.50	9.92	0.61
1101	2997000.00	2.94	0.15	368.00	7.50	9.92	0.61
1102	3022000.00	2.50	0.13	394.00	7.50	9.92	0.61

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
1103	3032000.00	2.06	0.13	418.50	7.50	9.92	0.61
1104	3032000.00	1.72	0.11	457.00	7.50	9.92	0.61
1105	2956000.00	1.57	0.10	483.00	7.50	9.92	0.61
1106	2956000.00	1.55	0.10	476.00	7.50	9.92	0.61
1107	499000.00	3.52	0.42	75.50	7.37	10.05	1.22
1108	499000.00	3.09	0.41	77.40	7.37	10.05	1.22
1109	498000.00	2.89	0.40	77.70	7.37	10.05	1.22
1110	498000.00	2.60	0.37	81.80	7.37	10.05	1.22
1111	498000.00	2.28	0.38	81.70	7.37	10.05	1.22
1112	498000.00	1.94	0.35	87.10	7.37	10.05	1.22
1113	498000.00	1.72	0.35	87.50	7.37	10.05	1.22
1114	500000.00	1.47	0.33	91.50	7.37	10.05	1.22
1115	503000.00	1.27	0.31	96.90	7.37	10.05	1.22
1116	503000.00	1.08	0.30	100.90	7.37	10.05	1.22
1117	507000.00	3.33	0.43	74.80	7.37	10.05	1.22
1118	506000.00	3.09	0.41	77.40	7.37	10.05	1.22
1119	506000.00	2.60	0.38	81.10	7.37	10.05	1.22
1120	514000.00	2.16	0.36	86.50	7.37	10.05	1.22
1121	515000.00	1.57	0.35	90.30	7.37	10.05	1.22
1122	514000.00	1.08	0.32	99.10	7.37	10.05	1.22
1123	986000.00	3.43	0.34	166.00	7.37	10.05	1.22
1124	990000.00	3.09	0.33	170.60	7.37	10.05	1.22
1125	990000.00	2.79	0.31	178.60	7.37	10.05	1.22
1126	1000000.00	2.25	0.27	195.00	7.37	10.05	1.22
1127	1000000.00	2.01	0.25	205.60	7.37	10.05	1.22
1128	1000000.00	1.86	0.24	210.10	7.37	10.05	1.22
1129	1004000.00	1.57	0.23	222.60	7.37	10.05	1.22
1130	1009000.00	1.37	0.21	237.40	7.37	10.05	1.22
1131	1034000.00	3.48	0.33	174.20	7.37	10.05	1.22
1132	1038000.00	3.14	0.31	183.00	7.37	10.05	1.22
1133	1038000.00	2.74	0.29	191.20	7.37	10.05	1.22
1134	1044000.00	2.55	0.26	202.50	7.37	10.05	1.22
1135	1047000.00	2.25	0.26	204.40	7.37	10.05	1.22
1136	1047000.00	1.96	0.24	215.70	7.37	10.05	1.22
1137	1036000.00	1.81	0.22	225.20	7.37	10.05	1.22
1138	1036000.00	1.57	0.21	232.70	7.37	10.05	1.22
1139	1036000.00	1.37	0.19	247.20	7.37	10.05	1.22
1140	1031000.00	1.76	0.23	225.80	7.37	10.05	1.22
1141	1473000.00	3.19	0.25	296.20	7.37	10.05	1.22
1142	1475000.00	2.89	0.24	306.90	7.37	10.05	1.22
1143	1478000.00	2.65	0.24	313.20	7.37	10.05	1.22
1144	1480000.00	2.30	0.22	330.80	7.37	10.05	1.22
1145	1480000.00	2.01	0.20	347.20	7.37	10.05	1.22
1146	1480000.00	1.76	0.18	367.30	7.37	10.05	1.22
1147	1493000.00	1.57	0.17	386.80	7.37	10.05	1.22
1148	1501000.00	1.39	0.18	398.10	7.37	10.05	1.22

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
1149	1470000.00	3.43	0.27	284.90	7.37	10.05	1.22
1150	1475000.00	3.19	0.26	297.50	7.37	10.05	1.22
1151	1478000.00	2.74	0.24	314.50	7.37	10.05	1.22
1152	1480000.00	2.50	0.22	325.80	7.37	10.05	1.22
1153	1483000.00	2.25	0.21	399.60	7.37	10.05	1.22
1154	1483000.00	1.96	0.20	353.40	7.37	10.05	1.22
1155	1486000.00	1.72	0.18	376.10	7.37	10.05	1.22
1156	1488000.00	1.62	0.18	388.70	7.37	10.05	1.22
1157	1975000.00	3.53	0.21	450.90	7.37	10.05	1.22
1158	1995000.00	2.65	0.19	503.10	7.37	10.05	1.22
1159	1998000.00	3.04	0.21	469.20	7.37	10.05	1.22
1160	2007000.00	2.50	0.19	509.40	7.37	10.05	1.22
1161	2007000.00	1.91	0.16	578.00	7.37	10.05	1.22
1162	1982000.00	3.38	0.21	450.30	7.37	10.05	1.22
1163	1997000.00	2.79	0.20	481.70	7.37	10.05	1.22
1164	1997000.00	2.45	0.20	494.30	7.37	10.05	1.22
1165	2006000.00	1.81	0.15	582.40	7.37	10.05	1.22
1166	2006000.00	1.52	0.12	661.00	7.37	10.05	1.22
1167	991000.00	3.28	0.56	50.60	14.99	9.96	1.22
1168	984000.00	3.40	0.53	51.10	14.99	9.96	1.22
1169	990000.00	2.74	0.49	54.50	14.99	9.96	1.22
1170	982000.00	3.14	0.50	52.80	14.99	9.96	1.22
1171	982000.00	2.40	0.45	57.00	14.99	9.96	1.22
1172	1023000.00	3.38	0.56	51.40	14.99	9.96	1.22
1173	1013000.00	3.04	0.47	56.50	14.99	9.96	1.22
1174	1023000.00	2.79	0.44	59.40	14.99	9.96	1.22
1175	1025000.00	2.35	0.41	62.80	14.99	9.96	1.22
1176	1025000.00	2.06	0.37	66.50	14.99	9.96	1.22
1177	978000.00	1.86	0.31	69.60	14.99	9.96	1.22
1178	978000.00	1.62	0.29	74.20	14.99	9.96	1.22
1179	1002000.00	2.25	0.37	64.70	14.99	9.96	1.22
1180	1001000.00	3.43	0.51	53.10	14.99	9.96	1.22
1181	1007000.00	2.99	0.46	57.00	14.99	9.96	1.22
1182	1009000.00	1.86	0.44	60.40	14.99	9.96	1.22
1183	1009000.00	1.86	0.32	71.10	14.99	9.96	1.22
1184	996000.00	1.57	0.28	76.90	14.99	9.96	1.22
1185	1005000.00	1.91	0.42	62.10	14.99	9.96	1.22
1186	1014000.00	1.57	0.27	78.90	14.99	9.96	1.22
1187	994000.00	3.53	0.54	49.70	14.99	9.96	1.22
1188	994000.00	3.04	0.50	51.80	14.99	9.96	1.22
1189	1003000.00	2.60	0.40	59.90	14.99	9.96	1.22
1190	986000.00	2.06	0.32	67.40	14.99	9.96	1.22
1191	992000.00	1.86	0.30	71.60	14.99	9.96	1.22
1192	992000.00	1.37	0.19	88.60	14.99	9.96	1.22
1193	992000.00	1.57	0.26	77.40	14.99	9.96	1.22
1194	1009000.00	3.09	0.56	50.90	14.99	9.96	1.22

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
1195	1011000.00	2.60	0.44	58.70	14.99	9.96	1.22
1196	999000.00	2.11	0.32	68.90	14.99	9.96	1.22
1197	1528000.00	3.33	0.32	101.70	14.99	9.96	1.22
1198	1542000.00	3.48	0.23	113.40	14.99	9.96	1.22
1199	1542000.00	3.38	0.29	105.60	14.99	9.96	1.22
1200	1523000.00	3.04	0.25	113.70	14.99	9.96	1.22
1201	1526000.00	2.99	0.27	112.20	14.99	9.96	1.22
1202	1530000.00	2.55	0.21	126.60	14.99	9.96	1.22
1203	1514000.00	2.60	0.21	123.20	14.99	9.96	1.22
1204	1526000.00	2.06	0.17	140.20	14.99	9.96	1.22
1205	1566000.00	3.33	0.28	107.30	14.99	9.96	1.22
1206	1547000.00	3.04	0.27	111.00	14.99	9.96	1.22
1207	1570000.00	2.50	0.20	127.10	14.99	9.96	1.22
1208	1553000.00	2.11	0.18	136.30	14.99	9.96	1.22
1209	1533000.00	2.35	0.20	127.30	14.99	9.96	1.22
1210	1547000.00	1.96	0.18	139.20	14.99	9.96	1.22
1211	1516000.00	2.84	0.23	118.80	14.99	9.96	1.22
1212	1520000.00	1.57	0.16	153.80	14.99	9.96	1.22
1213	1526000.00	1.76	0.16	150.40	14.99	9.96	1.22
1214	1534000.00	1.57	0.15	159.70	14.99	9.96	1.22
1215	1556000.00	1.76	0.16	151.60	14.99	9.96	1.22
1216	1571000.00	1.57	0.14	165.00	14.99	9.96	1.22
1217	2044000.00	3.48	0.20	198.10	14.99	9.96	1.22
1218	2044000.00	3.38	0.22	191.10	14.99	9.96	1.22
1219	2064000.00	3.53	0.21	189.90	14.99	9.96	1.22
1220	2050000.00	2.55	0.17	222.00	14.99	9.96	1.22
1221	2072000.00	3.04	0.18	207.40	14.99	9.96	1.22
1222	2058000.00	3.04	0.19	208.40	14.99	9.96	1.22
1223	2058000.00	2.06	0.15	252.20	14.99	9.96	1.22
1224	2049000.00	3.43	0.19	188.90	14.99	9.96	1.22
1225	2049000.00	2.55	0.16	215.70	14.99	9.96	1.22
1226	2098000.00	3.04	0.20	194.70	14.99	9.96	1.22
1227	2092000.00	2.11	0.15	244.90	14.99	9.96	1.22
1228	2092000.00	2.11	0.15	247.80	14.99	9.96	1.22
1229	2031000.00	2.55	0.17	210.30	14.99	9.96	1.22
1230	2031000.00	1.57	0.11	256.10	14.99	9.96	1.22
1231	2031000.00	2.11	0.16	228.80	14.99	9.96	1.22
1232	2013000.00	1.57	0.13	256.50	14.99	9.96	1.22
1234	3239699.20	6.90	0.15	2861.65	4.39	9.60	0.74
1235	3204999.40	6.90	0.15	2861.65	4.39	9.60	0.74
1236	3290171.63	6.90	0.15	2861.65	4.39	9.60	0.74
1237	3340644.06	6.90	0.15	2875.21	4.39	9.60	0.74
1238	3460516.09	6.90	0.14	2888.77	4.39	9.60	0.74
1239	3510988.52	6.90	0.14	2888.77	4.39	9.60	0.74
1240	3551997.37	6.90	0.13	2888.77	4.39	9.60	0.74
1241	3731805.41	6.90	0.12	2915.89	4.39	9.60	0.74

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
1242	3902149.86	6.90	0.10	2929.46	4.39	9.60	0.74
1243	3933695.13	6.90	0.10	2956.58	4.39	9.60	0.74
1244	4053567.16	6.90	0.08	2956.58	4.39	9.60	0.74
1245	4122966.75	6.90	0.09	2943.02	4.39	9.60	0.74
1246	4239684.25	6.90	0.06	2997.27	4.39	9.60	0.74
1247	4340629.11	6.90	0.07	2997.27	4.39	9.60	0.74
1248	1946343.14	6.90	0.31	1002.25	5.31	15.88	0.80
1249	1804389.43	6.90	0.29	1002.25	5.31	15.88	0.80
1250	1820162.06	6.90	0.29	1002.25	5.31	15.88	0.80
1251	2712893.19	6.90	0.22	1002.25	5.31	15.88	0.80
1252	2722356.78	6.90	0.22	1002.25	5.31	15.88	0.80
1253	2217632.46	6.90	0.26	1003.61	5.31	15.88	0.80
1254	2182932.66	6.90	0.26	1003.61	5.31	15.88	0.80
1255	3924231.55	6.90	0.10	2000.44	5.31	15.88	0.80
1256	3949467.77	6.90	0.10	2000.44	5.31	15.88	0.80
1257	3211308.46	6.90	0.16	2004.51	5.31	15.88	0.80
1259	2608793.80	6.90	0.20	2007.22	5.31	15.88	0.80
1260	2630875.49	6.90	0.20	2007.22	5.31	15.88	0.80
1261	3283862.58	6.90	0.15	2674.49	5.31	15.88	0.80
1263	2921091.97	6.90	0.17	2675.84	5.31	15.88	0.80
1264	2949482.72	6.90	0.17	2675.84	5.31	15.88	0.80
1265	3104054.54	6.90	0.16	2678.55	5.31	15.88	0.80
1267	1507863.89	6.90	0.24	401.44	13.26	35.05	1.07
1268	1602499.70	6.90	0.24	420.43	13.26	35.05	1.07
1269	1712908.14	6.90	0.20	423.14	13.26	35.05	1.07
1270	1895870.71	6.90	0.19	427.21	13.26	35.05	1.07
1271	2122996.65	6.90	0.19	428.57	13.26	35.05	1.07
1272	1917952.40	6.90	0.18	429.92	13.26	35.05	1.07
1273	2148232.87	6.90	0.17	444.84	13.26	35.05	1.07
1274	2034669.90	6.90	0.22	683.54	13.26	35.05	1.07
1275	1924261.45	6.90	0.21	687.61	13.26	35.05	1.07
1276	2264950.36	6.90	0.22	693.03	13.26	35.05	1.07
1277	2359586.17	6.90	0.17	697.10	13.26	35.05	1.07
1278	2239714.15	6.90	0.19	702.53	13.26	35.05	1.07
1279	2321731.85	6.90	0.14	714.73	13.26	35.05	1.07
1280	2611948.33	6.90	0.10	714.73	13.26	35.05	1.07
1281	2586712.12	6.90	0.07	728.30	13.26	35.05	1.07
1282	2495230.83	6.90	0.12	1349.45	13.26	35.05	1.07
1283	2561475.90	6.90	0.09	1380.64	13.26	35.05	1.07
1284	2656111.71	6.90	0.04	1414.55	13.26	35.05	1.07
1285	1037839.37	6.96	0.41	161.39	7.37	10.06	1.22
1286	1034684.85	6.96	0.39	162.75	7.37	10.06	1.22
1287	1264965.32	6.96	0.35	204.79	7.37	10.06	1.22
1288	1274428.90	6.96	0.34	208.86	7.37	10.06	1.22
1289	1511018.42	6.96	0.32	257.68	7.37	10.06	1.22
1290	1511018.42	6.96	0.29	261.75	7.37	10.06	1.22

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
1291	1511018.42	6.96	0.28	267.18	7.37	10.06	1.22
1292	1766535.10	6.96	0.28	322.78	7.37	10.06	1.22
1293	1757071.52	6.96	0.27	324.14	7.37	10.06	1.22
1294	1110393.49	6.96	0.36	179.02	12.22	13.79	2.00
1295	1179793.09	6.96	0.29	203.43	12.22	13.79	2.00
1296	1258656.26	6.96	0.33	212.93	12.22	13.79	2.00
1297	1309128.69	6.96	0.35	217.00	12.22	13.79	2.00
1298	1438464.30	6.96	0.35	240.05	12.22	13.79	2.00
1299	1523636.53	6.96	0.29	261.75	12.22	13.79	2.00
1300	1593036.12	6.96	0.29	265.82	12.22	13.79	2.00
1301	1665590.24	6.96	0.24	283.45	12.22	13.79	2.00
1302	1744453.41	6.96	0.25	291.59	12.22	13.79	2.00
1303	1813853.01	6.96	0.24	305.15	12.22	13.79	2.00
1304	1867479.97	6.96	0.24	314.65	12.22	13.79	2.00
1305	1955806.72	6.96	0.23	332.28	12.22	13.79	2.00
1306	2063060.64	6.96	0.24	347.19	12.22	13.79	2.00
1307	2122996.65	6.96	0.22	370.25	12.22	13.79	2.00
1308	2186087.19	6.96	0.22	387.88	12.22	13.79	2.00
1309	2242868.68	6.96	0.22	396.02	12.22	13.79	2.00
1310	2350122.59	6.96	0.21	427.21	12.22	13.79	2.00
1312	2413213.13	6.96	0.20	447.56	12.22	13.79	2.00
1313	1201874.78	6.90	0.29	1301.98	9.50	14.86	3.66
1314	1258656.26	6.90	0.28	1301.98	9.50	14.86	3.66
1315	1324901.33	6.90	0.28	1315.54	9.50	14.86	3.66
1316	1387991.87	6.90	0.28	1315.54	9.50	14.86	3.66
1317	1470009.57	6.90	0.27	1329.11	9.50	14.86	3.66
1318	1548872.74	6.90	0.26	1342.67	9.50	14.86	3.66
1319	621441.81	6.90	0.33	1314.19	5.08	15.88	4.57
1320	627750.87	6.90	0.34	1314.19	5.08	15.88	4.57
1321	719232.15	6.90	0.32	1338.60	5.08	15.88	4.57
1322	722386.68	6.90	0.31	1338.60	5.08	15.88	4.57
1323	507878.84	6.90	0.35	1352.16	5.08	15.88	4.57
1324	495260.73	6.90	0.34	1352.16	5.08	15.88	4.57
1325	873803.97	6.90	0.19	2689.40	5.08	15.88	4.57
1326	886422.08	6.90	0.20	2689.40	5.08	15.88	4.57
1327	1082002.75	6.90	0.18	2690.76	5.08	15.88	4.57
1328	637214.45	6.90	0.23	2692.12	5.08	15.88	4.57
1329	634059.92	6.90	0.22	2692.12	5.08	15.88	4.57
1330	1094620.86	6.90	0.19	2692.12	5.08	15.88	4.57
1331	624596.34	6.90	0.21	2693.47	5.08	15.88	4.57
1332	1082002.75	6.90	0.16	4017.15	5.08	15.88	4.57
1333	1391146.39	6.90	0.15	4018.51	5.08	15.88	4.57
1334	1432155.24	6.90	0.15	4021.22	5.08	15.88	4.57
1335	656141.61	6.90	0.16	4023.93	5.08	15.88	4.57
1336	1053612.01	6.90	0.14	4028.00	5.08	15.88	4.57
1337	1435309.77	6.90	0.14	4033.43	5.08	15.88	4.57

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
1338	968439.78	6.90	0.37	1003.61	8.48	15.88	3.66
1339	1028375.79	6.90	0.36	1003.61	8.48	15.88	3.66
1340	1100929.91	6.90	0.35	1017.17	8.48	15.88	3.66
1341	977903.36	6.90	0.36	1057.86	8.48	15.88	3.66
1342	1018912.21	6.90	0.35	1071.42	8.48	15.88	3.66
1343	1082002.75	6.90	0.35	1084.98	8.48	15.88	3.66
1344	1116702.55	6.90	0.34	1084.98	8.48	15.88	3.66
1345	1145093.29	6.90	0.31	1329.11	8.48	15.88	3.66
1346	1179793.09	6.90	0.30	1342.67	8.48	15.88	3.66
1347	1236574.57	6.90	0.30	1342.67	8.48	15.88	3.66
1348	1309128.69	6.90	0.30	1342.67	8.48	15.88	3.66
1349	1315437.75	6.90	0.29	1356.23	8.48	15.88	3.66
1350	1394300.92	6.90	0.29	1356.23	8.48	15.88	3.66
1351	1252347.21	6.90	0.24	1952.97	8.48	15.88	3.66
1352	1321746.80	6.90	0.24	1993.66	8.48	15.88	3.66
1353	1331210.38	6.90	0.24	2007.22	8.48	15.88	3.66
1354	1403764.50	6.90	0.23	2007.22	8.48	15.88	3.66
1355	1372219.23	6.90	0.23	2007.22	8.48	15.88	3.66
1356	1413228.08	6.90	0.22	2020.78	8.48	15.88	3.66
1357	1476318.62	6.90	0.23	2020.78	8.48	15.88	3.66
1358	1558336.32	6.90	0.21	2020.78	8.48	15.88	3.66
1359	1517327.47	6.90	0.21	2034.34	8.48	15.88	3.66
1360	1520482.00	6.90	0.19	2631.09	8.48	15.88	3.66
1361	1567799.90	6.90	0.19	2644.65	8.48	15.88	3.66
1362	1621426.86	6.90	0.18	2658.21	8.48	15.88	3.66
1363	1681362.88	6.90	0.18	2658.21	8.48	15.88	3.66
1979	728695.73	6.90	0.37	1342.67	1.61	96.47	1.88
1980	735004.78	6.90	0.32	1329.11	1.61	96.47	1.88
1981	835949.65	6.90	0.29	1342.67	1.61	96.47	1.88
1982	940049.04	6.90	0.28	1356.23	1.61	96.47	1.88
1983	1066230.12	6.90	0.30	1342.67	1.61	96.47	1.88
1984	817022.49	6.90	0.28	1993.66	1.61	96.47	1.88
1985	905349.24	6.90	0.24	1993.66	1.61	96.47	1.88
1986	1047302.95	6.90	0.21	2034.34	1.61	96.47	1.88
1987	1195565.72	6.90	0.21	2020.78	1.61	96.47	1.88
1988	1340673.96	6.90	0.21	2007.22	1.61	96.47	1.88
1989	911658.29	6.90	0.23	2671.77	1.61	96.47	1.88
1990	1072539.17	6.90	0.19	2685.34	1.61	96.47	1.88
1991	1290201.53	6.90	0.18	2671.77	1.61	96.47	1.88
1992	1447927.88	6.90	0.16	2685.34	1.61	96.47	1.88
1993	1678208.35	6.90	0.16	2712.46	1.61	96.47	1.88
1994	1082002.75	6.90	0.16	3973.75	1.61	96.47	1.88
1995	1255501.73	6.90	0.14	3905.94	1.61	96.47	1.88
1996	1570954.43	6.90	0.12	4082.25	1.61	96.47	1.88
1997	1826471.12	6.90	0.12	4000.88	1.61	96.47	1.88
1998	2003124.63	6.90	0.08	4082.25	1.61	96.47	1.88

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
1999	1750762.47	6.90	0.11	3946.63	1.61	96.47	1.88
2000	1608808.75	6.90	0.15	6740.46	1.61	96.47	1.88
2001	1362755.65	6.90	0.16	5316.42	1.61	96.47	1.88
2002	1271274.37	6.90	0.18	4014.44	1.61	96.47	1.88
2003	1498400.31	6.90	0.12	5235.05	1.61	96.47	1.88
2004	1927415.98	6.90	0.09	5411.36	1.61	96.47	1.88
2005	485797.15	6.90	0.51	691.68	1.61	96.47	1.88
2006	482642.63	6.90	0.44	678.11	1.61	96.47	1.88
2007	523651.48	6.90	0.41	678.11	1.61	96.47	1.88
2008	593051.07	6.90	0.44	664.55	1.61	96.47	1.88
2009	618287.29	6.90	0.41	664.55	1.61	96.47	1.88
2022	1053612.01	6.90	0.33	1329.11	2.64	96.47	1.88
2023	1138784.24	6.90	0.31	1315.54	2.64	96.47	1.88
2024	1274428.90	6.90	0.29	1329.11	2.64	96.47	1.88
2025	1410073.56	6.90	0.26	1315.54	2.64	96.47	1.88
2026	1574108.96	6.90	0.23	1342.67	2.64	96.47	1.88
2027	1277583.42	6.90	0.24	2047.91	2.64	96.47	1.88
2028	1429000.72	6.90	0.22	1980.10	2.64	96.47	1.88
2029	1643508.55	6.90	0.20	1993.66	2.64	96.47	1.88
2030	1832780.17	6.90	0.18	1993.66	2.64	96.47	1.88
2031	1993661.05	6.90	0.16	1980.10	2.64	96.47	1.88
2032	1429000.72	6.90	0.20	2712.46	2.64	96.47	1.88
2033	1662435.71	6.90	0.17	2726.02	2.64	96.47	1.88
2034	1886407.13	6.90	0.15	2671.77	2.64	96.47	1.88
2035	2100914.96	6.90	0.13	2658.21	2.64	96.47	1.88
2036	2343813.54	6.90	0.09	2671.77	2.64	96.47	1.88
2037	750777.42	6.90	0.45	678.11	2.64	96.47	1.88
2038	839104.17	6.90	0.43	678.11	2.64	96.47	1.88
2039	927430.93	6.90	0.40	678.11	2.64	96.47	1.88
2040	1037839.37	6.90	0.39	664.55	2.64	96.47	1.88
2041	1611963.28	6.90	0.15	4055.13	2.64	96.47	1.88
2042	1921106.93	6.90	0.13	3987.32	2.64	96.47	1.88
2043	1911643.34	6.90	0.06	4055.13	2.64	96.47	1.88
2044	2264950.36	6.90	0.09	4014.44	2.64	96.47	1.88
2045	2025206.32	6.90	0.11	3987.32	2.64	96.47	1.88
2046	451097.36	6.90	0.11	1396.92	2.64	96.47	1.88
2047	570969.38	6.90	0.09	1356.23	2.64	96.47	1.88
2048	646678.03	6.90	0.05	1356.23	2.64	96.47	1.88
2049	700304.99	6.90	0.01	1329.11	2.64	96.47	1.88
2050	826486.07	6.90	-0.03	1342.67	2.64	96.47	1.88
2051	507878.84	6.90	0.06	2088.59	2.64	96.47	1.88
2052	580432.96	6.90	0.02	2034.34	2.64	96.47	1.88
2053	706614.04	6.90	-0.01	1993.66	2.64	96.47	1.88
2054	823331.54	6.90	-0.05	1993.66	2.64	96.47	1.88
2055	949512.62	6.90	-0.09	2020.78	2.64	96.47	1.88
2056	400624.93	6.90	0.25	664.55	2.64	96.47	1.88

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
2057	466869.99	6.90	0.23	678.11	2.64	96.47	1.88
2058	514187.90	6.90	0.19	678.11	2.64	96.47	1.88
2059	593051.07	6.90	0.17	678.11	2.64	96.47	1.88
2060	608823.71	6.90	0.10	664.55	2.64	96.47	1.88
2061	567814.86	6.90	0.06	2671.77	2.64	96.47	1.88
2062	608823.71	6.90	0.01	2698.90	2.64	96.47	1.88
2063	731850.26	6.90	-0.04	2685.34	2.64	96.47	1.88
2064	851722.28	6.90	-0.08	2671.77	2.64	96.47	1.88
2065	892731.13	6.90	-0.15	2658.21	2.64	96.47	1.88
2066	671914.25	6.90	0.04	4041.57	2.64	96.47	1.88
2067	794940.80	6.90	0.03	5438.48	2.64	96.47	1.88
2068	747622.89	6.90	-0.02	4068.69	2.64	96.47	1.88
2069	867494.92	6.90	-0.07	4068.69	2.64	96.47	1.88
2070	984212.42	6.90	-0.12	4068.69	2.64	96.47	1.88
2071	1157711.40	6.90	-0.18	4028.00	2.64	96.47	1.88
2072	1037839.37	6.90	-0.12	2671.77	2.64	96.47	1.88
2093	801249.85	6.90	0.41	1342.67	1.63	76.33	1.88
2094	889576.61	6.90	0.38	1342.67	1.63	76.33	1.88
2095	936894.51	6.90	0.35	1329.11	1.63	76.33	1.88
2096	984212.42	6.90	0.31	1315.54	1.63	76.33	1.88
2097	1028375.79	6.90	0.26	1342.67	1.63	76.33	1.88
2098	927430.93	6.90	0.31	1993.66	1.63	76.33	1.88
2099	1063075.59	6.90	0.28	2047.91	1.63	76.33	1.88
2100	1164020.45	6.90	0.25	2047.91	1.63	76.33	1.88
2101	1261810.79	6.90	0.21	2047.91	1.63	76.33	1.88
2102	1356446.60	6.90	0.17	2061.47	1.63	76.33	1.88
2103	1037839.37	6.90	0.25	2726.02	1.63	76.33	1.88
2104	1189256.67	6.90	0.23	2671.77	1.63	76.33	1.88
2105	1302819.64	6.90	0.19	2712.46	1.63	76.33	1.88
2106	1479473.15	6.90	0.16	2753.15	1.63	76.33	1.88
2107	1662435.71	6.90	0.14	2753.15	1.63	76.33	1.88
2108	545733.17	6.90	0.55	705.24	1.63	76.33	1.88
2109	555196.75	6.90	0.52	678.11	1.63	76.33	1.88
2110	583587.49	6.90	0.46	678.11	1.63	76.33	1.88
2111	605669.18	6.90	0.46	650.99	1.63	76.33	1.88
2112	646678.03	6.90	0.42	678.11	1.63	76.33	1.88
2113	1160865.93	6.90	0.18	4082.25	1.63	76.33	1.88
2114	1369064.71	6.90	0.15	5343.55	1.63	76.33	1.88
2115	1627735.92	6.90	0.15	6645.53	1.63	76.33	1.88
2116	1602499.70	6.90	0.13	5275.73	1.63	76.33	1.88
2117	1962115.78	6.90	0.11	5411.36	1.63	76.33	1.88
2118	1457391.46	6.90	0.16	4082.25	1.63	76.33	1.88
2119	1706599.09	6.90	0.13	4204.31	1.63	76.33	1.88
2120	1927415.98	6.90	0.11	4150.06	1.63	76.33	1.88
2121	2044133.48	6.90	0.08	4109.38	1.63	76.33	1.88
2122	2157696.45	6.90	0.07	4150.06	1.63	76.33	1.88

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
2123	1646663.08	6.90	0.14	2753.15	1.63	76.33	1.88
2124	999985.05	6.90	0.24	1342.67	1.63	76.33	1.88
2125	545733.17	6.90	0.53	705.24	1.63	76.33	1.88
2126	539424.11	6.90	0.54	705.24	1.63	76.33	1.88
2127	1753917.00	6.90	0.11	4068.69	1.63	76.33	1.88
2128	1940034.09	6.90	0.10	4055.13	1.63	76.33	1.88
2151	1145093.29	6.90	0.33	1356.23	2.64	76.33	1.88
2152	1246038.15	6.90	0.32	1356.23	2.64	76.33	1.88
2153	1400609.97	6.90	0.30	1356.23	2.64	76.33	1.88
2154	1492091.26	6.90	0.27	1356.23	2.64	76.33	1.88
2155	1602499.70	6.90	0.23	1356.23	2.64	76.33	1.88
2156	1287047.00	6.90	0.25	2034.34	2.64	76.33	1.88
2157	1498400.31	6.90	0.23	2047.91	2.64	76.33	1.88
2158	1712908.14	6.90	0.20	2034.34	2.64	76.33	1.88
2159	1870634.49	6.90	0.18	2034.34	2.64	76.33	1.88
2160	2088296.85	6.90	0.16	2061.47	2.64	76.33	1.88
2161	1419537.14	6.90	0.20	2739.58	2.64	76.33	1.88
2162	1706599.09	6.90	0.17	2739.58	2.64	76.33	1.88
2163	1999970.10	6.90	0.15	2726.02	2.64	76.33	1.88
2164	2246023.20	6.90	0.13	2698.90	2.64	76.33	1.88
2165	2473149.14	6.90	0.12	2685.34	2.64	76.33	1.88
2166	779168.16	6.90	0.47	705.24	2.64	76.33	1.88
2167	826486.07	6.90	0.45	678.11	2.64	76.33	1.88
2168	902194.71	6.90	0.40	691.68	2.64	76.33	1.88
2169	1009448.63	6.90	0.35	678.11	2.64	76.33	1.88
2170	1823316.59	6.90	0.17	4095.81	2.64	76.33	1.88
2171	2072524.22	6.90	0.14	4109.38	2.64	76.33	1.88
2172	2331195.43	6.90	0.10	4122.94	2.64	76.33	1.88
2173	2668729.82	6.90	0.07	4122.94	2.64	76.33	1.88
2482	1264965.32	6.96	0.26	709.31	11.33	15.42	1.83
2484	1258656.26	6.83	0.27	676.76	11.33	15.42	1.83
2486	1482627.68	6.96	0.26	695.75	11.33	15.42	1.83
2488	1643508.55	6.86	0.21	697.10	11.33	15.42	1.83
2490	2034669.90	6.90	0.20	716.09	11.33	15.42	1.83
2492	2271259.42	6.93	0.12	2003.15	11.33	15.42	1.83
2493	2261795.84	6.93	0.13	2003.15	11.33	15.42	1.83
2494	2268104.89	6.93	0.15	2003.15	11.33	15.42	1.83
2496	2570939.48	6.95	0.12	2011.29	11.33	15.42	1.83
2498	1646663.08	6.93	0.22	675.40	11.33	15.42	1.83
2500	1034684.85	10.31	0.25	660.48	11.33	15.42	1.83
2502	1236574.57	10.34	0.23	693.03	11.33	15.42	1.83
2504	1501554.84	10.27	0.19	694.39	11.33	15.42	1.83
2506	1798080.37	10.34	0.17	695.75	11.33	15.42	1.83
2508	1706599.09	10.31	0.10	2046.55	11.33	15.42	1.83
2510	2031515.37	10.34	0.08	2030.28	11.33	15.42	1.83
2512	2599330.22	10.34	0.02	2004.51	11.33	15.42	1.83

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
2514	2911628.39	10.38	-0.05	2030.28	11.33	15.42	1.83
2516	1425846.19	13.82	0.09	2015.36	11.33	15.42	1.83
2518	1712908.14	13.76	0.04	2035.70	11.33	15.42	1.83
2520	2141923.81	13.79	-0.05	2053.33	11.33	15.42	1.83
2522	2652957.18	13.79	-0.12	2016.71	11.33	15.42	1.83
2524	899040.19	13.82	0.23	688.96	11.33	15.42	1.83
2526	933739.98	13.79	0.22	680.83	11.33	15.42	1.83
2528	1094620.86	13.79	0.19	671.33	11.33	15.42	1.83
2530	1324901.33	13.82	0.12	669.98	11.33	15.42	1.83
2532	1599345.17	13.82	0.06	688.96	11.33	15.42	1.83
2534	1968424.83	13.86	0.01	3345.82	11.33	15.42	1.83
2536	1741298.89	13.82	0.04	3252.24	11.33	15.42	1.83
2538	2220786.99	13.76	-0.02	3337.68	11.33	15.42	1.83
2540	3239699.20	13.79	-0.10	3420.41	11.33	15.42	1.83
2542	2807529.00	13.76	-0.17	2041.13	11.33	15.42	1.83
2544	3321716.90	6.94	0.05	2009.93	11.33	15.42	1.83
2546	2015742.73	6.93	0.17	682.18	11.33	15.42	1.83
2548	2447912.93	6.90	0.05	3310.56	11.33	15.42	1.83
2549	1438464.30	6.96	0.24	722.87	11.33	15.42	1.83
2551	1933725.03	6.93	0.19	1106.68	11.33	15.42	1.83
2553	2264950.36	6.86	0.17	1384.71	11.33	15.42	1.83
2555	2498385.36	6.86	0.12	2024.85	11.33	15.42	1.83
2557	1552027.27	6.93	0.22	717.45	11.33	15.42	1.83
2559	2063060.64	6.92	0.18	1076.85	11.33	15.42	1.83
2561	2394285.97	7.00	0.15	1344.02	11.33	15.42	1.83
2563	2810683.53	6.98	0.09	2005.86	11.33	15.42	1.83
2565	3037809.47	6.86	0.06	2673.13	11.33	15.42	1.83
2567	2981027.99	6.86	0.04	3280.72	11.33	15.42	1.83
2568	1782307.74	6.90	0.20	707.95	11.33	15.42	1.83
2570	2391131.44	6.93	0.15	1095.83	11.33	15.42	1.83
2572	2734974.88	6.93	0.12	1365.72	11.33	15.42	1.83
2574	3362725.75	6.85	0.00	2617.52	11.33	15.42	1.83
2575	3596160.75	6.83	-0.04	3363.45	11.33	15.42	1.83
2576	3192381.29	6.90	0.06	2007.22	11.33	15.42	1.83
2578	1088311.80	10.36	0.22	699.81	11.33	15.42	1.83
2580	1324901.33	10.36	0.19	962.92	11.33	15.42	1.83
2582	1589881.59	10.41	0.14	1365.72	11.33	15.42	1.83
2584	1911643.34	10.36	0.11	1380.64	11.33	15.42	1.83
2586	1574108.96	10.34	0.17	979.20	11.33	15.42	1.83
2588	1302819.64	10.33	0.20	716.09	11.33	15.42	1.83
2590	1552027.27	10.34	0.17	684.90	11.33	15.42	1.83
2592	1921106.93	10.45	0.13	948.00	11.33	15.42	1.83
2594	1851707.33	10.32	0.07	2678.55	11.33	15.42	1.83
2596	2088296.85	10.31	0.05	3413.63	11.33	15.42	1.83
2598	2580403.06	10.41	0.01	3387.86	11.33	15.42	1.83
2600	2312268.27	10.31	0.03	2755.86	11.33	15.42	1.83

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
2602	2962100.83	10.29	-0.04	2743.65	11.33	15.42	1.83
2604	3350107.64	10.31	-0.05	3370.23	11.33	15.42	1.83
2606	2025206.32	10.29	0.20	679.47	11.33	15.42	1.83
2608	2309113.74	10.34	0.10	937.16	11.33	15.42	1.83
2610	2719202.25	10.31	0.00	1391.49	11.33	15.42	1.83
2612	3031500.42	10.27	-0.05	2007.22	11.33	15.42	1.83
2614	2965255.35	10.27	-0.03	2026.21	11.33	15.42	1.83
2616	3397425.55	10.40	-0.07	2726.02	11.33	15.42	1.83
2618	3810668.58	10.38	-0.10	3370.23	11.33	15.42	1.83
2620	2227096.04	13.82	-0.06	2001.80	11.33	15.42	1.83
2622	1864325.44	13.84	-0.04	1367.08	11.33	15.42	1.83
2623	1646663.08	13.72	0.08	945.29	11.33	15.42	1.83
2625	1331210.38	13.74	0.13	950.72	11.33	15.42	1.83
2627	1552027.27	13.81	0.05	1344.02	11.33	15.42	1.83
2628	1555181.80	13.81	0.07	1344.02	11.33	15.42	1.83
2630	1119857.07	13.86	0.16	950.72	11.33	15.42	1.83
2632	1283892.48	13.82	0.11	1371.15	11.33	15.42	1.83
2634	1697135.51	13.88	0.05	2689.40	11.33	15.42	1.83
2636	2059906.11	13.86	-0.02	2726.02	11.33	15.42	1.83
2637	2063060.64	13.86	-0.01	2726.02	11.33	15.42	1.83
2639	911658.29	15.24	0.20	678.12	11.33	15.42	1.83
2641	933739.98	15.21	0.21	675.40	11.33	15.42	1.83
2643	999985.05	15.11	0.17	847.64	11.33	15.42	1.83
2645	1044148.43	15.29	0.15	938.51	11.33	15.42	1.83
2647	1088311.80	15.18	0.14	1098.55	11.33	15.42	1.83
2649	1091466.33	15.04	0.14	1101.26	11.33	15.42	1.83
2651	1100929.91	15.04	0.14	1101.26	11.33	15.42	1.83
2653	1116702.55	15.19	0.11	1223.32	11.33	15.42	1.83
2655	1157711.40	15.03	0.12	1337.24	11.33	15.42	1.83
2657	1277583.42	14.99	0.10	1657.31	11.33	15.42	1.83
2659	1406919.03	15.44	0.08	2009.93	11.33	15.42	1.83
2661	1574108.96	15.29	0.06	2321.87	11.33	15.42	1.83
2663	1671899.29	15.23	0.06	2681.27	11.33	15.42	1.83
2665	1753917.00	15.18	0.06	3035.24	11.33	15.42	1.83
2667	1861170.91	15.30	0.06	3341.75	11.33	15.42	1.83
2669	1987351.99	15.41	0.05	3649.62	11.33	15.42	1.83
2671	1100929.91	15.21	0.19	676.76	11.33	15.42	1.83
2672	1236574.57	15.19	0.15	832.73	11.33	15.42	1.83
2673	1318592.27	15.22	0.12	949.36	11.33	15.42	1.83
2674	1391146.39	15.23	0.09	1090.41	11.33	15.42	1.83
2675	1435309.77	15.15	0.07	1220.61	11.33	15.42	1.83
2676	1419537.14	15.21	0.07	1226.03	11.33	15.42	1.83
2677	1492091.26	15.21	0.05	1369.79	11.33	15.42	1.83
2678	1589881.59	15.09	0.03	1691.22	11.33	15.42	1.83
2679	1829625.64	15.25	0.00	2024.85	11.33	15.42	1.83
2680	2075678.75	15.07	-0.01	2410.02	11.33	15.42	1.83

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
2681	2246023.20	15.11	-0.02	2728.73	11.33	15.42	1.83
2682	2387976.92	15.11	-0.02	3065.08	11.33	15.42	1.83
2683	2577248.53	15.10	-0.02	3390.58	11.33	15.42	1.83
2684	2955791.77	15.13	-0.02	4099.88	11.33	15.42	1.83
2685	1391146.39	15.15	0.12	693.03	11.33	15.42	1.83
2687	1492091.26	15.43	0.07	827.30	11.33	15.42	1.83
2689	1624581.39	15.29	0.03	957.50	11.33	15.42	1.83
2691	1712908.14	15.14	0.02	1090.41	11.33	15.42	1.83
2693	1798080.37	15.25	-0.05	1238.24	11.33	15.42	1.83
2694	1782307.74	15.24	-0.06	1246.38	11.33	15.42	1.83
2695	1864325.44	15.08	-0.06	1367.08	11.33	15.42	1.83
2696	1867479.97	15.08	-0.04	1367.08	11.33	15.42	1.83
2698	2075678.75	15.12	-0.07	1708.85	11.33	15.42	1.83
2700	2274413.95	15.13	-0.08	2026.21	11.33	15.42	1.83
2702	2659266.24	15.08	-0.09	2401.88	11.33	15.42	1.83
2704	2940019.14	15.15	-0.10	2721.95	11.33	15.42	1.83
2706	3246008.25	15.11	-0.10	3063.72	11.33	15.42	1.83
2708	3586697.17	15.13	-0.11	3424.48	11.33	15.42	1.83
2710	2790000.00	1.10	0.01	244.00	10.00	12.00	0.35
2711	3290000.00	1.10	-0.04	338.00	10.00	12.00	0.35
2712	3400000.00	1.60	0.04	244.00	10.00	12.00	0.35
2713	3890000.00	1.60	-0.03	338.00	10.00	12.00	0.35
2714	4870000.00	1.60	-0.05	450.00	10.00	12.00	0.35
2715	5240000.00	1.60	-0.10	600.00	10.00	12.00	0.35
2716	5520000.00	1.60	-0.13	750.00	10.00	12.00	0.35
2717	3820000.00	2.10	0.05	244.00	10.00	12.00	0.35
2718	4550000.00	2.10	0.00	338.00	10.00	12.00	0.35
2719	5040000.00	2.10	-0.07	450.00	10.00	12.00	0.35
2720	5470000.00	2.10	-0.12	600.00	10.00	12.00	0.35
2721	6070000.00	2.10	-0.15	750.00	10.00	12.00	0.35
2722	4030000.00	2.60	0.05	244.00	10.00	12.00	0.35
2723	4730000.00	2.60	-0.02	338.00	10.00	12.00	0.35
2724	5320000.00	2.60	-0.07	450.00	10.00	12.00	0.35
2725	5590000.00	2.60	-0.13	600.00	10.00	12.00	0.35
2726	6630000.00	2.60	-0.16	750.00	10.00	12.00	0.35
2727	4190000.00	3.10	0.05	244.00	10.00	12.00	0.35
2728	4970000.00	3.10	-0.02	338.00	10.00	12.00	0.35
2729	5600000.00	3.10	-0.08	450.00	10.00	12.00	0.35
2730	6020000.00	3.10	-0.15	600.00	10.00	12.00	0.35
2731	6730000.00	3.10	-0.17	750.00	10.00	12.00	0.35
2732	5320000.00	1.10	-0.10	750.00	10.00	12.00	0.35
2733	5600000.00	1.10	-0.13	939.00	10.00	12.00	0.35
2734	6390000.00	1.10	-0.13	1125.00	10.00	12.00	0.35
2735	6880000.00	1.10	-0.14	1312.00	10.00	12.00	0.35
2736	7200000.00	1.10	-0.15	1500.00	10.00	12.00	0.35
2737	7530000.00	1.10	-0.16	1690.00	10.00	12.00	0.35

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
2738	8000000.00	1.10	-0.17	1877.00	10.00	12.00	0.35
2739	8400000.00	1.10	-0.17	2060.00	10.00	12.00	0.35
2740	8490000.00	1.10	-0.18	2250.00	10.00	12.00	0.35
2741	8850000.00	1.10	-0.18	2320.00	10.00	12.00	0.35
2742	9120000.00	1.10	-0.19	2630.00	10.00	12.00	0.35
2743	9470000.00	1.10	-0.19	2820.00	10.00	12.00	0.35
2744	9650000.00	1.10	-0.19	3000.00	10.00	12.00	0.35
2745	9940000.00	1.10	-0.20	3190.00	10.00	12.00	0.35
2746	10160000.00	1.10	-0.20	3380.00	10.00	12.00	0.35
2747	10190000.00	1.10	-0.20	3560.00	10.00	12.00	0.35
2748	10350000.00	1.10	-0.20	3750.00	10.00	12.00	0.35
2749	5720000.00	1.58	-0.13	750.00	10.00	12.00	0.35
2750	6210000.00	1.59	-0.16	939.00	10.00	12.00	0.35
2751	6900000.00	1.61	-0.17	1125.00	10.00	12.00	0.35
2752	7320000.00	1.60	-0.18	1312.00	10.00	12.00	0.35
2753	7800000.00	1.59	-0.19	1500.00	10.00	12.00	0.35
2754	8010000.00	1.58	-0.20	1690.00	10.00	12.00	0.35
2755	8480000.00	1.61	-0.21	1877.00	10.00	12.00	0.35
2756	8770000.00	1.59	-0.22	2060.00	10.00	12.00	0.35
2757	9070000.00	1.60	-0.22	2250.00	10.00	12.00	0.35
2758	9420000.00	1.62	-0.23	2320.00	10.00	12.00	0.35
2759	9710000.00	1.60	-0.23	2630.00	10.00	12.00	0.35
2760	9950000.00	1.60	-0.23	2820.00	10.00	12.00	0.35
2761	10360000.00	1.60	-0.24	3000.00	10.00	12.00	0.35
2762	10770000.00	1.58	-0.24	3190.00	10.00	12.00	0.35
2763	10900000.00	1.59	-0.24	3380.00	10.00	12.00	0.35
2764	11280000.00	1.60	-0.24	3560.00	10.00	12.00	0.35
2765	11380000.00	1.60	-0.25	3750.00	10.00	12.00	0.35
2766	12400000.00	1.58	-0.25	4500.00	10.00	12.00	0.35
2767	6450000.00	2.10	-0.15	755.00	10.00	12.00	0.35
2768	6720000.00	2.10	-0.18	943.00	10.00	12.00	0.35
2769	7580000.00	2.12	-0.19	1130.00	10.00	12.00	0.35
2770	8060000.00	2.10	-0.21	1320.00	10.00	12.00	0.35
2771	8370000.00	2.09	-0.22	1510.00	10.00	12.00	0.35
2772	8900000.00	2.08	-0.23	1700.00	10.00	12.00	0.35
2773	9550000.00	2.11	-0.25	2070.00	10.00	12.00	0.35
2774	10000000.00	2.12	-0.25	2260.00	10.00	12.00	0.35
2775	10220000.00	2.09	-0.25	2375.00	10.00	12.00	0.35
2776	10650000.00	2.11	-0.26	2630.00	10.00	12.00	0.35
2777	11000000.00	2.10	-0.26	2810.00	10.00	12.00	0.35
2778	11060000.00	2.10	-0.27	3000.00	10.00	12.00	0.35
2779	11070000.00	2.11	-0.28	3190.00	10.00	12.00	0.35
2780	11620000.00	2.10	-0.28	3380.00	10.00	12.00	0.35
2781	11740000.00	2.09	-0.28	3560.00	10.00	12.00	0.35
2782	12230000.00	2.08	-0.28	3750.00	10.00	12.00	0.35
2783	7350000.00	2.60	-0.14	750.00	10.00	12.00	0.35

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
2784	7600000.00	2.61	-0.18	939.00	10.00	12.00	0.35
2785	8380000.00	2.60	-0.20	1125.00	10.00	12.00	0.35
2786	8840000.00	2.62	-0.22	1312.00	10.00	12.00	0.35
2787	8960000.00	2.60	-0.24	1500.00	10.00	12.00	0.35
2788	9500000.00	2.58	-0.25	1690.00	10.00	12.00	0.35
2789	10030000.00	2.60	-0.26	1877.00	10.00	12.00	0.35
2790	10400000.00	2.59	-0.27	2060.00	10.00	12.00	0.35
2791	10510000.00	2.59	-0.27	2250.00	10.00	12.00	0.35
2792	10820000.00	2.60	-0.28	2320.00	10.00	12.00	0.35
2793	10800000.00	2.60	-0.30	2630.00	10.00	12.00	0.35
2794	11670000.00	2.60	-0.30	2820.00	10.00	12.00	0.35
2795	8280000.00	3.10	-0.20	939.00	10.00	12.00	0.35
2796	8590000.00	3.09	-0.21	1125.00	10.00	12.00	0.35
2797	8960000.00	3.10	-0.25	1312.00	10.00	12.00	0.35
2798	9300000.00	3.10	-0.27	1500.00	10.00	12.00	0.35
2799	9860000.00	3.08	-0.28	1690.00	10.00	12.00	0.35
2800	3130000.00	1.10	-0.03	244.00	10.00	12.00	0.35
2801	3850000.00	1.10	-0.07	338.00	10.00	12.00	0.35
2802	4500000.00	1.10	-0.10	450.00	10.00	12.00	0.35
2803	5180000.00	1.10	-0.13	600.00	10.00	12.00	0.35
2804	6180000.00	1.10	-0.14	750.00	10.00	12.00	0.35
2805	3930000.00	1.60	0.02	244.00	10.00	12.00	0.35
2806	4480000.00	1.60	-0.05	338.00	10.00	12.00	0.35
2807	5320000.00	1.60	-0.09	450.00	10.00	12.00	0.35
2808	6160000.00	1.60	-0.13	600.00	10.00	12.00	0.35
2809	7120000.00	1.60	-0.15	750.00	10.00	12.00	0.35
2810	4270000.00	2.10	0.03	244.00	10.00	12.00	0.35
2811	5090000.00	2.10	-0.04	338.00	10.00	12.00	0.35
2812	5870000.00	2.10	-0.09	450.00	10.00	12.00	0.35
2813	6680000.00	2.10	-0.14	600.00	10.00	12.00	0.35
2814	7450000.00	2.10	-0.17	750.00	10.00	12.00	0.35
2815	4570000.00	2.60	0.03	244.00	10.00	12.00	0.35
2816	5390000.00	2.60	-0.05	338.00	10.00	12.00	0.35
2817	6030000.00	2.60	-0.11	450.00	10.00	12.00	0.35
2818	6940000.00	2.60	-0.16	600.00	10.00	12.00	0.35
2819	7650000.00	2.60	-0.20	750.00	10.00	12.00	0.35
2820	4810000.00	3.10	0.04	244.00	10.00	12.00	0.35
2821	5770000.00	3.10	-0.03	338.00	10.00	12.00	0.35
2822	6520000.00	3.10	-0.10	450.00	10.00	12.00	0.35
2823	3530000.00	1.10	0.01	244.00	10.00	12.00	0.35
2824	4120000.00	1.10	0.00	338.00	10.00	12.00	0.35
2825	4620000.00	1.10	-0.01	450.00	10.00	12.00	0.35
2826	5400000.00	1.10	-0.12	600.00	10.00	12.00	0.35
2827	5820000.00	1.10	-0.02	750.00	10.00	12.00	0.35
2828	3850000.00	1.60	0.01	244.00	10.00	12.00	0.35
2829	4550000.00	1.60	-0.06	338.00	10.00	12.00	0.35

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
2830	4380000.00	2.10	0.03	244.00	10.00	12.00	0.35
2831	5020000.00	2.10	-0.05	338.00	10.00	12.00	0.35
2832	5560000.00	2.10	-0.12	450.00	10.00	12.00	0.35
2833	4570000.00	2.60	0.03	244.00	10.00	12.00	0.35
2834	5310000.00	2.60	-0.06	338.00	10.00	12.00	0.35
2835	6040000.00	2.60	-0.12	450.00	10.00	12.00	0.35
2836	6670000.00	1.10	-0.13	755.00	10.00	12.00	0.35
2837	6820000.00	1.10	-0.16	863.00	10.00	12.00	0.35
2838	7150000.00	1.10	-0.17	943.00	10.00	12.00	0.35
2839	7530000.00	1.10	-0.17	1035.00	10.00	12.00	0.35
2840	7690000.00	1.10	-0.21	1130.00	10.00	12.00	0.35
2841	8310000.00	1.10	-0.20	1320.00	10.00	12.00	0.35
2842	8640000.00	1.10	-0.21	1510.00	10.00	12.00	0.35
2843	8970000.00	1.10	-0.22	1700.00	10.00	12.00	0.35
2844	9320000.00	1.10	-0.23	1885.00	10.00	12.00	0.35
2845	9620000.00	1.10	-0.15	2070.00	10.00	12.00	0.35
2846	9950000.00	1.10	-0.24	2260.00	10.00	12.00	0.35
2847	10100000.00	1.10	-0.14	2375.00	10.00	12.00	0.35
2848	10580000.00	1.10	-0.25	2630.00	10.00	12.00	0.35
2849	11020000.00	1.10	-0.26	2810.00	10.00	12.00	0.35
2850	11370000.00	1.10	-0.26	3000.00	10.00	12.00	0.35
2851	11600000.00	1.10	-0.26	3190.00	10.00	12.00	0.35
2852	11930000.00	1.10	-0.27	3380.00	10.00	12.00	0.35
2853	12420000.00	1.10	-0.27	3560.00	10.00	12.00	0.35
2854	12650000.00	1.10	-0.27	3750.00	10.00	12.00	0.35
2855	13320000.00	1.10	-0.28	4500.00	10.00	12.00	0.35
2856	7090000.00	1.58	-0.16	755.00	10.00	12.00	0.35
2857	7460000.00	1.58	-0.18	863.00	10.00	12.00	0.35
2858	7650000.00	1.58	-0.19	943.00	10.00	12.00	0.35
2859	7950000.00	1.59	-0.21	1035.00	10.00	12.00	0.35
2860	8430000.00	1.60	-0.21	1130.00	10.00	12.00	0.35
2861	8720000.00	1.60	-0.24	1320.00	10.00	12.00	0.35
2862	8890000.00	1.58	-0.25	1510.00	10.00	12.00	0.35
2863	9260000.00	1.59	-0.26	1700.00	10.00	12.00	0.35
2864	9520000.00	1.58	-0.28	1885.00	10.00	12.00	0.35
2865	9960000.00	1.60	-0.28	2070.00	10.00	12.00	0.35
2866	10350000.00	1.60	-0.29	2260.00	10.00	12.00	0.35
2867	10480000.00	1.59	-0.29	2375.00	10.00	12.00	0.35
2868	11170000.00	1.60	-0.29	2630.00	10.00	12.00	0.35
2869	11650000.00	1.62	-0.30	2820.00	10.00	12.00	0.35
2870	12120000.00	1.61	-0.30	3000.00	10.00	12.00	0.35
2871	12390000.00	1.62	-0.31	3190.00	10.00	12.00	0.35
2872	12790000.00	1.59	-0.31	3380.00	10.00	12.00	0.35
2873	13000000.00	1.59	-0.31	3560.00	10.00	12.00	0.35
2874	13420000.00	1.60	-0.31	3750.00	10.00	12.00	0.35
2875	14530000.00	1.59	-0.32	4500.00	10.00	12.00	0.35

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
2876	7650000.00	2.09	-0.18	755.00	10.00	12.00	0.35
2877	7730000.00	2.10	-0.21	863.00	10.00	12.00	0.35
2878	8180000.00	2.10	-0.22	943.00	10.00	12.00	0.35
2879	8280000.00	2.10	-0.24	1035.00	10.00	12.00	0.35
2880	8550000.00	2.10	-0.25	1130.00	10.00	12.00	0.35
2881	9010000.00	2.10	-0.27	1320.00	10.00	12.00	0.35
2882	9450000.00	2.10	-0.28	1510.00	10.00	12.00	0.35
2883	9900000.00	2.10	-0.29	1700.00	10.00	12.00	0.35
2884	10310000.00	2.09	-0.30	1885.00	10.00	12.00	0.35
2885	10490000.00	2.10	-0.32	2070.00	10.00	12.00	0.35
2886	11050000.00	2.10	-0.32	2260.00	10.00	12.00	0.35
2887	11320000.00	2.11	-0.32	2375.00	10.00	12.00	0.35
2888	11900000.00	2.08	-0.32	2630.00	10.00	12.00	0.35
2889	12200000.00	2.11	-0.33	2810.00	10.00	12.00	0.35
2890	12540000.00	2.10	-0.34	3000.00	10.00	12.00	0.35
2891	13040000.00	2.10	-0.33	3190.00	10.00	12.00	0.35
2892	13300000.00	2.10	-0.34	3380.00	10.00	12.00	0.35
2893	13800000.00	2.10	-0.35	3560.00	10.00	12.00	0.35
2894	14100000.00	2.11	-0.35	3750.00	10.00	12.00	0.35
2895	7840000.00	2.60	-0.20	755.00	10.00	12.00	0.35
2896	8330000.00	2.61	-0.22	863.00	10.00	12.00	0.35
2897	8570000.00	2.57	-0.24	943.00	10.00	12.00	0.35
2898	8770000.00	2.60	-0.25	1035.00	10.00	12.00	0.35
2899	9090000.00	2.61	-0.26	1130.00	10.00	12.00	0.35
2900	9550000.00	2.59	-0.29	1320.00	10.00	12.00	0.35
2901	10270000.00	2.61	-0.30	1510.00	10.00	12.00	0.35
2902	10450000.00	2.60	-0.32	1700.00	10.00	12.00	0.35
2903	10530000.00	2.61	-0.34	1885.00	10.00	12.00	0.35
2904	10900000.00	2.61	-0.34	2070.00	10.00	12.00	0.35
2905	11200000.00	2.60	-0.35	2260.00	10.00	12.00	0.35
2906	11720000.00	2.59	-0.35	2375.00	10.00	12.00	0.35
2907	12280000.00	2.61	-0.36	2630.00	10.00	12.00	0.35
2908	12700000.00	2.59	-0.36	2820.00	10.00	12.00	0.35
2909	12970000.00	2.62	-0.37	3000.00	10.00	12.00	0.35
2910	13370000.00	2.55	-0.37	3190.00	10.00	12.00	0.35
2911	8230000.00	3.08	-0.22	750.00	10.00	12.00	0.35
2912	8750000.00	3.09	-0.24	863.00	10.00	12.00	0.35
2913	8990000.00	3.08	-0.25	939.00	10.00	12.00	0.35
2914	9100000.00	3.08	-0.27	1030.00	10.00	12.00	0.35
2915	9420000.00	3.09	-0.29	1125.00	10.00	12.00	0.35
2916	9740000.00	3.10	-0.32	1312.00	10.00	12.00	0.35
2917	10150000.00	3.10	-0.33	1500.00	10.00	12.00	0.35
2918	10600000.00	3.09	-0.36	1800.00	10.00	12.00	0.35
2919	10390000.00	3.08	-0.35	1690.00	10.00	12.00	0.35
2920	11580000.00	2.90	-0.37	2230.00	10.00	12.00	0.35
2941	270658.41	6.88	0.50	859.85	4.06	19.71	0.32

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
2942	281383.81	6.89	0.40	1325.04	4.06	19.71	0.32
2943	335010.76	6.90	0.46	1318.26	4.06	19.71	0.32
2944	93374.00	6.87	0.48	2001.80	4.06	19.71	0.32
2945	54257.86	6.91	0.68	1315.54	4.06	19.71	0.32
2946	201574.27	6.90	0.29	3097.63	4.06	19.71	0.32
2947	229018.66	6.91	0.29	2669.06	4.06	19.71	0.32
2948	234065.90	6.90	0.48	538.42	4.06	19.71	0.32
2949	148578.22	6.89	0.55	298.37	4.06	19.71	0.32
2950	600621.94	6.89	0.34	1154.15	4.06	19.71	0.32
2951	639422.62	6.91	0.34	1357.59	4.06	19.71	0.32
2952	718285.79	6.87	0.31	1357.59	4.06	19.71	0.32
2953	276652.02	3.42	0.61	646.92	4.06	19.71	0.32
2954	270342.96	3.46	0.61	1327.75	4.06	19.71	0.32
2955	306935.47	3.48	0.31	2801.97	4.06	19.71	0.32
2956	431854.74	3.41	0.42	1323.68	4.06	19.71	0.32
2957	461822.75	3.46	0.52	1342.67	4.06	19.71	0.32
2958	674122.41	3.53	0.33	2007.22	4.06	19.71	0.32
2959	707875.85	3.45	0.34	1360.30	4.06	19.71	0.32
2960	314821.79	3.47	0.59	272.60	4.06	19.71	0.32
2961	147000.96	6.91	0.68	1308.76	4.06	19.71	0.32
2962	254254.87	6.93	0.29	2689.40	4.06	19.71	0.32
2963	482958.08	6.90	0.51	1337.24	4.06	19.71	0.32
2964	1088942.71	6.87	0.36	1339.96	4.06	19.71	0.32
2965	1839404.68	6.85	0.31	1335.89	4.06	19.71	0.32
2966	1226795.54	6.87	0.43	638.78	4.06	19.71	0.32
2967	199997.01	3.41	0.60	1318.26	4.06	19.71	0.32
2968	593051.07	3.48	0.42	787.97	4.06	19.71	0.32
2969	531853.25	3.44	0.31	1984.16	4.06	19.71	0.32
2970	1201243.87	3.16	0.35	1325.04	4.06	19.71	0.32
2971	142269.17	6.87	0.68	1326.39	4.06	19.71	1.31
2972	373811.45	6.87	0.28	3336.33	4.06	19.71	1.31
2973	453620.98	6.90	0.28	2651.43	4.06	19.71	1.31
2974	348575.23	6.92	0.47	1319.61	4.06	19.71	1.31
2975	1350453.00	6.94	0.29	1364.37	4.06	19.71	1.31
2976	1660227.54	6.92	0.26	1357.59	4.06	19.71	1.31
2977	1661489.36	3.52	0.30	1363.01	4.06	19.71	1.31
2978	491475.30	3.53	0.30	2749.08	4.06	19.71	1.31
2979	799357.13	3.45	0.39	1329.11	4.06	19.71	1.31
2980	974748.83	3.51	0.28	2009.93	4.06	19.71	1.31
2981	234696.81	3.49	0.58	1319.61	4.06	19.71	1.31
3032	693995.93	6.90	0.51	678.11	9.53	12.70	3.05
3033	735004.78	6.90	0.50	675.40	9.53	12.70	3.05
3034	766550.05	6.90	0.49	675.40	9.53	12.70	3.05
3035	820177.01	6.90	0.47	678.11	9.53	12.70	3.05
3036	861185.86	6.90	0.45	678.11	9.53	12.70	3.05
3037	905349.24	6.90	0.45	669.98	9.53	12.70	3.05

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
3038	952667.15	6.90	0.44	667.27	9.53	12.70	3.05
3039	1003139.58	6.90	0.41	678.11	9.53	12.70	3.05
3040	921121.88	6.90	0.38	1337.24	9.53	12.70	3.05
3041	977903.36	6.90	0.34	1335.89	9.53	12.70	3.05
3042	1009448.63	6.90	0.33	1342.67	9.53	12.70	3.05
3043	1107238.97	6.90	0.30	1363.01	9.53	12.70	3.05
3044	1151402.34	6.90	0.30	1356.23	9.53	12.70	3.05
3045	1239729.10	6.90	0.29	1356.23	9.53	12.70	3.05
3046	1268119.84	6.90	0.27	1356.23	9.53	12.70	3.05
3047	1346983.02	6.90	0.26	1353.52	9.53	12.70	3.05
3048	1416382.61	6.90	0.26	1346.74	9.53	12.70	3.05
3049	1463700.51	6.90	0.25	1348.09	9.53	12.70	3.05
3050	1507863.89	6.90	0.23	1356.23	9.53	12.70	3.05
3051	1050457.48	6.90	0.29	2015.36	9.53	12.70	3.05
3085	223971.42	3.54	0.94	774.41	6.35	9.53	0.74
3086	215454.19	3.54	0.94	771.69	6.35	9.53	0.74
3087	335957.12	3.54	0.87	781.19	6.35	9.53	0.74
3088	318922.68	3.39	0.86	771.69	6.35	9.53	0.74
3089	525544.19	3.45	0.77	813.74	6.35	9.53	0.74
3090	517026.97	3.45	0.77	813.74	6.35	9.53	0.74
3091	534061.42	3.54	0.77	790.68	6.35	9.53	0.74
3092	680746.92	3.54	0.73	778.48	6.35	9.53	0.74
3093	732481.16	3.49	0.71	796.11	6.35	9.53	0.74
3094	895885.66	3.61	0.68	793.39	6.35	9.53	0.74
3095	844782.32	3.41	0.68	785.26	6.35	9.53	0.74
3096	844466.87	3.54	0.68	781.19	6.35	9.53	0.74
3097	1137206.97	3.54	0.68	766.27	6.35	9.53	0.74
3098	1085788.18	3.54	0.61	789.33	6.35	9.53	0.74
3099	296525.54	6.92	0.88	764.91	6.35	9.53	0.74
3100	236274.07	6.96	0.90	741.86	6.35	9.53	0.74
3101	300626.42	6.85	0.83	750.00	6.35	9.53	0.74
3102	326493.54	6.97	0.85	751.35	6.35	9.53	0.74
3103	395262.23	6.97	0.79	771.69	6.35	9.53	0.74
3104	382328.67	7.02	0.81	767.63	6.35	9.53	0.74
3105	541316.83	6.99	0.75	735.08	6.35	9.53	0.74
3106	1589881.59	6.90	0.29	1505.42	8.51	13.72	2.74
3107	2334349.96	6.93	0.24	1518.98	8.51	13.72	2.74
3108	1485782.20	6.93	0.29	1518.98	8.51	13.72	2.74
3109	1305974.17	6.93	0.34	1139.23	8.51	13.72	2.74
3110	1413228.08	6.93	0.32	1139.23	8.51	13.72	2.74
3111	1589881.59	6.93	0.31	1139.23	8.51	13.72	2.74
3112	1892716.18	6.92	0.31	1139.23	8.51	13.72	2.74
3113	2097760.44	6.90	0.29	1139.23	8.51	13.72	2.74
3114	2359586.17	6.92	0.29	1139.23	8.51	13.72	2.74
3115	2637184.55	6.90	0.30	1139.23	8.51	13.72	2.74
3116	1766535.10	6.93	0.31	1125.67	8.51	13.72	2.74

ID Number	q_{cr}	P	x	G	D_{hy}	D_{he}	L_{he}
3117	1690826.46	6.91	0.32	1139.23	8.51	13.72	2.74
3118	1861170.91	6.91	0.30	1139.23	8.51	13.72	2.74
3119	1438464.30	6.92	0.33	1139.23	8.51	13.72	2.74
3120	1356446.60	6.90	0.35	1139.23	8.51	13.72	2.74
3121	1526791.05	6.93	0.24	1898.72	8.51	13.72	2.74
3122	1813853.01	6.90	0.22	1898.72	8.51	13.72	2.74
3123	2145078.34	6.90	0.19	1898.72	8.51	13.72	2.74
3124	2469994.62	6.90	0.18	1885.16	8.51	13.72	2.74
3125	3533070.21	6.93	0.15	1885.16	8.51	13.72	2.74
3126	1892716.18	6.90	0.23	1898.72	8.51	13.72	2.74
3127	2233405.10	6.90	0.21	1858.04	8.51	13.72	2.74
3128	1589881.59	6.90	0.26	1898.72	8.51	13.72	2.74
3129	2794910.90	6.90	0.22	1505.42	8.51	13.72	2.74
3130	3122981.70	6.90	0.20	1518.98	8.51	13.72	2.74
3131	1804389.43	7.00	0.22	1885.16	8.51	13.72	2.31
3132	2110378.54	6.83	0.21	1885.16	8.51	13.72	2.31
3133	2394285.97	6.92	0.17	1898.72	8.51	13.72	2.31
3134	2350122.59	6.92	0.17	1898.72	8.51	13.72	2.31
3135	3135599.81	6.90	0.12	1898.72	8.51	13.72	2.31
3136	1728680.78	6.90	0.25	1546.10	8.51	13.72	2.31
3137	1895870.71	6.90	0.24	1546.10	8.51	13.72	2.31
3138	2078833.27	6.93	0.22	1546.10	8.51	13.72	2.31
3139	2195550.77	6.93	0.21	1546.10	8.51	13.72	2.31
3140	2681347.92	6.90	0.17	1532.54	8.51	13.72	2.31
3141	3040964.00	6.93	0.18	1532.54	8.51	13.72	2.31
3142	1463700.51	6.93	0.29	1152.80	8.51	13.72	2.31
3143	1567799.90	6.93	0.26	1139.23	8.51	13.72	2.31
3144	1574108.96	6.93	0.26	1139.23	8.51	13.72	2.31
3145	1728680.78	6.93	0.25	1139.23	8.51	13.72	2.31
3146	1858016.39	6.93	0.23	1152.80	8.51	13.72	2.31
3147	1867479.97	6.90	0.23	1152.80	8.51	13.72	2.31
3148	2129305.71	6.90	0.21	1152.80	8.51	13.72	2.31
3149	2290186.58	6.93	0.22	1125.67	8.51	13.72	2.31
3150	2539394.21	6.93	0.21	1125.67	8.51	13.72	2.31
3151	2580403.06	6.96	0.20	1152.80	8.51	13.72	2.31
3152	2725511.30	6.86	0.16	1518.98	8.51	13.72	2.31
3153	2839074.27	6.90	0.15	1532.54	8.51	13.72	2.31

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
1	176671.16	1292638.38	681.01	277.47	0.01
2	194904.12	1292638.38	681.01	261.48	0.01
3	201191.35	1292638.38	681.01	256.39	0.01
4	220681.76	1292638.38	681.01	241.78	0.01
5	231998.78	1292638.38	681.01	234.04	0.01
6	260920.03	1292638.38	681.01	216.34	0.01

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
7	237028.56	1292638.38	681.01	230.76	0.01
8	342654.03	1292638.38	681.01	178.24	0.01
9	403011.42	1292638.38	681.01	157.73	0.01
10	433818.86	1292638.38	681.01	148.98	0.01
11	383521.00	1506271.81	740.08	125.30	0.02
12	0.00	1292638.38	688.76	681.01	0.01
13	23874.93	1292638.38	681.01	569.15	0.01
14	48974.21	1292638.38	681.01	485.34	0.01
15	107131.09	1292638.38	681.01	361.87	0.01
16	134679.08	1292638.38	681.01	322.96	0.01
17	30608.88	1292638.38	681.01	543.95	0.01
18	134679.08	1292638.38	681.01	322.96	0.01
19	195896.84	1292638.38	681.01	260.66	0.01
20	219159.59	1506271.81	740.08	194.56	0.02
21	0.00	1292638.38	724.18	681.01	0.01
22	0.00	1292638.38	708.29	681.01	0.01
23	0.00	1292638.38	692.97	681.01	0.01
24	30608.88	1292638.38	681.01	543.95	0.01
25	0.00	1292638.38	750.65	681.01	0.01
26	0.00	1292638.38	724.18	681.01	0.01
27	0.00	1292638.38	694.27	681.01	0.01
28	20201.86	1292638.38	681.01	583.91	0.01
29	101009.31	1292638.38	681.01	371.83	0.01
30	104682.38	1506271.81	740.08	316.38	0.02
31	0.00	1292638.38	731.27	681.01	0.01
32	0.00	1292638.38	716.20	681.01	0.01
33	0.00	1292638.38	702.50	681.01	0.01
34	0.00	1292638.38	701.48	681.01	0.01
35	6121.78	1292638.38	681.01	648.34	0.01
36	0.00	1292638.38	762.22	681.01	0.01
37	0.00	1292638.38	736.16	681.01	0.01
38	0.00	1292638.38	710.54	681.01	0.01
39	0.00	1292638.38	685.04	681.01	0.01
40	61217.76	1292638.38	681.01	452.82	0.01
41	45913.32	1506271.81	740.08	466.23	0.02
42	0.00	1292638.38	721.54	681.01	0.01
43	0.00	1292638.38	707.54	681.01	0.01
44	0.00	1292638.38	710.04	681.01	0.01
45	0.00	1292638.38	686.11	681.01	0.01
46	0.00	1292638.38	712.02	681.01	0.01
47	0.00	1292638.38	682.36	681.01	0.01
48	24487.11	1292638.38	681.01	566.76	0.01
49	18977.51	1506271.81	740.08	595.50	0.02
50	0.00	1292638.38	709.54	681.01	0.01
51	0.00	1292638.38	713.26	681.01	0.01
52	0.00	1292638.38	688.50	681.01	0.01

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
53	0.00	1292638.38	690.35	681.01	0.01
54	35506.30	1292638.38	681.01	526.98	0.01
55	0.00	1506271.81	741.24	740.08	0.02
56	506780.52	2368133.27	985.13	0.51	0.07
57	531829.06	2353225.95	981.99	0.63	0.07
58	563905.15	2369349.35	985.37	0.45	0.07
59	313639.77	2450310.68	997.91	0.15	0.07
60	317189.38	2439918.29	996.83	0.19	0.07
61	283030.52	2439918.29	996.83	0.21	0.07
62	307009.52	2417397.77	993.87	0.32	0.07
65	1012369.85	2439445.43	996.78	0.06	0.07
66	1423895.68	2385084.90	988.44	0.13	0.07
67	831434.41	2389179.33	989.20	0.21	0.07
68	1431918.56	2386530.93	988.71	0.13	0.07
69	1427283.90	2378806.50	987.25	0.15	0.07
70	1041145.99	2432584.08	995.95	0.07	0.07
71	1797154.58	2431873.59	995.86	0.04	0.07
74	1680290.92	2380015.46	987.48	0.12	0.07
75	864034.19	2373720.30	986.25	0.27	0.07
76	798996.26	2421200.78	994.43	0.11	0.07
77	858898.76	2412636.96	993.16	0.13	0.07
78	708761.98	2394466.14	990.15	0.22	0.07
79	1060688.78	2388938.70	989.15	0.17	0.07
80	1484272.38	2386289.99	988.66	0.12	0.07
81	659352.27	2442045.42	997.07	0.09	0.07
82	323155.63	2429741.60	995.59	0.23	0.07
83	494560.12	2389179.33	989.20	0.35	0.07
84	1761844.17	2447005.79	997.59	0.03	0.07
85	1256679.64	2440154.63	996.86	0.05	0.07
86	534960.10	2431636.81	995.83	0.14	0.07
87	697811.78	2431399.94	995.80	0.10	0.07
88	515155.44	2429978.49	995.62	0.15	0.07
89	363144.48	2420963.22	994.39	0.25	0.07
90	404534.54	2365699.06	984.63	0.67	0.07
91	2025001.69	2357394.28	982.89	0.15	0.07
93	1304769.00	2376628.41	986.82	0.17	0.07
94	673270.68	2379048.35	987.29	0.32	0.07
95	392503.07	2378806.50	987.25	0.54	0.07
96	467622.90	2373720.30	986.25	0.50	0.07
97	486228.01	2360330.13	983.51	0.61	0.07
99	1796859.50	2367403.81	984.98	0.15	0.07
100	1111680.83	2370321.60	985.57	0.22	0.07
101	785219.55	2372264.51	985.96	0.31	0.07
102	538834.51	2373720.30	986.25	0.44	0.07
103	392260.78	2363016.74	984.07	0.72	0.07
104	884961.22	2444644.27	997.35	0.06	0.07

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
105	1036028.37	2443463.13	997.22	0.05	0.07
106	1168720.86	2439918.29	996.83	0.05	0.07
107	1331937.20	2439445.43	996.78	0.05	0.07
108	1489345.29	2437553.66	996.56	0.04	0.07
109	1842790.57	2437553.66	996.56	0.03	0.07
112	1579381.49	2437317.12	996.53	0.04	0.07
113	1269808.89	2432584.08	995.95	0.06	0.07
114	971187.27	2421913.39	994.53	0.09	0.07
115	0.00	2138036.18	965.88	924.13	0.05
116	0.00	2139988.08	963.68	924.70	0.05
117	0.00	2136961.92	956.86	923.81	0.05
118	0.00	2138173.41	948.29	924.17	0.05
119	0.00	2139157.10	949.18	924.46	0.05
120	0.00	2141022.92	942.74	925.01	0.05
121	0.00	2136631.31	937.29	923.71	0.05
122	0.00	2198664.13	959.11	941.81	0.05
123	0.00	2191288.59	953.01	939.69	0.05
124	0.00	2202504.19	948.46	942.91	0.05
125	0.00	2196787.26	974.99	941.27	0.05
126	0.00	2199205.55	972.98	941.96	0.05
127	0.00	2199416.73	970.93	942.02	0.05
128	0.00	2194937.75	966.99	940.74	0.05
129	0.00	2197856.34	964.32	941.58	0.05
130	0.00	2183613.14	945.31	937.47	0.05
131	0.00	2135161.47	967.60	923.28	0.05
132	0.00	2138821.97	965.91	924.36	0.05
133	0.00	2076263.97	960.32	905.76	0.05
134	0.00	2074194.72	956.57	905.14	0.05
135	0.00	2075664.67	947.91	905.58	0.05
136	0.00	2075108.75	937.13	905.42	0.05
137	0.00	2073987.55	933.02	905.08	0.05
138	0.00	2075303.15	924.55	905.47	0.05
139	0.00	2138703.86	963.92	924.32	0.05
140	0.00	2136165.71	950.99	923.57	0.05
141	0.00	2137254.19	950.01	923.89	0.05
142	0.00	2135759.41	971.03	923.45	0.05
143	0.00	2130960.79	964.43	922.03	0.05
144	0.00	2134757.66	961.92	923.16	0.05
145	0.00	2137098.24	956.28	923.85	0.05
146	0.00	2136223.84	946.37	923.59	0.05
147	0.00	2133781.10	941.97	922.87	0.05
148	0.00	2135914.07	933.42	923.50	0.05
149	0.00	2060913.01	926.48	901.18	0.05
150	0.00	2201763.58	961.22	942.70	0.05
151	0.00	2200356.27	958.37	942.29	0.05
152	0.00	2199840.17	949.13	942.15	0.05

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
153	0.00	2137859.90	954.85	924.07	0.05
154	0.00	2137879.48	952.88	924.08	0.05
155	0.00	2140723.72	941.91	924.92	0.05
156	0.00	2140644.03	934.00	924.89	0.05
157	0.00	2139928.58	964.69	924.68	0.05
158	0.00	2137801.18	962.79	924.06	0.05
159	0.00	2200417.13	970.74	942.31	0.05
160	0.00	2200417.13	969.51	942.31	0.05
161	0.00	2200538.93	962.02	942.35	0.05
162	0.00	2137039.80	958.57	923.83	0.05
163	0.00	2138036.18	955.64	924.13	0.05
164	0.00	2137488.39	953.09	923.96	0.05
165	0.00	2135585.59	951.07	923.40	0.05
166	0.00	2131788.64	952.86	922.28	0.05
167	0.00	2137938.22	941.10	924.10	0.05
168	0.00	2136165.71	949.49	923.57	0.05
169	0.00	2135566.29	935.77	923.40	0.05
170	0.00	2138448.24	962.46	924.25	0.05
171	0.00	2137059.28	959.08	923.84	0.05
172	0.00	2136961.92	953.42	923.81	0.05
173	0.00	2136825.70	948.83	923.77	0.05
174	0.00	2137137.22	942.46	923.86	0.05
175	0.00	2136961.92	928.57	923.81	0.05
176	0.00	2138134.19	966.27	924.15	0.05
177	0.00	2137781.61	963.75	924.05	0.05
178	0.00	2069832.49	960.62	903.84	0.05
179	0.00	2069832.49	956.74	903.84	0.05
180	0.00	2069345.84	939.69	903.70	0.05
181	0.00	2068107.22	935.55	903.33	0.05
182	0.00	2057754.83	924.40	900.23	0.05
183	0.00	2130436.12	969.17	921.88	0.05
184	0.00	2135662.82	965.46	923.42	0.05
185	0.00	2136825.70	963.27	923.77	0.05
186	0.00	2135875.39	959.92	923.49	0.05
187	0.00	2136262.60	957.73	923.60	0.05
188	0.00	2136650.74	953.71	923.72	0.05
189	0.00	2136301.37	949.25	923.61	0.05
190	0.00	2137195.69	948.62	923.88	0.05
191	0.00	2135662.82	943.32	923.42	0.05
192	0.00	2138900.76	928.56	924.38	0.05
193	0.00	2136126.97	961.45	923.56	0.05
194	0.00	2135161.47	957.59	923.28	0.05
195	0.00	2135759.41	955.78	923.45	0.05
196	0.00	2135007.52	952.47	923.23	0.05
197	0.00	2135450.52	950.83	923.36	0.05
198	0.00	2137078.76	941.78	923.84	0.05

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
199	0.00	2137918.64	966.25	924.09	0.05
200	0.00	2136728.48	962.30	923.74	0.05
201	0.00	2134892.15	956.57	923.20	0.05
202	0.00	2136650.74	953.78	923.72	0.05
203	0.00	2135875.39	939.33	923.49	0.05
204	0.00	2137683.81	971.95	924.02	0.05
205	0.00	2135392.67	968.63	923.34	0.05
206	0.00	2135046.00	966.08	923.24	0.05
207	0.00	2135798.06	963.85	923.46	0.05
208	0.00	2136514.79	960.69	923.68	0.05
209	0.00	2135952.76	957.07	923.51	0.05
210	0.00	2133723.84	952.88	922.85	0.05
211	0.00	2137351.73	949.24	923.92	0.05
212	0.00	2136709.04	967.65	923.73	0.05
213	0.00	2139157.10	962.11	924.46	0.05
214	0.00	2137605.61	961.18	924.00	0.05
215	0.00	2137742.49	957.79	924.04	0.05
216	0.00	2130137.06	966.81	921.79	0.05
217	0.00	2132166.30	963.31	922.39	0.05
218	0.00	2132829.31	959.74	922.59	0.05
219	0.00	2131261.35	957.86	922.12	0.05
220	0.00	2131298.96	966.24	922.13	0.05
221	0.00	2132015.13	965.54	922.35	0.05
222	0.00	2130380.01	961.85	921.86	0.05
223	0.00	2134469.83	958.94	923.07	0.05
224	0.00	2132260.86	963.53	922.42	0.05
225	0.00	2132109.60	960.68	922.37	0.05
226	0.00	2133475.93	958.33	922.78	0.05
227	0.00	2133456.87	954.45	922.77	0.05
228	0.00	2130698.25	965.20	921.96	0.05
229	0.00	2132260.86	964.72	922.42	0.05
230	0.00	2132829.31	964.36	922.59	0.05
231	0.00	2131129.79	961.97	922.08	0.05
232	0.00	2132431.18	958.82	922.47	0.05
233	0.00	2132204.12	955.82	922.40	0.05
234	0.00	2131111.00	965.75	922.08	0.05
235	0.00	2131298.96	959.52	922.13	0.05
236	0.00	2134029.48	965.07	922.94	0.05
237	0.00	2130773.22	967.41	921.98	0.05
238	0.00	2131223.75	964.39	922.11	0.05
239	0.00	2131656.66	961.18	922.24	0.05
240	0.00	2131223.75	956.73	922.11	0.05
241	0.00	2131204.95	967.04	922.11	0.05
242	0.00	2130174.41	960.59	921.80	0.05
243	0.00	2136689.60	967.69	923.73	0.05
244	0.00	2136806.25	964.97	923.76	0.05

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
245	0.00	2135933.42	961.85	923.50	0.05
246	0.00	2135952.76	958.28	923.51	0.05
247	0.00	2137586.07	967.89	923.99	0.05
248	0.00	2137586.07	963.55	923.99	0.05
249	0.00	2136747.92	959.30	923.74	0.05
250	0.00	2136981.38	956.47	923.81	0.05
251	0.00	2136262.60	967.09	923.60	0.05
252	0.00	2135643.51	959.04	923.42	0.05
253	0.00	2133647.52	962.95	922.83	0.05
254	0.00	2136126.97	957.38	923.56	0.05
255	0.00	2134988.29	955.01	923.22	0.05
256	0.00	2134316.53	952.53	923.03	0.05
257	0.00	2135065.24	949.17	923.25	0.05
258	0.00	2135952.76	970.87	923.51	0.05
259	0.00	2136107.61	969.78	923.56	0.05
260	0.00	2136845.15	963.14	923.77	0.05
261	0.00	2137879.48	950.27	924.08	0.05
262	0.00	2137840.32	966.70	924.07	0.05
263	0.00	2138703.86	965.01	924.32	0.05
264	0.00	2138212.65	961.63	924.18	0.05
265	0.00	2138036.18	957.87	924.13	0.05
266	0.00	2137977.40	967.77	924.11	0.05
267	0.00	2136903.52	963.86	923.79	0.05
268	0.00	2136088.24	960.83	923.55	0.05
269	0.00	2137351.73	957.60	923.92	0.05
270	0.00	2137429.81	955.00	923.95	0.05
271	0.00	2137020.33	952.64	923.83	0.05
272	0.00	2137507.92	949.35	923.97	0.05
273	0.00	2138861.36	969.37	924.37	0.05
274	0.00	2137078.76	967.50	923.84	0.05
275	0.00	2136884.06	964.14	923.78	0.05
276	0.00	2137566.53	961.16	923.99	0.05
277	0.00	2136689.60	957.51	923.73	0.05
278	0.00	2135161.47	961.54	923.28	0.05
279	0.00	2135450.52	959.46	923.36	0.05
280	0.00	2135026.76	957.15	923.24	0.05
281	0.00	2135952.76	954.63	923.51	0.05
282	0.00	2136185.09	951.94	923.58	0.05
283	0.00	2136185.09	948.29	923.58	0.05
284	0.00	2137996.99	969.74	924.11	0.05
285	0.00	2137117.73	965.94	923.85	0.05
286	0.00	2138841.67	948.85	924.36	0.05
287	0.00	2135161.47	945.17	923.28	0.05
288	0.00	2139176.84	934.90	924.46	0.05
289	0.00	2137215.19	968.63	923.88	0.05
290	0.00	2067022.64	929.26	903.00	0.05

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
291	0.00	2136786.80	977.18	923.76	0.05
292	0.00	2136728.48	967.33	923.74	0.05
293	0.00	2136689.60	949.57	923.73	0.05
294	0.00	2136553.62	962.16	923.69	0.05
295	0.00	2137020.33	959.59	923.83	0.05
296	0.00	2136631.31	968.82	923.71	0.05
297	0.00	2136806.25	964.16	923.76	0.05
298	0.00	2136204.46	961.40	923.58	0.05
299	0.00	2135798.06	958.66	923.46	0.05
300	0.00	2136262.60	956.00	923.60	0.05
301	0.00	2136068.88	953.31	923.54	0.05
302	0.00	2136922.98	950.37	923.80	0.05
303	0.00	2137390.76	970.69	923.93	0.05
304	0.00	2136689.60	970.70	923.73	0.05
305	0.00	2148232.95	933.83	927.13	0.05
306	0.00	2198844.34	969.56	941.86	0.05
307	0.00	2200569.40	967.23	942.36	0.05
308	0.00	2200417.13	962.81	942.31	0.05
309	0.00	2137488.39	971.24	923.96	0.05
310	0.00	2120801.36	950.53	919.02	0.05
311	0.00	2073174.66	935.76	904.84	0.05
312	0.00	2068995.06	925.90	903.59	0.05
313	0.00	2137254.19	973.62	923.89	0.05
314	0.00	2137507.92	966.33	923.97	0.05
315	0.00	2137918.64	963.92	924.09	0.05
316	0.00	2139275.55	961.56	924.49	0.05
317	0.00	2138232.27	957.97	924.18	0.05
318	0.00	2136417.75	961.84	923.65	0.05
319	0.00	2136437.15	959.95	923.65	0.05
320	0.00	2135740.09	957.17	923.45	0.05
321	0.00	2135411.95	954.89	923.35	0.05
322	0.00	2135450.52	952.17	923.36	0.05
323	0.00	2137078.76	968.82	923.84	0.05
324	0.00	2137273.69	969.19	923.90	0.05
325	0.00	2138212.65	968.44	924.18	0.05
326	0.00	2139097.91	966.70	924.44	0.05
327	0.00	2138428.59	963.17	924.24	0.05
328	0.00	2138134.19	959.70	924.15	0.05
329	0.00	2139453.38	954.84	924.54	0.05
330	0.00	2137938.22	951.15	924.10	0.05
331	0.00	2137840.32	946.41	924.07	0.05
332	0.00	2138979.59	970.95	924.40	0.05
333	0.00	2136728.48	966.87	923.74	0.05
334	0.00	2136573.04	966.65	923.69	0.05
335	0.00	2136728.48	962.82	923.74	0.05
336	0.00	2136514.79	959.37	923.68	0.05

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
337	0.00	2073105.92	956.35	904.82	0.05
338	0.00	2073463.63	947.57	904.93	0.05
339	0.00	2137410.28	966.25	923.94	0.05
340	0.00	2139216.31	964.63	924.47	0.05
341	0.00	2137039.80	958.08	923.83	0.05
342	0.00	2134988.29	958.18	923.22	0.05
343	0.00	2136747.92	955.70	923.74	0.05
344	0.00	2134335.69	973.77	923.03	0.05
345	0.00	2137742.49	929.70	924.04	0.05
346	0.00	2137527.45	966.56	923.97	0.05
347	0.00	2136884.06	963.11	923.78	0.05
348	0.00	2137390.76	970.51	923.93	0.05
349	0.00	2136942.45	968.29	923.80	0.05
350	0.00	2136301.37	965.73	923.61	0.05
351	0.00	2136767.36	962.13	923.75	0.05
352	0.00	2137000.86	958.82	923.82	0.05
353	0.00	2137000.86	956.29	923.82	0.05
354	0.00	2136767.36	952.87	923.75	0.05
355	0.00	2137312.71	967.30	923.91	0.05
356	0.00	2137527.45	965.55	923.97	0.05
357	0.00	2137215.19	960.65	923.88	0.05
358	0.00	2136030.17	959.77	923.53	0.05
359	0.00	2136942.45	970.24	923.80	0.05
360	0.00	2138821.97	967.52	924.36	0.05
361	0.00	2136126.97	959.99	923.56	0.05
362	0.00	2135682.13	957.22	923.43	0.05
363	0.00	2136049.52	954.34	923.54	0.05
364	0.00	2136728.48	951.28	923.74	0.05
365	0.00	2073532.49	957.90	904.95	0.05
366	0.00	2073381.03	961.12	904.90	0.05
367	0.00	2073725.42	958.89	905.00	0.05
368	0.00	2137546.99	973.65	923.98	0.05
369	0.00	2138232.27	971.23	924.18	0.05
370	0.00	2136767.36	970.84	923.75	0.05
371	0.00	2123007.14	942.30	919.68	0.05
372	0.00	2177985.29	945.24	935.84	0.05
373	0.00	2135508.39	940.83	923.38	0.05
374	0.00	2137078.76	972.46	923.84	0.05
375	0.00	2137566.53	967.77	923.99	0.05
376	0.00	2137137.22	963.88	923.86	0.05
377	0.00	2137468.86	960.34	923.96	0.05
378	0.00	2137020.33	957.17	923.83	0.05
379	0.00	2137605.61	953.80	924.00	0.05
380	0.00	2138153.80	965.12	924.16	0.05
381	0.00	2137762.05	961.28	924.04	0.05
382	0.00	2137742.49	958.55	924.04	0.05

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
383	0.00	2136223.84	952.68	923.59	0.05
384	0.00	2137429.81	972.33	923.95	0.05
385	0.00	2136107.61	963.79	923.56	0.05
386	0.00	2136592.46	960.63	923.70	0.05
387	0.00	2136611.88	957.67	923.70	0.05
388	0.00	2136204.46	955.34	923.58	0.05
389	0.00	2136243.22	952.10	923.60	0.05
390	0.00	2072872.36	964.71	904.75	0.05
391	0.00	2073202.16	960.78	904.85	0.05
392	0.00	2134853.72	970.73	923.18	0.05
393	0.00	2135469.81	964.82	923.37	0.05
394	0.00	2132317.61	936.56	922.44	0.05
395	0.00	2137644.71	950.25	924.01	0.05
396	0.00	2137781.61	946.44	924.05	0.05
397	0.00	2139196.57	935.21	924.47	0.05
398	0.00	2137117.73	941.39	923.85	0.05
399	0.00	2136301.37	953.32	923.61	0.05
400	0.00	2136670.17	949.71	923.72	0.05
401	0.00	2135527.69	935.85	923.38	0.05
402	0.00	2138428.59	948.84	924.24	0.05
403	0.00	2136884.06	945.16	923.78	0.05
404	0.00	2135546.99	945.12	923.39	0.05
405	0.00	2143376.24	935.26	925.70	0.05
406	0.00	2137039.80	952.48	923.83	0.05
407	0.00	2137234.69	945.94	923.89	0.05
408	0.00	2138821.97	969.62	924.36	0.05
409	0.00	2138841.67	967.22	924.36	0.05
410	0.00	2138075.38	964.87	924.14	0.05
411	0.00	2138959.88	963.12	924.40	0.05
412	0.00	2138881.06	973.51	924.37	0.05
413	0.00	2138782.59	944.21	924.35	0.05
414	0.00	2139176.84	934.26	924.46	0.05
415	0.00	2136961.92	964.72	923.81	0.05
416	0.00	2137156.71	949.29	923.87	0.05
417	0.00	2138291.14	939.57	924.20	0.05
418	0.00	2133991.24	963.88	922.93	0.05
419	0.00	2141883.77	934.50	925.26	0.05
420	0.00	2138212.65	964.36	924.18	0.05
421	0.00	2137840.32	965.84	924.07	0.05
422	0.00	2138428.59	942.16	924.24	0.05
423	0.00	2146797.28	933.77	926.71	0.05
424	0.00	2137332.22	966.31	923.92	0.05
425	0.00	2135142.22	962.11	923.27	0.05
426	0.00	2136709.04	941.77	923.73	0.05
427	0.00	2140226.30	932.07	924.77	0.05
428	0.00	2137039.80	967.00	923.83	0.05

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
429	0.00	2152578.88	934.86	928.41	0.05
430	0.00	2140266.03	935.00	924.78	0.05
431	0.00	2139374.32	942.50	924.52	0.05
432	0.00	2148882.31	931.57	927.32	0.05
433	0.00	2137703.37	948.89	924.03	0.05
434	0.00	2135065.24	969.37	923.25	0.05
435	0.00	2137722.93	966.41	924.03	0.05
436	0.00	2138959.88	941.90	924.40	0.05
437	0.00	2136670.17	966.73	923.72	0.05
438	0.00	2137312.71	952.79	923.91	0.05
439	0.00	2133133.28	970.57	922.68	0.05
440	0.00	2069237.85	932.35	903.66	0.05
441	0.00	2196108.92	966.02	941.07	0.05
442	0.00	2196050.11	957.12	941.06	0.05
443	0.00	2196050.11	953.80	941.06	0.05
444	0.00	2135161.47	972.95	923.28	0.05
445	0.00	2134335.69	970.44	923.03	0.05
446	0.00	2199024.81	970.94	941.91	0.05
447	0.00	2198154.92	968.13	941.66	0.05
448	0.00	2198154.92	964.37	941.66	0.05
449	0.00	2195434.18	952.62	940.88	0.05
450	0.00	2161482.03	970.92	931.02	0.05
451	0.00	2199024.81	976.51	941.91	0.05
452	0.00	2199054.92	972.67	941.92	0.05
453	0.00	2199024.81	969.72	941.91	0.05
454	0.00	2198424.24	966.44	941.74	0.05
455	0.00	2136126.97	953.09	923.56	0.05
456	0.00	2134565.72	973.67	923.10	0.05
457	0.00	2133876.59	959.97	922.90	0.05
458	0.00	2133285.48	952.13	922.72	0.05
459	0.00	2135585.59	949.83	923.40	0.05
460	0.00	2132943.23	934.40	922.62	0.05
461	0.00	2189879.68	949.29	939.28	0.05
462	0.00	2195229.54	965.89	940.82	0.05
463	0.00	2134604.09	972.74	923.11	0.05
464	0.00	2133781.10	971.08	922.87	0.05
465	0.00	2134182.51	969.25	922.99	0.05
466	0.00	2134125.11	975.26	922.97	0.05
467	0.00	2134316.53	950.08	923.03	0.05
468	0.00	2135450.52	946.62	923.36	0.05
469	0.00	2138782.59	935.99	924.35	0.05
470	0.00	2133781.10	975.85	922.87	0.05
471	0.00	2135334.84	972.57	923.33	0.05
472	0.00	2134930.60	968.84	923.21	0.05
473	0.00	2134930.60	964.59	923.21	0.05
474	0.00	2132109.60	959.18	922.37	0.05

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
475	0.00	2132317.61	954.48	922.44	0.05
476	0.00	2134067.72	971.20	922.95	0.05
477	0.00	2133000.22	952.21	922.64	0.05
478	0.00	2133000.22	949.11	922.64	0.05
479	0.00	2134412.33	946.43	923.05	0.05
480	0.00	2134776.87	938.08	923.16	0.05
481	0.00	2093476.01	936.77	910.90	0.05
482	0.00	2133895.69	961.34	922.90	0.05
483	0.00	2132715.46	956.30	922.55	0.05
484	0.00	2136281.99	951.48	923.61	0.05
485	0.00	2197826.52	973.99	941.57	0.05
486	0.00	2206627.03	970.66	944.09	0.06
487	0.00	2195258.75	967.82	940.83	0.05
488	0.00	2133857.49	977.08	922.89	0.05
489	0.00	2133209.36	953.44	922.70	0.05
490	0.00	2134010.36	950.77	922.94	0.05
491	0.00	2150464.77	935.65	927.79	0.05
492	0.00	2198574.12	978.45	941.78	0.05
493	0.00	2197320.67	974.50	941.42	0.05
494	0.00	2197796.71	970.57	941.56	0.05
495	0.00	2133819.29	980.99	922.88	0.05
496	0.00	2133475.93	966.41	922.78	0.05
497	0.00	2134067.72	963.22	922.95	0.05
498	0.00	2136709.04	941.58	923.73	0.05
499	0.00	2133152.30	949.91	922.68	0.05
500	0.00	2134393.17	967.79	923.05	0.05
501	0.00	2137312.71	945.72	923.91	0.05
502	0.00	2136417.75	941.58	923.65	0.05
503	0.00	2143355.97	934.67	925.69	0.05
504	0.00	2134393.17	967.98	923.05	0.05
505	0.00	2134815.29	968.92	923.17	0.05
506	0.00	2133933.90	957.87	922.91	0.05
507	0.00	2130660.78	950.90	921.94	0.05
508	0.00	2133133.28	965.22	922.68	0.05
509	0.00	2132355.46	946.33	922.45	0.05
510	0.00	2134105.98	945.67	922.96	0.05
511	0.00	2135142.22	940.99	923.27	0.05
512	0.00	2130904.50	942.28	922.02	0.05
513	0.00	2134450.66	966.23	923.07	0.05
514	0.00	2133304.52	966.54	922.73	0.05
515	0.00	2131882.97	955.90	922.31	0.05
516	0.00	2132848.29	959.06	922.59	0.05
517	0.00	2133095.25	953.04	922.67	0.05
518	0.00	2132943.23	949.97	922.62	0.05
519	0.00	2134546.54	945.09	923.09	0.05
520	0.00	2132336.54	939.15	922.44	0.05

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
521	0.00	2138920.47	946.94	924.39	0.05
522	0.00	2133800.20	942.21	922.87	0.05
523	0.00	2137488.39	934.71	923.96	0.05
524	0.00	2133781.10	956.21	922.87	0.05
525	0.00	2133704.76	953.54	922.85	0.05
526	0.00	2134259.08	968.51	923.01	0.05
527	0.00	2120713.01	963.24	919.00	0.05
528	0.00	2120713.01	976.92	919.00	0.05
529	0.00	2120713.01	976.33	919.00	0.05
530	0.00	2120713.01	957.13	919.00	0.05
531	0.00	2120713.01	977.50	919.00	0.05
532	0.00	2120713.01	960.72	919.00	0.05
533	0.00	2120713.01	976.33	919.00	0.05
534	0.00	2120713.01	955.66	919.00	0.05
535	0.00	2120713.01	955.66	919.00	0.05
536	0.00	2120713.01	978.08	919.00	0.05
537	0.00	2120713.01	979.22	919.00	0.05
538	0.00	2120713.01	976.33	919.00	0.05
539	0.00	2120713.01	957.13	919.00	0.05
540	0.00	2120713.01	977.50	919.00	0.05
542	0.00	2120713.01	955.66	919.00	0.05
543	0.00	2120713.01	956.40	919.00	0.05
544	0.00	2120713.01	976.33	919.00	0.05
545	0.00	2120713.01	944.89	919.00	0.05
546	0.00	2120713.01	947.27	919.00	0.05
547	0.00	2120713.01	957.13	919.00	0.05
548	0.00	2120713.01	942.48	919.00	0.05
549	0.00	2120713.01	956.40	919.00	0.05
550	0.00	2120713.01	944.89	919.00	0.05
551	0.00	2120713.01	944.89	919.00	0.05
552	0.00	2120713.01	945.69	919.00	0.05
553	0.00	2120713.01	944.09	919.00	0.05
554	0.00	2120713.01	977.50	919.00	0.05
555	0.00	2120713.01	966.90	919.00	0.05
556	0.00	2120713.01	968.22	919.00	0.05
557	0.00	2120713.01	976.33	919.00	0.05
558	0.00	2120713.01	972.70	919.00	0.05
559	0.00	2120713.01	976.33	919.00	0.05
560	0.00	2120713.01	976.33	919.00	0.05
561	0.00	2120713.01	939.20	919.00	0.05
562	0.00	2120713.01	948.06	919.00	0.05
563	0.00	2120713.01	957.13	919.00	0.05
564	0.00	2120713.01	976.92	919.00	0.05
565	0.00	2120713.01	976.92	919.00	0.05
566	0.00	2120713.01	960.01	919.00	0.05
567	0.00	2120713.01	978.65	919.00	0.05

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
568	0.00	2120713.01	957.86	919.00	0.05
569	0.00	2120713.01	960.01	919.00	0.05
570	0.00	2120713.01	966.97	919.00	0.05
571	0.00	2120713.01	968.35	919.00	0.05
572	0.00	2120713.01	966.97	919.00	0.05
573	0.00	2120713.01	966.37	919.00	0.05
574	0.00	2120713.01	966.23	919.00	0.05
575	0.00	2120713.01	965.76	919.00	0.05
576	0.00	2120713.01	960.01	919.00	0.05
577	0.00	2120713.01	958.00	919.00	0.05
578	0.00	2120713.01	955.96	919.00	0.05
579	0.00	2120713.01	962.55	919.00	0.05
580	0.00	2120713.01	958.58	919.00	0.05
581	0.00	2120713.01	967.96	919.00	0.05
582	0.00	2120713.01	956.69	919.00	0.05
583	0.00	2120713.01	956.25	919.00	0.05
584	0.00	2120713.01	956.25	919.00	0.05
585	0.00	2120713.01	956.25	919.00	0.05
586	0.00	2120713.01	944.73	919.00	0.05
587	0.00	2120713.01	941.75	919.00	0.05
588	0.00	2164409.91	949.59	931.88	0.05
589	0.00	2166757.64	951.52	932.56	0.05
590	0.00	2166757.64	951.95	932.56	0.05
591	0.00	2169144.41	949.03	933.26	0.05
592	0.00	2189879.68	942.24	939.28	0.05
593	0.00	2142769.48	953.25	925.52	0.05
594	0.00	2125550.33	953.84	920.43	0.05
595	0.00	2123742.75	937.04	919.90	0.05
596	0.00	2120183.83	952.33	918.84	0.05
597	0.00	2166757.64	945.73	932.56	0.05
598	0.00	2151059.75	946.13	927.96	0.05
599	0.00	2151059.75	943.24	927.96	0.05
600	0.00	2148945.30	939.95	927.34	0.05
601	0.00	2171571.94	949.28	933.97	0.05
602	0.00	2148945.30	951.04	927.34	0.05
603	0.00	2142769.48	945.41	925.52	0.05
604	0.00	2006243.17	931.89	884.84	0.04
605	0.00	2198574.12	960.43	941.78	0.05
606	0.00	2076501.38	926.96	905.83	0.05
607	0.00	2073725.42	930.88	905.00	0.05
608	0.00	2066942.52	927.63	902.98	0.05
609	0.00	2082168.59	939.92	907.52	0.05
610	0.00	2151059.75	950.51	927.96	0.05
611	0.00	2148945.30	946.50	927.34	0.05
612	0.00	2146859.43	950.25	926.73	0.05
613	0.00	2120183.83	949.78	918.84	0.05

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
614	0.00	2053985.74	935.58	899.11	0.04
615	0.00	2214564.68	963.77	946.35	0.06
616	0.00	2066942.52	932.63	902.98	0.05
617	0.00	2171571.94	957.22	933.97	0.05
618	0.00	2083610.52	935.40	907.95	0.05
619	0.00	2123742.75	943.04	919.90	0.05
620	0.00	2120183.83	949.44	918.84	0.05
621	0.00	2120183.83	947.62	918.84	0.05
622	0.00	2142769.48	948.35	925.52	0.05
623	0.00	1743135.71	841.62	807.40	0.03
624	0.00	1744786.31	857.09	807.87	0.03
625	0.00	1742586.40	863.87	807.24	0.03
626	0.00	1744786.31	835.14	807.87	0.03
627	0.00	1416740.06	786.19	715.20	0.01
628	0.00	2066942.52	926.64	902.98	0.05
629	0.00	2066942.52	918.03	902.98	0.05
630	0.00	2148945.30	952.06	927.34	0.05
631	0.00	2066942.52	925.65	902.98	0.05
632	0.00	2066942.52	923.64	902.98	0.05
633	0.00	2066942.52	922.64	902.98	0.05
634	0.00	2066942.52	918.03	902.98	0.05
635	0.00	2066942.52	920.09	902.98	0.05
636	0.00	2066942.52	945.40	902.98	0.05
637	0.00	2066942.52	941.81	902.98	0.05
638	0.00	2066942.52	940.45	902.98	0.05
639	0.00	2066942.52	922.13	902.98	0.05
640	0.00	2066942.52	921.62	902.98	0.05
641	0.00	2066942.52	949.76	902.98	0.05
642	0.00	2066942.52	925.15	902.98	0.05
643	0.00	2066942.52	949.33	902.98	0.05
644	0.00	2066942.52	922.13	902.98	0.05
645	0.00	2066942.52	948.03	902.98	0.05
646	0.00	2123742.75	947.99	919.90	0.05
647	0.00	2080736.90	943.64	907.10	0.05
648	0.00	2120183.83	949.18	918.84	0.05
649	0.00	2207914.12	963.47	944.45	0.06
650	0.00	2053985.74	937.18	899.11	0.04
651	0.00	2204721.52	963.23	943.54	0.06
652	0.00	2065611.58	939.11	902.58	0.05
653	0.00	1744786.31	850.14	807.87	0.03
654	0.00	1451111.09	799.56	724.72	0.02
655	0.00	2066942.52	935.34	902.98	0.05
656	0.00	2144801.13	952.45	926.12	0.05
657	0.00	2129224.48	951.84	921.52	0.05
658	0.00	2103392.72	946.64	913.85	0.05
987	655637.44	1748366.50	808.91	45.73	0.03

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
988	675056.90	1794886.72	822.41	38.60	0.03
989	610381.29	1820946.56	830.02	38.97	0.03
990	626155.12	1877526.58	846.63	30.93	0.03
991	544763.04	1939348.66	864.91	27.25	0.04
992	506305.52	1980851.02	877.26	23.95	0.04
993	469732.15	2009119.55	885.70	22.19	0.04
994	637406.90	1757878.92	811.66	45.68	0.03
995	772770.24	1752313.47	810.05	38.69	0.03
996	661513.04	1839068.78	835.32	33.88	0.03
997	555723.84	1936994.92	864.21	27.02	0.04
998	469682.24	2016669.13	887.95	21.28	0.04
999	649184.69	1757878.92	811.66	44.90	0.03
1000	639915.01	1865641.42	843.13	31.71	0.03
1001	600064.85	1905572.73	854.90	28.77	0.04
1002	477487.89	1948930.18	867.76	29.62	0.04
1003	685566.53	1848386.43	838.06	31.65	0.03
1004	524726.86	1757878.92	811.66	54.83	0.03
1005	538431.59	1761883.47	812.82	52.90	0.03
1006	515634.99	1799145.10	823.66	49.14	0.03
1007	485828.54	1820946.56	830.02	48.38	0.03
1008	466755.66	1839068.78	835.32	47.21	0.03
1009	448971.03	1867599.95	843.70	44.16	0.03
1010	428270.94	1903426.41	854.27	40.12	0.04
1011	371228.38	1925458.38	860.79	41.90	0.04
1012	320572.66	1936994.92	864.21	45.79	0.04
1013	374785.37	1955061.92	869.58	36.34	0.04
1014	507346.85	1765913.15	813.99	55.26	0.03
1015	507175.22	1788977.86	820.69	51.53	0.03
1016	485926.04	1807760.57	826.17	50.53	0.03
1017	475449.15	1820946.56	830.02	49.37	0.03
1018	495500.02	1837226.63	834.78	44.91	0.03
1019	456422.19	1853114.86	839.45	45.87	0.03
1020	441356.46	1872534.84	845.16	44.05	0.03
1021	426652.29	1892867.32	851.15	42.03	0.04
1022	390415.57	1910991.51	856.51	42.47	0.04
1023	389335.98	1936994.92	864.21	38.06	0.04
1024	386182.33	1961311.98	871.44	34.28	0.04
1025	334367.65	1980851.02	877.26	35.77	0.04
1026	292660.00	2001778.37	883.50	36.49	0.04
1027	378090.27	1942909.92	865.97	38.11	0.04
1028	357922.42	1967687.85	873.34	35.76	0.04
1029	318883.29	2001778.37	883.50	33.60	0.04
1030	365038.01	1749942.50	809.36	78.26	0.03
1031	424682.42	1780639.06	818.27	62.37	0.03
1032	405733.61	1812119.75	827.44	58.96	0.03
1033	393559.82	1825416.58	831.33	58.05	0.03

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
1034	383445.84	1839068.78	835.32	56.77	0.03
1035	379009.97	1857891.99	840.85	53.69	0.03
1036	373691.64	1882577.54	848.11	49.61	0.03
1037	400672.13	1764298.22	813.52	69.05	0.03
1038	409165.80	1790659.94	821.18	62.61	0.03
1039	399333.58	1820946.56	830.02	58.13	0.03
1040	365980.51	1848386.43	838.06	57.39	0.03
1041	363833.52	1872534.84	845.16	52.85	0.03
1042	356569.17	1884615.06	848.72	51.44	0.03
1043	355421.31	1908814.77	855.86	46.84	0.04
1044	334853.57	1928880.00	861.81	45.53	0.04
1045	307533.78	1952595.43	868.85	44.38	0.04
1046	346016.15	1892867.32	851.15	51.23	0.04
1047	311453.40	1914280.29	857.48	51.86	0.04
1048	339037.64	1885637.57	849.02	53.72	0.03
1049	316621.96	1914280.29	857.48	51.07	0.04
1050	305245.62	1940531.62	865.26	47.21	0.04
1051	296158.11	1961311.98	871.44	44.17	0.04
1052	270782.34	1980851.02	877.26	43.75	0.04
1053	270039.90	2001778.37	883.50	39.41	0.04
1054	364567.42	1774050.68	816.35	73.16	0.03
1055	376028.77	1794886.72	822.41	66.80	0.03
1056	362186.27	1820946.56	830.02	63.63	0.03
1057	346664.47	1839068.78	835.32	62.35	0.03
1058	325789.68	1862719.70	842.27	60.75	0.03
1059	328133.27	1882577.54	848.11	56.04	0.03
1060	299493.04	1908814.77	855.86	55.03	0.04
1061	354668.25	1752313.47	810.05	79.80	0.03
1062	345893.03	1784793.75	819.48	74.34	0.03
1063	358135.09	1806026.67	825.66	67.46	0.03
1064	338646.96	1823623.92	830.80	67.10	0.03
1065	330979.57	1841845.15	836.14	64.45	0.03
1066	339716.43	1867599.95	843.70	57.40	0.03
1067	316565.65	1887690.22	849.62	56.82	0.03
1068	298200.12	1906650.37	855.22	55.74	0.04
1069	297675.87	1925458.38	860.79	51.63	0.04
1070	281035.73	1948930.18	867.76	49.15	0.04
1071	261431.13	1971577.17	874.50	47.33	0.04
1072	245937.78	1994629.22	881.37	44.71	0.04
1073	303406.17	1903426.41	854.27	55.56	0.04
1074	293575.54	1928880.00	861.81	51.54	0.04
1075	264080.04	1948930.18	867.76	52.12	0.04
1076	271207.24	1963846.78	872.19	47.44	0.04
1077	263160.57	1974197.80	875.28	46.45	0.04
1078	238717.69	1987657.70	879.29	47.65	0.04
1079	323727.26	1769968.64	815.17	82.43	0.03

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
1080	308668.40	1810371.85	826.93	76.22	0.03
1081	318879.24	1757878.92	811.66	86.45	0.03
1082	294600.07	1797437.90	823.16	82.75	0.03
1083	320538.85	1795735.84	822.66	77.07	0.03
1084	312228.23	1812119.75	827.44	75.01	0.03
1085	296267.92	1834476.31	833.98	73.16	0.03
1086	283778.60	1855975.18	840.29	70.68	0.03
1087	280314.72	1877526.58	846.63	66.11	0.03
1088	259133.54	1892867.32	851.15	67.06	0.04
1089	316081.90	1761883.47	812.82	86.17	0.03
1090	317335.97	1794886.72	822.41	77.98	0.03
1091	306403.78	1803436.04	824.91	78.41	0.03
1092	293536.59	1820946.56	830.02	77.13	0.03
1093	290388.96	1839068.78	835.32	73.37	0.03
1094	276529.88	1864665.38	842.84	70.17	0.03
1095	256104.95	1892867.32	851.15	67.79	0.04
1096	224915.79	1786463.81	819.96	108.50	0.03
1097	219979.93	1816514.69	828.72	101.20	0.03
1098	231393.35	1807760.57	826.17	99.42	0.03
1099	192775.94	1882577.54	848.11	91.16	0.03
1100	242852.50	1882577.54	848.11	74.00	0.03
1101	267532.88	1799145.10	823.66	89.74	0.03
1102	247170.84	1839068.78	835.32	84.89	0.03
1103	243229.02	1882577.54	848.11	73.90	0.03
1104	217324.39	1919826.79	859.12	70.81	0.04
1105	191956.20	1936994.92	864.21	73.84	0.04
1106	203437.67	1939348.66	864.91	69.31	0.04
1107	729880.13	1750731.89	809.59	41.04	0.03
1108	724053.78	1786463.81	819.96	37.09	0.03
1109	725883.01	1803436.04	824.91	35.02	0.03
1110	675425.71	1829926.05	832.65	34.30	0.03
1111	706730.42	1859816.90	841.41	29.46	0.03
1112	654707.58	1894956.83	851.77	27.63	0.04
1113	675395.07	1919826.79	859.12	24.13	0.04
1114	646460.14	1948930.18	867.76	22.07	0.04
1115	610619.38	1974197.80	875.28	20.64	0.04
1116	593126.93	2001778.37	883.50	18.39	0.04
1117	766229.71	1765913.15	813.99	37.45	0.03
1118	732271.52	1786463.81	819.96	36.69	0.03
1119	695737.88	1829926.05	832.65	33.33	0.03
1120	668120.43	1872534.84	845.16	29.63	0.03
1121	682984.41	1936994.92	864.21	22.11	0.04
1122	635564.63	2001778.37	883.50	17.18	0.04
1123	595042.01	1757878.92	811.66	48.74	0.03
1124	591498.17	1786463.81	819.96	44.94	0.03
1125	553965.01	1812119.75	827.44	44.02	0.03

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
1126	506100.94	1862719.70	842.27	40.14	0.03
1127	472111.33	1887690.22	849.62	38.96	0.03
1128	461390.56	1903426.41	854.27	37.37	0.04
1129	438729.35	1936994.92	864.21	33.94	0.04
1130	403441.87	1961311.98	871.44	32.87	0.04
1131	581592.85	1753898.81	810.51	50.38	0.03
1132	545917.71	1782297.46	818.75	49.10	0.03
1133	519523.20	1816514.69	828.72	46.09	0.03
1134	472377.65	1834476.31	833.98	47.43	0.03
1135	493248.18	1862719.70	842.27	41.13	0.03
1136	460913.19	1892867.32	851.15	39.05	0.04
1137	418603.08	1908814.77	855.86	40.10	0.04
1138	414516.91	1936994.92	864.21	35.84	0.04
1139	379710.00	1961311.98	871.44	34.84	0.04
1140	449664.44	1914280.29	857.48	36.60	0.04
1141	442761.85	1778160.02	817.55	60.46	0.03
1142	427955.37	1803436.04	824.91	57.70	0.03
1143	429155.44	1825416.58	831.33	53.54	0.03
1144	404277.30	1857891.99	840.85	50.54	0.03
1145	385466.34	1887690.22	849.62	47.23	0.03
1146	337679.04	1914280.29	857.48	48.06	0.04
1147	333163.13	1936994.92	864.21	44.15	0.04
1148	355521.71	1958797.30	870.69	37.55	0.04
1149	468826.31	1757878.92	811.66	60.87	0.03
1150	457698.39	1778160.02	817.55	58.63	0.03
1151	433420.41	1816514.69	828.72	54.65	0.03
1152	410664.06	1839068.78	835.32	53.25	0.03
1153	392847.59	1862719.70	842.27	51.01	0.03
1154	384252.07	1892867.32	851.15	46.41	0.04
1155	354975.97	1919826.79	859.12	44.78	0.04
1156	348964.13	1931179.48	862.49	43.34	0.04
1157	363288.06	1749942.50	809.36	78.60	0.03
1158	338614.78	1825416.58	831.33	66.71	0.03
1159	374247.93	1790659.94	821.18	67.97	0.03
1160	346480.56	1839068.78	835.32	62.38	0.03
1161	297054.48	1898111.69	852.70	57.89	0.04
1162	371052.66	1761883.47	812.82	74.57	0.03
1163	358980.92	1812119.75	827.44	66.02	0.03
1164	366159.81	1843704.96	836.68	58.32	0.03
1165	292812.19	1908814.77	855.86	56.20	0.04
1166	239755.08	1942909.92	865.97	58.61	0.04
1167	988881.48	1769968.64	815.17	28.96	0.03
1168	930307.28	1760278.68	812.36	31.63	0.03
1169	884642.65	1816514.69	828.72	27.71	0.03
1170	890970.50	1782297.46	818.75	30.80	0.03
1171	833067.77	1848386.43	838.06	26.22	0.03

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
1172	992997.53	1761883.47	812.82	29.56	0.03
1173	836596.32	1790659.94	821.18	31.86	0.03
1174	791896.33	1812119.75	827.44	31.29	0.03
1175	751438.07	1853114.86	839.45	28.47	0.03
1176	701260.13	1882577.54	848.11	27.18	0.03
1177	595962.81	1903426.41	854.27	29.22	0.04
1178	551158.62	1931179.48	862.49	27.96	0.04
1179	688274.93	1862719.70	842.27	29.89	0.03
1180	891420.40	1757878.92	811.66	33.20	0.03
1181	818827.32	1794886.72	822.41	32.08	0.03
1182	843598.59	1903426.41	854.27	20.85	0.04
1183	613283.99	1903426.41	854.27	28.42	0.04
1184	535579.09	1936994.92	864.21	28.00	0.04
1185	792651.44	1898111.69	852.70	22.65	0.04
1186	527831.12	1936994.92	864.21	28.40	0.04
1187	941294.07	1749942.50	809.36	32.26	0.03
1188	902671.67	1790659.94	821.18	29.61	0.03
1189	739656.11	1829926.05	832.65	31.43	0.03
1190	610519.90	1882577.54	848.11	31.07	0.03
1191	561891.48	1903426.41	854.27	30.93	0.04
1192	381279.05	1961311.98	871.44	34.70	0.04
1193	509042.26	1936994.92	864.21	29.41	0.04
1194	1007029.65	1786463.81	819.96	27.01	0.03
1195	809559.29	1829926.05	832.65	28.81	0.03
1196	607004.34	1877526.58	846.63	31.87	0.03
1197	560147.65	1765913.15	813.99	50.37	0.03
1198	403572.12	1753898.81	810.51	70.66	0.03
1199	512003.34	1761883.47	812.82	55.44	0.03
1200	443367.40	1790659.94	821.18	58.12	0.03
1201	477260.38	1794886.72	822.41	53.55	0.03
1202	380470.39	1834476.31	833.98	58.09	0.03
1203	377147.76	1829926.05	832.65	59.48	0.03
1204	312319.61	1882577.54	848.11	58.68	0.03
1205	496398.19	1765913.15	813.99	56.39	0.03
1206	479180.60	1790659.94	821.18	54.06	0.03
1207	368917.20	1839068.78	835.32	58.85	0.03
1208	331758.95	1877526.58	846.63	56.55	0.03
1209	377294.19	1853114.86	839.45	54.86	0.03
1210	335416.09	1892867.32	851.15	52.75	0.04
1211	412711.74	1807760.57	826.17	58.85	0.03
1212	302558.61	1936994.92	864.21	48.36	0.04
1213	304944.85	1914280.29	857.48	52.90	0.04
1214	281251.66	1936994.92	864.21	51.80	0.04
1215	298627.73	1914280.29	857.48	53.95	0.04
1216	276602.87	1936994.92	864.21	52.62	0.04
1217	347798.13	1753898.81	810.51	80.86	0.03

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
1218	381976.34	1761883.47	812.82	72.63	0.03
1219	369237.87	1749942.50	809.36	77.46	0.03
1220	305440.31	1834476.31	833.98	71.15	0.03
1221	330734.89	1790659.94	821.18	76.08	0.03
1222	341657.92	1790659.94	821.18	73.87	0.03
1223	273915.03	1882577.54	848.11	66.27	0.03
1224	340325.36	1757878.92	811.66	81.55	0.03
1225	292232.08	1834476.31	833.98	74.08	0.03
1226	360280.78	1790659.94	821.18	70.37	0.03
1227	274494.39	1877526.58	846.63	67.40	0.03
1228	273931.13	1877526.58	846.63	67.53	0.03
1229	313878.90	1834476.31	833.98	69.39	0.03
1230	206096.26	1936994.92	864.21	69.18	0.04
1231	294396.17	1877526.58	846.63	63.19	0.03
1232	247354.25	1936994.92	864.21	58.42	0.04
1234	78628.10	1512781.01	741.90	186.06	0.02
1235	75603.94	1512781.01	741.90	186.06	0.02
1236	90724.73	1512781.01	741.90	189.80	0.02
1237	92120.49	1512781.01	741.90	188.86	0.02
1238	119337.91	1512781.01	741.90	200.92	0.02
1239	128410.38	1512781.01	741.90	203.08	0.02
1240	141902.78	1512781.01	741.90	211.03	0.02
1241	175168.51	1512781.01	741.90	227.56	0.02
1242	208434.24	1512781.01	741.90	245.31	0.02
1243	216110.95	1512781.01	741.90	255.26	0.02
1244	249376.68	1512781.01	741.90	281.96	0.02
1245	244724.13	1512781.01	741.90	266.06	0.02
1246	300554.73	1512781.01	741.90	349.91	0.02
1247	284038.18	1512781.01	741.90	302.28	0.02
1248	34894.13	1512781.01	741.90	104.89	0.02
1249	34894.13	1512781.01	741.90	112.39	0.02
1250	34894.13	1512781.01	741.90	111.72	0.02
1251	362898.90	1512781.01	741.90	137.83	0.02
1252	362898.90	1512781.01	741.90	137.33	0.02
1253	172144.35	1512781.01	741.90	119.88	0.02
1254	172144.35	1512781.01	741.90	122.21	0.02
1255	362898.90	1512781.01	741.90	258.76	0.02
1256	362898.90	1512781.01	741.90	255.26	0.02
1257	172144.35	1512781.01	741.90	179.00	0.02
1259	30241.58	1512781.01	741.90	149.27	0.02
1260	34894.13	1512781.01	741.90	149.87	0.02
1261	86072.18	1512781.01	741.90	185.15	0.02
1263	30241.58	1512781.01	741.90	173.25	0.02
1264	30241.58	1512781.01	741.90	172.46	0.02
1265	55830.60	1512781.01	741.90	178.16	0.02
1267	143763.80	1512781.01	741.90	129.33	0.02

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
1268	160047.72	1512781.01	741.90	131.58	0.02
1269	239838.95	1512781.01	741.90	148.10	0.02
1270	309394.58	1512781.01	741.90	154.78	0.02
1271	382439.61	1512781.01	741.90	156.06	0.02
1272	334750.97	1512781.01	741.90	164.93	0.02
1273	392675.22	1512781.01	741.90	168.61	0.02
1274	67927.23	1512781.01	741.90	138.33	0.02
1275	67927.23	1512781.01	741.90	146.95	0.02
1276	110498.06	1512781.01	741.90	139.35	0.02
1277	194941.85	1512781.01	741.90	167.86	0.02
1278	141204.89	1512781.01	741.90	155.42	0.02
1279	229370.72	1512781.01	741.90	198.80	0.02
1280	344986.58	1512781.01	741.90	251.86	0.02
1281	372669.26	1512781.01	741.90	307.20	0.02
1282	62809.43	1512781.01	741.90	215.85	0.02
1283	121664.18	1512781.01	741.90	275.78	0.02
1284	194941.85	1512781.01	741.90	419.98	0.02
1285	942141.38	1508350.70	740.66	83.47	0.02
1286	942141.38	1508350.70	740.66	85.72	0.02
1287	965404.13	1508350.70	740.66	95.11	0.02
1288	965404.13	1508350.70	740.66	98.04	0.02
1289	937488.83	1508350.70	740.66	103.35	0.02
1290	958425.30	1508350.70	740.66	111.82	0.02
1291	946793.93	1508350.70	740.66	115.54	0.02
1292	907247.25	1508350.70	740.66	116.60	0.02
1293	907247.25	1508350.70	740.66	119.90	0.02
1294	865374.30	1508350.70	740.66	93.26	0.02
1295	877005.68	1508350.70	740.66	111.82	0.02
1296	846764.10	1508350.70	740.66	100.89	0.02
1297	846764.10	1508350.70	740.66	96.31	0.02
1298	837459.00	1508350.70	740.66	96.31	0.02
1299	877005.68	1508350.70	740.66	110.85	0.02
1300	916552.35	1508350.70	740.66	110.85	0.02
1301	977035.50	1508350.70	740.66	132.82	0.02
1302	981688.05	1508350.70	740.66	127.50	0.02
1303	993319.43	1508350.70	740.66	133.28	0.02
1304	988666.88	1508350.70	740.66	132.36	0.02
1305	988666.88	1508350.70	740.66	136.13	0.02
1306	981688.05	1508350.70	740.66	130.11	0.02
1307	967730.40	1508350.70	740.66	140.65	0.02
1308	951446.48	1508350.70	740.66	142.75	0.02
1309	956099.03	1508350.70	740.66	142.22	0.02
1310	925857.45	1508350.70	740.66	144.37	0.02
1312	925857.45	1508350.70	740.66	153.66	0.02
1313	107008.65	1512781.01	741.90	112.05	0.02
1314	137250.23	1512781.01	741.90	113.06	0.02

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
1315	167491.80	1512781.01	741.90	114.78	0.02
1316	195407.10	1512781.01	741.90	114.78	0.02
1317	234953.78	1512781.01	741.90	116.91	0.02
1318	279153.00	1512781.01	741.90	121.04	0.02
1319	230301.23	1512781.01	741.90	98.33	0.02
1320	234953.78	1512781.01	741.90	97.82	0.02
1321	358246.35	1512781.01	741.90	103.17	0.02
1322	365225.18	1512781.01	741.90	103.74	0.02
1323	48851.78	1512781.01	741.90	93.23	0.02
1324	48851.78	1512781.01	741.90	95.59	0.02
1325	216343.58	1512781.01	741.90	156.06	0.02
1326	216343.58	1512781.01	741.90	153.52	0.02
1327	348941.25	1512781.01	741.90	162.09	0.02
1328	25589.03	1512781.01	741.90	136.33	0.02
1329	39546.68	1512781.01	741.90	141.44	0.02
1330	348941.25	1512781.01	741.90	158.69	0.02
1331	39546.68	1512781.01	741.90	143.60	0.02
1332	174470.63	1512781.01	741.90	178.16	0.02
1333	318699.68	1512781.01	741.90	192.71	0.02
1334	325678.50	1512781.01	741.90	187.92	0.02
1335	11631.38	1512781.01	741.90	179.00	0.02
1336	195407.10	1512781.01	741.90	198.80	0.02
1337	344288.70	1512781.01	741.90	199.85	0.02
1338	97703.55	1512781.01	741.90	89.69	0.02
1339	151207.88	1512781.01	741.90	91.43	0.02
1340	209364.75	1512781.01	741.90	94.40	0.02
1341	83745.90	1512781.01	741.90	91.65	0.02
1342	113987.48	1512781.01	741.90	93.46	0.02
1343	155860.43	1512781.01	741.90	95.11	0.02
1344	188428.28	1512781.01	741.90	96.82	0.02
1345	125618.85	1512781.01	741.90	106.07	0.02
1346	141902.78	1512781.01	741.90	106.97	0.02
1347	174470.63	1512781.01	741.90	107.89	0.02
1348	216343.58	1512781.01	741.90	108.82	0.02
1349	223322.40	1512781.01	741.90	111.06	0.02
1350	269847.90	1512781.01	741.90	112.39	0.02
1351	76767.08	1512781.01	741.90	130.67	0.02
1352	93051.00	1512781.01	741.90	131.13	0.02
1353	95377.28	1512781.01	741.90	131.58	0.02
1354	125618.85	1512781.01	741.90	133.44	0.02
1355	125618.85	1512781.01	741.90	136.83	0.02
1356	141902.78	1512781.01	741.90	138.84	0.02
1357	155860.43	1512781.01	741.90	136.33	0.02
1358	204712.20	1512781.01	741.90	143.60	0.02
1359	186102.00	1512781.01	741.90	143.05	0.02
1360	104682.38	1512781.01	741.90	156.06	0.02

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
1361	120966.30	1512781.01	741.90	158.69	0.02
1362	139576.50	1512781.01	741.90	162.09	0.02
1363	162839.25	1512781.01	741.90	165.65	0.02
1979	561241.75	1512781.01	741.90	89.48	0.02
1980	478038.80	1512781.01	741.90	102.89	0.02
1981	440219.27	1512781.01	741.90	110.41	0.02
1982	425091.46	1512781.01	741.90	113.74	0.02
1983	459885.43	1512781.01	741.90	106.37	0.02
1984	419040.34	1512781.01	741.90	115.13	0.02
1985	363067.44	1512781.01	741.90	129.77	0.02
1986	313145.67	1512781.01	741.90	146.38	0.02
1987	319196.79	1512781.01	741.90	144.14	0.02
1988	316171.23	1512781.01	741.90	145.25	0.02
1989	340375.73	1512781.01	741.90	136.83	0.02
1990	285915.61	1512781.01	741.90	157.36	0.02
1991	270787.80	1512781.01	741.90	164.21	0.02
1992	242044.96	1512781.01	741.90	179.00	0.02
1993	234481.06	1512781.01	741.90	183.35	0.02
1994	246583.30	1512781.01	741.90	176.49	0.02
1995	211789.34	1512781.01	741.90	197.76	0.02
1996	181533.72	1512781.01	741.90	220.91	0.02
1997	181533.72	1512781.01	741.90	220.91	0.02
1998	117996.92	1512781.01	741.90	292.89	0.02
1999	170944.25	1512781.01	741.90	230.34	0.02
2000	222378.81	1512781.01	741.90	190.76	0.02
2001	242044.96	1512781.01	741.90	179.00	0.02
2002	270787.80	1512781.01	741.90	164.21	0.02
2003	178508.16	1512781.01	741.90	223.52	0.02
2004	140688.63	1512781.01	741.90	262.36	0.02
2005	771518.31	1512781.01	741.90	67.30	0.02
2006	659572.52	1512781.01	741.90	77.53	0.02
2007	617214.65	1512781.01	741.90	82.26	0.02
2008	665623.64	1512781.01	741.90	76.90	0.02
2009	624778.56	1512781.01	741.90	81.38	0.02
2022	502243.30	1512781.01	741.90	98.59	0.02
2023	465936.55	1512781.01	741.90	105.18	0.02
2024	434168.15	1512781.01	741.90	111.72	0.02
2025	388784.72	1512781.01	741.90	122.61	0.02
2026	347939.63	1512781.01	741.90	134.39	0.02
2027	369118.57	1512781.01	741.90	128.01	0.02
2028	338862.95	1512781.01	741.90	137.33	0.02
2029	302556.20	1512781.01	741.90	150.46	0.02
2030	273813.36	1512781.01	741.90	162.79	0.02
2031	234481.06	1512781.01	741.90	183.35	0.02
2032	302556.20	1512781.01	741.90	150.46	0.02
2033	258685.55	1512781.01	741.90	170.13	0.02

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
2034	219353.25	1512781.01	741.90	192.71	0.02
2035	189097.63	1512781.01	741.90	214.63	0.02
2036	131611.95	1512781.01	741.90	273.78	0.02
2037	683777.02	1512781.01	741.90	75.06	0.02
2038	647470.27	1512781.01	741.90	78.83	0.02
2039	605112.40	1512781.01	741.90	83.72	0.02
2040	596035.72	1512781.01	741.90	84.85	0.02
2041	222378.81	1512781.01	741.90	190.76	0.02
2042	196661.53	1512781.01	741.90	208.69	0.02
2043	87741.30	1512781.01	741.90	346.70	0.02
2044	140688.63	1512781.01	741.90	262.36	0.02
2045	167918.69	1512781.01	741.90	233.19	0.02
2046	169431.47	1512781.01	741.90	231.76	0.02
2047	140688.63	1512781.01	741.90	262.36	0.02
2048	72613.49	1512781.01	741.90	381.76	0.02
2049	7563.91	1512781.01	741.90	675.52	0.02
2050	0.00	1512781.01	758.56	741.90	0.02
2051	87741.30	1512781.01	741.90	346.70	0.02
2052	28742.84	1512781.01	741.90	540.18	0.02
2053	0.00	1512781.01	746.42	741.90	0.02
2054	0.00	1512781.01	767.66	741.90	0.02
2055	0.00	1512781.01	791.64	741.90	0.02
2056	378195.25	1512781.01	741.90	125.46	0.02
2057	341888.51	1512781.01	741.90	136.33	0.02
2058	282890.05	1512781.01	741.90	158.69	0.02
2059	251121.65	1512781.01	741.90	174.05	0.02
2060	154303.66	1512781.01	741.90	246.91	0.02
2061	90766.86	1512781.01	741.90	340.44	0.02
2062	13615.03	1512781.01	741.90	630.39	0.02
2063	0.00	1512781.01	762.33	741.90	0.02
2064	0.00	1512781.01	785.67	741.90	0.02
2065	0.00	1512781.01	817.32	741.90	0.02
2066	54460.12	1512781.01	741.90	434.49	0.02
2067	46896.21	1512781.01	741.90	461.02	0.02
2068	0.00	1512781.01	753.65	741.90	0.02
2069	0.00	1512781.01	778.07	741.90	0.02
2070	0.00	1512781.01	804.72	741.90	0.02
2071	0.00	1512781.01	833.43	741.90	0.02
2072	0.00	1512781.01	805.67	741.90	0.02
2093	618727.43	1512781.01	741.90	82.08	0.02
2094	576369.56	1512781.01	741.90	87.40	0.02
2095	523422.23	1512781.01	741.90	95.11	0.02
2096	464423.77	1512781.01	741.90	105.48	0.02
2097	387271.94	1512781.01	741.90	123.01	0.02
2098	471987.67	1512781.01	741.90	104.02	0.02
2099	416014.78	1512781.01	741.90	115.84	0.02

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
2100	373656.91	1512781.01	741.90	126.72	0.02
2101	323735.14	1512781.01	741.90	142.51	0.02
2102	261711.11	1512781.01	741.90	168.61	0.02
2103	375169.69	1512781.01	741.90	126.30	0.02
2104	350965.19	1512781.01	741.90	133.44	0.02
2105	284402.83	1512781.01	741.90	158.02	0.02
2106	248096.09	1512781.01	741.90	175.67	0.02
2107	214814.90	1512781.01	741.90	195.71	0.02
2108	835055.12	1512781.01	741.90	62.61	0.02
2109	779082.22	1512781.01	741.90	66.71	0.02
2110	692853.70	1512781.01	741.90	74.18	0.02
2111	691340.92	1512781.01	741.90	74.33	0.02
2112	630829.68	1512781.01	741.90	80.68	0.02
2113	275326.14	1512781.01	741.90	162.09	0.02
2114	232968.28	1512781.01	741.90	184.25	0.02
2115	219353.25	1512781.01	741.90	192.71	0.02
2116	201199.87	1512781.01	741.90	205.29	0.02
2117	160354.79	1512781.01	741.90	240.62	0.02
2118	237506.62	1512781.01	741.90	181.59	0.02
2119	195148.75	1512781.01	741.90	209.85	0.02
2120	164893.13	1512781.01	741.90	236.10	0.02
2121	114971.36	1512781.01	741.90	297.51	0.02
2122	111945.80	1512781.01	741.90	302.28	0.02
2123	205738.22	1512781.01	741.90	201.99	0.02
2124	355503.54	1512781.01	741.90	132.04	0.02
2125	806312.28	1512781.01	741.90	64.65	0.02
2126	816901.74	1512781.01	741.90	63.89	0.02
2127	167918.69	1512781.01	741.90	233.19	0.02
2128	146739.76	1512781.01	741.90	255.26	0.02
2151	505268.86	1512781.01	741.90	98.08	0.02
2152	484089.92	1512781.01	741.90	101.78	0.02
2153	459885.43	1512781.01	741.90	106.37	0.02
2154	403912.53	1512781.01	741.90	118.75	0.02
2155	346426.85	1512781.01	741.90	134.87	0.02
2156	381220.81	1512781.01	741.90	124.63	0.02
2157	346426.85	1512781.01	741.90	134.87	0.02
2158	308607.33	1512781.01	741.90	148.10	0.02
2159	278351.71	1512781.01	741.90	160.71	0.02
2160	234481.06	1512781.01	741.90	183.35	0.02
2161	298017.86	1512781.01	741.90	152.28	0.02
2162	261711.11	1512781.01	741.90	168.61	0.02
2163	231455.49	1512781.01	741.90	185.15	0.02
2164	202712.66	1512781.01	741.90	204.18	0.02
2165	173969.82	1512781.01	741.90	227.56	0.02
2166	709494.29	1512781.01	741.90	72.61	0.02
2167	683777.02	1512781.01	741.90	75.06	0.02

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
2168	603599.62	1512781.01	741.90	83.91	0.02
2169	534011.70	1512781.01	741.90	93.46	0.02
2170	252634.43	1512781.01	741.90	173.25	0.02
2171	207251.00	1512781.01	741.90	200.92	0.02
2172	155816.44	1512781.01	741.90	245.31	0.02
2173	111945.80	1512781.01	741.90	302.28	0.02
2482	394240.83	1508350.70	740.66	121.81	0.02
2484	415127.37	1517221.30	743.14	115.03	0.02
2486	394706.08	1508350.70	740.66	121.57	0.02
2488	312601.90	1514999.89	742.52	144.14	0.02
2490	302434.50	1512781.01	741.90	150.28	0.02
2492	178517.16	1510564.62	741.28	223.72	0.02
2493	200151.52	1510564.62	741.28	206.34	0.02
2494	222949.01	1510564.62	741.28	190.60	0.02
2496	182797.19	1509235.97	740.91	220.48	0.02
2498	335540.72	1510564.62	741.28	138.62	0.02
2500	321070.64	1300914.62	683.28	185.02	0.01
2502	291912.80	1298814.01	682.71	198.56	0.01
2504	245548.04	1303015.30	683.86	222.95	0.01
2506	213749.96	1298814.01	682.71	245.02	0.01
2508	132874.99	1300914.62	683.28	322.99	0.01
2510	97436.21	1298814.01	682.71	376.08	0.01
2512	19971.25	1298814.01	682.71	584.71	0.01
2514	0.00	1296713.44	707.83	682.13	0.01
2516	92991.77	1082168.90	623.93	402.37	0.01
2518	505139.81	1086641.65	625.12	503.98	0.01
2520	0.00	1084406.68	652.92	624.52	0.01
2522	0.00	1084406.68	685.12	624.52	0.01
2524	246293.29	1082168.90	623.93	254.85	0.01
2526	233697.26	1084406.68	624.52	262.42	0.01
2528	203455.69	1084406.68	624.52	283.74	0.01
2530	123233.34	1082168.90	623.93	361.23	0.01
2532	59726.04	1082168.90	623.93	460.64	0.01
2534	9513.03	1079928.29	623.33	579.69	0.01
2536	46931.52	1082168.90	623.93	487.66	0.01
2538	0.00	1086641.65	635.01	625.12	0.01
2540	0.00	1084406.68	676.14	624.52	0.01
2542	0.00	1086641.65	706.72	625.12	0.01
2544	74873.55	1510121.64	741.16	373.10	0.02
2546	261099.92	1510564.62	741.28	169.12	0.02
2548	68411.24	1512781.01	741.90	392.07	0.02
2549	365627.65	1508350.70	740.66	129.66	0.02
2551	292272.01	1510564.62	741.28	154.97	0.02
2553	251653.50	1514999.89	742.52	172.90	0.02
2555	188146.19	1514999.89	742.52	214.39	0.02
2557	331818.68	1510564.62	741.28	139.90	0.02

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
2559	264140.77	1511450.88	741.53	167.41	0.02
2561	221946.63	1506139.19	740.04	192.37	0.02
2563	141935.61	1507023.50	740.29	262.03	0.02
2565	87883.73	1514999.89	742.52	345.10	0.02
2567	55781.14	1514999.89	742.52	428.68	0.02
2568	306389.17	1512781.01	741.90	148.69	0.02
2570	231556.23	1510564.62	741.28	185.30	0.02
2572	182006.57	1510564.62	741.28	220.73	0.02
2574	3693.21	1515888.15	742.77	707.67	0.02
2575	0.00	1517221.30	763.66	743.14	0.02
2576	83764.65	1512781.01	741.90	354.84	0.02
2578	288764.37	1297973.78	682.48	200.24	0.01
2580	240843.10	1297973.78	682.48	226.73	0.01
2582	178702.74	1294612.90	681.55	274.67	0.01
2584	142906.92	1297973.78	682.48	311.31	0.01
2586	215145.72	1298814.01	682.71	244.07	0.01
2588	254584.35	1299654.25	682.94	218.08	0.01
2590	217239.37	1298814.01	682.71	242.48	0.01
2592	164904.00	1292512.35	680.98	288.10	0.01
2594	96460.06	1300074.37	683.05	377.75	0.01
2596	60062.59	1300914.62	683.28	453.84	0.01
2598	15863.49	1294612.90	681.55	601.75	0.01
2600	35171.44	1300914.62	683.28	527.78	0.01
2602	0.00	1302175.01	704.32	683.63	0.01
2604	0.00	1300914.62	711.97	683.28	0.01
2606	260014.96	1301754.88	683.51	214.62	0.01
2608	133493.47	1298814.01	682.71	322.65	0.01
2610	5627.75	1300914.62	683.28	652.76	0.01
2612	0.00	1303015.30	711.44	683.86	0.01
2614	0.00	1303015.30	701.01	683.86	0.01
2616	0.00	1295453.11	720.67	681.78	0.01
2618	0.00	1296713.44	734.48	682.13	0.01
2620	0.00	1082168.90	657.01	623.93	0.01
2622	0.00	1081273.00	643.97	623.69	0.01
2623	84050.71	1088873.85	625.72	416.27	0.01
2625	139761.68	1087534.86	625.36	341.73	0.01
2627	56315.97	1083064.35	624.17	467.53	0.01
2628	79578.72	1083064.35	624.17	423.97	0.01
2630	175143.81	1079928.29	623.33	307.42	0.01
2632	119046.05	1082168.90	623.93	366.44	0.01
2634	48941.02	1078582.55	622.97	482.86	0.01
2636	0.00	1079928.29	634.37	623.33	0.01
2637	0.00	1079928.29	626.36	623.33	0.01
2639	197600.14	987720.59	598.85	295.89	0.00
2641	207759.70	989618.33	599.35	288.48	0.00
2643	170155.41	996242.15	601.11	317.96	0.01

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
2645	143084.19	983918.08	597.85	344.16	0.00
2647	132118.60	991987.24	599.98	355.19	0.01
2649	134526.33	1001426.77	602.48	351.48	0.01
2651	135417.96	1000956.16	602.36	351.15	0.01
2653	111569.23	991040.11	599.73	379.34	0.01
2655	115489.75	1001897.25	602.61	374.13	0.01
2657	94786.38	1004717.10	603.35	400.58	0.01
2659	72428.40	973412.53	595.06	434.59	0.00
2661	58447.04	984393.91	597.97	458.05	0.00
2663	58993.32	988195.24	598.98	457.68	0.00
2665	55584.15	991987.24	599.98	463.77	0.01
2667	53018.07	983442.11	597.72	467.76	0.00
2669	45408.82	975806.46	595.70	482.67	0.00
2671	187986.36	989618.33	599.35	303.73	0.00
2672	146463.35	991040.11	599.73	340.21	0.01
2673	116491.46	988669.75	599.10	373.39	0.00
2674	84582.34	988195.24	598.98	416.13	0.00
2675	72722.13	993879.75	600.48	434.69	0.01
2676	71439.99	989618.33	599.35	436.03	0.00
2677	47479.35	989618.33	599.35	478.89	0.00
2678	26508.50	997657.86	601.48	526.76	0.01
2679	0.00	986770.84	598.60	598.30	0.00
2680	0.00	999072.27	606.94	601.86	0.01
2681	0.00	996242.15	609.92	601.11	0.01
2682	0.00	996242.15	611.51	601.11	0.01
2683	0.00	997186.10	613.30	601.36	0.01
2684	0.00	995297.62	615.08	600.86	0.01
2685	113431.94	993879.75	600.48	377.54	0.01
2687	61574.09	974370.55	595.32	451.23	0.00
2689	29368.61	984393.91	597.97	517.51	0.00
2691	13441.13	994352.52	600.61	557.78	0.01
2693	0.00	986770.84	626.37	598.60	0.00
2694	0.00	987245.79	627.98	598.73	0.00
2695	0.00	998600.94	634.66	601.73	0.01
2696	0.00	998600.94	621.17	601.73	0.01
2698	0.00	995769.96	638.74	600.98	0.01
2700	0.00	995297.62	643.34	600.86	0.01
2702	0.00	998600.94	646.54	601.73	0.01
2704	0.00	993879.75	649.77	600.48	0.01
2706	0.00	996242.15	653.05	601.11	0.01
2708	0.00	994825.14	657.29	600.73	0.01
2710	10000.00	1998545.69	882.54	496.28	0.04
2711	0.00	1998545.69	900.11	882.54	0.04
2712	72000.00	1933186.14	863.08	174.76	0.04
2713	0.00	1933186.14	876.57	863.08	0.04
2714	0.00	1933186.14	885.31	863.08	0.04

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
2715	0.00	1933186.14	909.54	863.08	0.04
2716	0.00	1933186.14	923.91	863.08	0.04
2717	103000.00	1878244.47	846.84	158.23	0.03
2718	0.00	1878244.47	849.34	846.84	0.03
2719	0.00	1878244.47	879.91	846.84	0.03
2720	0.00	1878244.47	904.61	846.84	0.03
2721	0.00	1878244.47	915.15	846.84	0.03
2722	98000.00	1829648.80	832.57	190.35	0.03
2723	0.00	1829648.80	840.91	832.57	0.03
2724	0.00	1829648.80	869.43	832.57	0.03
2725	0.00	1829648.80	893.35	832.57	0.03
2726	0.00	1829648.80	906.86	832.57	0.03
2727	91000.00	1785355.59	819.64	225.03	0.03
2728	0.00	1785355.59	829.78	819.64	0.03
2729	0.00	1785355.59	861.65	819.64	0.03
2730	0.00	1785355.59	890.80	819.64	0.03
2731	0.00	1785355.59	902.37	819.64	0.03
2732	0.00	1998545.69	929.49	882.54	0.04
2733	0.00	1998545.69	939.10	882.54	0.04
2734	0.00	1998545.69	940.85	882.54	0.04
2735	0.00	1998545.69	945.05	882.54	0.04
2736	0.00	1998545.69	948.77	882.54	0.04
2737	0.00	1998545.69	952.05	882.54	0.04
2738	0.00	1998545.69	953.48	882.54	0.04
2739	0.00	1998545.69	955.43	882.54	0.04
2740	0.00	1998545.69	957.52	882.54	0.04
2741	0.00	1998545.69	957.86	882.54	0.04
2742	0.00	1998545.69	961.60	882.54	0.04
2743	0.00	1998545.69	961.09	882.54	0.04
2744	0.00	1998545.69	962.43	882.54	0.04
2745	0.00	1998545.69	963.58	882.54	0.04
2746	0.00	1998545.69	964.40	882.54	0.04
2747	0.00	1998545.69	965.21	882.54	0.04
2748	0.00	1998545.69	966.01	882.54	0.04
2749	0.00	1935561.73	923.42	863.79	0.04
2750	0.00	1934371.91	933.26	863.43	0.04
2751	0.00	1932004.36	939.09	862.73	0.04
2752	0.00	1933186.14	943.01	863.08	0.04
2753	0.00	1934371.91	946.66	863.43	0.04
2754	0.00	1935561.73	951.32	863.79	0.04
2755	0.00	1932004.36	953.48	862.73	0.04
2756	0.00	1934371.91	955.37	863.43	0.04
2757	0.00	1933186.14	957.58	863.08	0.04
2758	0.00	1930826.55	957.81	862.38	0.04
2759	0.00	1933186.14	960.48	863.08	0.04
2760	0.00	1933186.14	961.49	863.08	0.04

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
2761	0.00	1933186.14	962.32	863.08	0.04
2762	0.00	1935561.73	963.26	863.79	0.04
2763	0.00	1934371.91	964.03	863.43	0.04
2764	0.00	1933186.14	964.30	863.08	0.04
2765	0.00	1933186.14	965.60	863.08	0.04
2766	0.00	1935561.73	967.62	863.79	0.04
2767	0.00	1878244.47	915.37	846.84	0.03
2768	0.00	1878244.47	926.90	846.84	0.03
2769	0.00	1876196.57	932.21	846.23	0.03
2770	0.00	1878244.47	938.82	846.84	0.03
2771	0.00	1879272.12	944.42	847.14	0.03
2772	0.00	1880302.28	946.32	847.44	0.03
2773	0.00	1877219.29	952.69	846.54	0.03
2774	0.00	1876196.57	954.11	846.23	0.03
2775	0.00	1879272.12	954.33	847.14	0.03
2776	0.00	1877219.29	957.63	846.54	0.03
2777	0.00	1878244.47	958.67	846.84	0.03
2778	0.00	1878244.47	960.04	846.84	0.03
2779	0.00	1877219.29	962.38	846.54	0.03
2780	0.00	1878244.47	962.56	846.84	0.03
2781	0.00	1879272.12	963.40	847.14	0.03
2782	0.00	1880302.28	963.58	847.44	0.03
2783	0.00	1829648.80	899.26	832.57	0.03
2784	0.00	1828725.74	916.89	832.30	0.03
2785	0.00	1829648.80	925.21	832.57	0.03
2786	0.00	1827804.37	932.86	832.03	0.03
2787	0.00	1829648.80	938.41	832.57	0.03
2788	0.00	1831500.02	942.07	833.11	0.03
2789	0.00	1829648.80	945.34	832.57	0.03
2790	0.00	1830573.56	948.50	832.84	0.03
2791	0.00	1830573.56	950.70	832.84	0.03
2792	0.00	1829648.80	952.16	832.57	0.03
2793	0.00	1829648.80	957.64	832.57	0.03
2794	0.00	1829648.80	957.99	832.57	0.03
2795	0.00	1785355.59	911.45	819.64	0.03
2796	0.00	1786207.89	918.22	819.89	0.03
2797	0.00	1785355.59	930.68	819.64	0.03
2798	0.00	1785355.59	938.29	819.64	0.03
2799	0.00	1787061.42	941.53	820.14	0.03
2800	0.00	1998545.69	896.83	882.54	0.04
2801	0.00	1998545.69	913.28	882.54	0.04
2802	0.00	1998545.69	927.84	882.54	0.04
2803	0.00	1998545.69	941.62	882.54	0.04
2804	0.00	1998545.69	945.05	882.54	0.04
2805	39000.00	1933186.14	863.08	275.44	0.04
2806	0.00	1933186.14	889.22	863.08	0.04

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
2807	0.00	1933186.14	906.61	863.08	0.04
2808	0.00	1933186.14	923.07	863.08	0.04
2809	0.00	1933186.14	931.58	863.08	0.04
2810	50000.00	1878244.47	846.84	272.08	0.03
2811	0.00	1878244.47	866.59	846.84	0.03
2812	0.00	1878244.47	892.42	846.84	0.03
2813	0.00	1878244.47	913.38	846.84	0.03
2814	0.00	1878244.47	926.07	846.84	0.03
2815	64000.00	1829648.80	832.57	259.91	0.03
2816	0.00	1829648.80	855.90	832.57	0.03
2817	0.00	1829648.80	886.33	832.57	0.03
2818	0.00	1829648.80	908.45	832.57	0.03
2819	0.00	1829648.80	922.04	832.57	0.03
2820	73000.00	1785355.59	819.64	262.73	0.03
2821	0.00	1785355.59	836.47	819.64	0.03
2822	0.00	1785355.59	871.09	819.64	0.03
2823	27000.00	1998545.69	882.54	284.56	0.04
2824	0.00	1998545.69	884.62	882.54	0.04
2825	0.00	1998545.69	887.07	882.54	0.04
2826	0.00	1998545.69	937.73	882.54	0.04
2827	0.00	1998545.69	890.07	882.54	0.04
2828	13000.00	1933186.14	863.08	504.39	0.04
2829	0.00	1933186.14	890.43	863.08	0.04
2830	53000.00	1878244.47	846.84	261.43	0.03
2831	0.00	1878244.47	874.35	846.84	0.03
2832	0.00	1878244.47	904.61	846.84	0.03
2833	47000.00	1829648.80	832.57	318.01	0.03
2834	0.00	1829648.80	862.87	832.57	0.03
2835	0.00	1829648.80	892.39	832.57	0.03
2836	0.00	1998545.69	941.81	882.54	0.04
2837	0.00	1998545.69	950.06	882.54	0.04
2838	0.00	1998545.69	953.48	882.54	0.04
2839	0.00	1998545.69	955.60	882.54	0.04
2840	0.00	1998545.69	967.60	882.54	0.04
2841	0.00	1998545.69	963.58	882.54	0.04
2842	0.00	1998545.69	968.39	882.54	0.04
2843	0.00	1998545.69	971.61	882.54	0.04
2844	0.00	1998545.69	974.13	882.54	0.04
2845	0.00	1998545.69	948.77	882.54	0.04
2846	0.00	1998545.69	977.96	882.54	0.04
2847	0.00	1998545.69	945.61	882.54	0.04
2848	0.00	1998545.69	980.40	882.54	0.04
2849	0.00	1998545.69	981.19	882.54	0.04
2850	0.00	1998545.69	982.09	882.54	0.04
2851	0.00	1998545.69	983.23	882.54	0.04
2852	0.00	1998545.69	983.73	882.54	0.04

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
2853	0.00	1998545.69	983.85	882.54	0.04
2854	0.00	1998545.69	984.47	882.54	0.04
2855	0.00	1998545.69	986.72	882.54	0.04
2856	0.00	1935561.73	936.53	863.79	0.04
2857	0.00	1935561.73	943.90	863.79	0.04
2858	0.00	1935561.73	947.65	863.79	0.04
2859	0.00	1934371.91	953.24	863.43	0.04
2860	0.00	1933186.14	954.78	863.08	0.04
2861	0.00	1933186.14	961.82	863.08	0.04
2862	0.00	1935561.73	967.62	863.79	0.04
2863	0.00	1934371.91	970.97	863.43	0.04
2864	0.00	1935561.73	974.30	863.79	0.04
2865	0.00	1933186.14	975.80	863.08	0.04
2866	0.00	1933186.14	977.07	863.08	0.04
2867	0.00	1934371.91	977.95	863.43	0.04
2868	0.00	1933186.14	978.73	863.08	0.04
2869	0.00	1930826.55	979.60	862.38	0.04
2870	0.00	1932004.36	980.31	862.73	0.04
2871	0.00	1930826.55	981.45	862.38	0.04
2872	0.00	1934371.91	981.97	863.43	0.04
2873	0.00	1934371.91	983.11	863.43	0.04
2874	0.00	1933186.14	983.32	863.08	0.04
2875	0.00	1934371.91	985.45	863.43	0.04
2876	0.00	1879272.12	928.58	847.14	0.03
2877	0.00	1878244.47	940.37	846.84	0.03
2878	0.00	1878244.47	943.45	846.84	0.03
2879	0.00	1878244.47	949.62	846.84	0.03
2880	0.00	1878244.47	953.42	846.84	0.03
2881	0.00	1878244.47	959.53	846.84	0.03
2882	0.00	1878244.47	964.37	846.84	0.03
2883	0.00	1878244.47	968.06	846.84	0.03
2884	0.00	1879272.12	970.86	847.14	0.03
2885	0.00	1878244.47	973.85	846.84	0.03
2886	0.00	1878244.47	974.14	846.84	0.03
2887	0.00	1877219.29	974.86	846.54	0.03
2888	0.00	1880302.28	976.76	847.44	0.03
2889	0.00	1877219.29	977.00	846.54	0.03
2890	0.00	1878244.47	979.50	846.84	0.03
2891	0.00	1878244.47	978.82	846.84	0.03
2892	0.00	1878244.47	981.10	846.84	0.03
2893	0.00	1878244.47	981.63	846.84	0.03
2894	0.00	1877219.29	982.14	846.54	0.03
2895	0.00	1829648.80	925.63	832.57	0.03
2896	0.00	1828725.74	933.05	832.30	0.03
2897	0.00	1832428.20	938.37	833.38	0.03
2898	0.00	1829648.80	942.87	832.57	0.03

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
2899	0.00	1828725.74	944.59	832.30	0.03
2900	0.00	1830573.56	955.36	832.84	0.03
2901	0.00	1828725.74	960.06	832.30	0.03
2902	0.00	1829648.80	964.71	832.57	0.03
2903	0.00	1828725.74	969.34	832.30	0.03
2904	0.00	1828725.74	971.79	832.30	0.03
2905	0.00	1829648.80	974.17	832.57	0.03
2906	0.00	1830573.56	974.16	832.84	0.03
2907	0.00	1828725.74	976.49	832.30	0.03
2908	0.00	1830573.56	977.32	832.84	0.03
2909	0.00	1827804.37	978.74	832.03	0.03
2910	0.00	1834289.77	979.49	833.92	0.03
2911	0.00	1787061.42	919.91	820.14	0.03
2912	0.00	1786207.89	928.58	819.89	0.03
2913	0.00	1787061.42	933.04	820.14	0.03
2914	0.00	1787061.42	938.81	820.14	0.03
2915	0.00	1786207.89	945.95	819.89	0.03
2916	0.00	1785355.59	954.57	819.64	0.03
2917	0.00	1785355.59	959.11	819.64	0.03
2918	0.00	1786207.89	967.34	819.89	0.03
2919	0.00	1787061.42	965.23	820.14	0.03
2920	0.00	1802645.43	973.93	824.68	0.03
2941	758347.80	1513668.26	742.15	68.26	0.02
2942	602263.38	1513224.58	742.02	84.01	0.02
2943	688315.36	1512781.01	741.90	74.62	0.02
2944	722231.44	1514112.03	742.27	71.28	0.02
2945	1028088.03	1511894.16	741.65	51.76	0.02
2946	441732.05	1512781.01	741.90	110.09	0.02
2947	439961.20	1511894.16	741.65	110.63	0.02
2948	727647.67	1512781.01	741.90	70.97	0.02
2949	824707.40	1513224.58	742.02	63.28	0.02
2950	519036.03	1513224.58	742.02	95.74	0.02
2951	517067.80	1511894.16	741.65	96.27	0.02
2952	470888.84	1514112.03	742.27	104.00	0.02
2953	1074566.12	1758700.69	811.90	27.66	0.03
2954	1061977.41	1755334.56	810.93	28.27	0.03
2955	536790.20	1754216.34	810.60	54.25	0.03
2956	739127.18	1759826.61	812.23	39.47	0.03
2957	909263.30	1755334.56	810.93	32.82	0.03
2958	572172.24	1749762.20	809.31	51.77	0.03
2959	591736.41	1755894.38	811.09	49.28	0.03
2960	1042336.47	1754775.21	810.76	28.83	0.03
2961	1028088.03	1511894.16	741.65	51.76	0.02
2962	439574.31	1510564.62	741.28	110.95	0.02
2963	768492.75	1512781.01	741.90	67.54	0.02
2964	545240.13	1514555.91	742.40	91.50	0.02

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
2965	463725.86	1515443.97	742.65	105.15	0.02
2966	657317.27	1514555.91	742.40	77.53	0.02
2967	1050280.26	1759263.41	812.06	28.23	0.03
2968	731275.36	1753657.94	810.44	40.61	0.03
2969	542917.78	1757015.46	811.41	53.24	0.03
2970	628291.21	1779861.79	818.04	43.33	0.03
2971	1025354.35	1514555.91	742.40	51.64	0.02
2972	420923.15	1514112.03	742.27	114.44	0.02
2973	423454.51	1512337.53	741.78	114.20	0.02
2974	704336.11	1511450.88	741.53	73.26	0.02
2975	442335.88	1509678.76	741.03	110.53	0.02
2976	399023.03	1511450.88	741.53	120.23	0.02
2977	528763.63	1750872.95	809.63	55.55	0.03
2978	519679.37	1749762.20	809.31	56.63	0.03
2979	679531.13	1755894.38	811.09	43.25	0.03
2980	490400.12	1751429.02	809.79	59.48	0.03
2981	1011538.70	1753100.00	810.28	29.82	0.03
3032	777569.44	1512781.01	741.90	66.83	0.02
3033	762441.63	1512781.01	741.90	68.03	0.02
3034	735211.57	1512781.01	741.90	70.31	0.02
3035	715545.42	1512781.01	741.90	72.06	0.02
3036	683777.02	1512781.01	741.90	75.06	0.02
3037	674700.33	1512781.01	741.90	75.97	0.02
3038	661085.30	1512781.01	741.90	77.37	0.02
3039	617214.65	1512781.01	741.90	82.26	0.02
3040	567292.88	1512781.01	741.90	88.64	0.02
3041	520396.67	1512781.01	741.90	95.59	0.02
3042	500730.51	1512781.01	741.90	98.85	0.02
3043	459885.43	1512781.01	741.90	106.37	0.02
3044	450808.74	1512781.01	741.90	108.20	0.02
3045	432655.37	1512781.01	741.90	112.05	0.02
3046	409963.65	1512781.01	741.90	117.27	0.02
3047	388784.72	1512781.01	741.90	122.61	0.02
3048	399374.19	1512781.01	741.90	119.88	0.02
3049	378195.25	1512781.01	741.90	125.46	0.02
3050	341888.51	1512781.01	741.90	136.33	0.02
3051	443244.84	1512781.01	741.90	109.77	0.02
3085	2641252.64	1748653.28	808.99	18.93	0.03
3086	2641950.52	2801861.43	808.99	18.93	0.03
3087	2492603.66	1748653.28	808.99	20.42	0.03
3088	2490975.27	1760954.50	812.55	19.60	0.03
3089	2290450.37	1755894.38	811.09	22.25	0.03
3090	2278353.73	1756454.68	811.25	22.43	0.03
3091	2274631.70	1748653.28	808.99	23.03	0.03
3092	2183906.97	1748653.28	808.99	24.01	0.03
3093	2133892.06	1753100.00	810.28	24.37	0.03

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
3094	2051541.92	1743135.71	807.40	26.25	0.03
3095	2047122.00	1759826.61	812.23	24.95	0.03
3096	2054333.45	1748653.28	808.99	25.85	0.03
3097	1985708.34	1748653.28	808.99	25.81	0.03
3098	1882886.99	1748653.28	808.99	28.62	0.03
3099	2523775.75	1511007.70	741.40	40.64	0.02
3100	2568905.48	1508793.28	740.79	39.93	0.02
3101	2444682.40	1515443.97	742.65	42.57	0.02
3102	2463292.60	1507908.20	740.54	42.55	0.02
3103	2364193.28	1507908.20	740.54	45.43	0.02
3104	2389782.31	1504813.44	739.67	44.98	0.02
3105	2260208.79	1506581.30	740.17	48.10	0.02
3106	85141.67	1512781.01	741.90	111.39	0.02
3107	400584.56	1510564.62	741.28	132.20	0.02
3108	49549.66	1510564.62	741.28	111.94	0.02
3109	57458.99	1510564.62	741.28	97.81	0.02
3110	132830.30	1510564.62	741.28	103.40	0.02
3111	219135.11	1510564.62	741.28	104.83	0.02
3112	347312.86	1511450.88	741.53	104.33	0.02
3113	465022.37	1512337.53	741.78	110.52	0.02
3114	586919.18	1511007.70	741.40	111.83	0.02
3115	698347.76	1512781.01	741.90	108.82	0.02
3116	304509.40	1510564.62	741.28	105.41	0.02
3117	248446.17	1511894.16	741.65	101.17	0.02
3118	352430.66	1511894.16	741.65	107.49	0.02
3119	117011.63	1511450.88	741.53	98.37	0.02
3120	59552.64	1512781.01	741.90	93.93	0.02
3121	40011.93	1510564.62	741.28	132.20	0.02
3122	144926.93	1512781.01	741.90	141.44	0.02
3123	270080.53	1512781.01	741.90	156.71	0.02
3124	376856.55	1512781.01	741.90	165.65	0.02
3125	692299.44	1510564.62	741.28	186.85	0.02
3126	149346.86	1512781.01	741.90	136.83	0.02
3127	281014.02	1512781.01	741.90	146.38	0.02
3128	27450.05	1512781.01	741.90	123.41	0.02
3129	586221.30	1512781.01	741.90	139.87	0.02
3130	713003.29	1512781.01	741.90	150.46	0.02
3131	65135.70	1506139.19	740.04	139.75	0.02
3132	155860.43	1516776.82	743.02	146.31	0.02
3133	264032.21	1511450.88	741.53	169.05	0.02
3134	264032.21	1511450.88	741.53	174.50	0.02
3135	507127.95	1512781.01	741.90	222.21	0.02
3136	87235.31	1512781.01	741.90	125.04	0.02
3137	155860.43	1512781.01	741.90	132.04	0.02
3138	227974.95	1510564.62	741.28	141.04	0.02
3139	274500.45	1510564.62	741.28	145.36	0.02

ID Number	Δh	h_{fg}	ρ_f	ρ_g	σ
3140	465255.00	1512781.01	741.90	168.61	0.02
3141	561795.41	1510564.62	741.28	167.11	0.02
3142	90724.73	1510564.62	741.28	111.61	0.02
3143	174470.63	1510564.62	741.28	120.84	0.02
3144	180286.31	1510564.62	741.28	122.01	0.02
3145	251237.70	1510564.62	741.28	126.48	0.02
3146	323352.23	1510564.62	741.28	135.02	0.02
3147	334983.60	1512781.01	741.90	136.33	0.02
3148	448971.08	1512781.01	741.90	143.05	0.02
3149	509454.23	1510564.62	741.28	138.98	0.02
3150	624604.84	1510564.62	741.28	145.36	0.02
3151	623441.70	1508350.70	740.66	151.83	0.02
3152	504801.68	1514999.89	742.52	179.09	0.02
3153	544348.35	1512781.01	741.90	188.86	0.02

Computer listing of Shepard's Method program designed, compiled, and used on Visual Studio C++ 6.0:

ChildFrm.cpp

```
// ChildFrm.cpp : implementation of the CChildFrame class
//
#include "stdafx.h"
#include "sheppard.h"
#include "ChildFrm.h"
#ifdef _DEBUG
#define new DEBUG_NEW
#undef THIS_FILE
static char THIS_FILE[] = __FILE__;
#endif
/////////////////////////////////////////////////////////////////////////////
// CChildFrame
IMPLEMENT_DYNCREATE(CChildFrame, CMDIChildWnd)
BEGIN_MESSAGE_MAP(CChildFrame, CMDIChildWnd)
	//{{AFX_MSG_MAP(CChildFrame)
		// NOTE - the ClassWizard will add and remove mapping macros here.
		//    DO NOT EDIT what you see in these blocks of generated code !
	//}}AFX_MSG_MAP
END_MESSAGE_MAP()
/////////////////////////////////////////////////////////////////////////////
// CChildFrame construction/destruction
CChildFrame::CChildFrame()
{
	// TODO: add member initialization code here
}
CChildFrame::~CChildFrame()
{
}
BOOL CChildFrame::PreCreateWindow(CREATESTRUCT& cs)
{
	// TODO: Modify the Window class or styles here by modifying
	//  the CREATESTRUCT cs
	if( !CMDIChildWnd::PreCreateWindow(cs) )
		return FALSE;
	return TRUE;
}
/////////////////////////////////////////////////////////////////////////////
// CChildFrame diagnostics
#ifdef _DEBUG
void CChildFrame::AssertValid() const
{
	CMDIChildWnd::AssertValid();
}
void CChildFrame::Dump(CDumpContext& dc) const
{
	CMDIChildWnd::Dump(dc);
}
#endif //_DEBUG
/////////////////////////////////////////////////////////////////////////////
// CChildFrame message handlers
```

ChildFrm.h

```
// ChildFrm.h : interface of the CChildFrame class
//
/////////////////////////////////////////////////////////////////////////////
#if !defined(AFX_CHILDFRM_H__82A2236B_066E_11D4_941E_00C04F200EBC__INCLUDED_)
#define AFX_CHILDFRM_H__82A2236B_066E_11D4_941E_00C04F200EBC__INCLUDED_
#if _MSC_VER > 1000
#pragma once
#endif // _MSC_VER > 1000
class CChildFrame : public CMDIChildWnd
{
	DECLARE_DYNCREATE(CChildFrame)
public:
	CChildFrame();
// Attributes
public:
// Operations
public:
// Overrides
	// ClassWizard generated virtual function overrides
	//{{AFX_VIRTUAL(CChildFrame)
	virtual BOOL PreCreateWindow(CREATESTRUCT& cs);
	//}}AFX_VIRTUAL
// Implementation
public:
	virtual ~CChildFrame();
#ifdef _DEBUG
	virtual void AssertValid() const;
	virtual void Dump(CDumpContext& dc) const;
#endif
// Generated message map functions
protected:
	//{{AFX_MSG(CChildFrame)
		// NOTE - the ClassWizard will add and remove member functions here.
		//    DO NOT EDIT what you see in these blocks of generated code!
	//}}AFX_MSG
	DECLARE_MESSAGE_MAP()
};
/////////////////////////////////////////////////////////////////////////////
//{{AFX_INSERT_LOCATION}}
// Microsoft Visual C++ will insert additional declarations immediately before the previous line.
#endif //
!defined(AFX_CHILDFRM_H__82A2236B_066E_11D4_941E_00C04F200EBC__INCLUDED_)
```

Evaluator.cpp

```
// Evaluator.cpp: implementation of the Evaluator class.
//
//////////////////////////////////////////////////////////////////////
#include "stdafx.h"
#include "sheppard.h"
#include "Evaluator.h"
#ifdef _DEBUG
#undef THIS_FILE
static char THIS_FILE[]=__FILE__;
#define new DEBUG_NEW
```

```
#endif
//////////////////////////////////////////////////////////////////////
// Construction/Destruction
//////////////////////////////////////////////////////////////////////
Evaluator::Evaluator(int N,Point **PointSet,double **ValueSet,int *Marray)
{NumberOfHyperplanes=N;
 for(int i=0;i<N;i++)
; }
double Evaluator::operator() ( Point &X)
{ int j=0,j1=0;
  double d1=0.0,d2=0.0,Value=0.0;
 return Value;
}
Evaluator::~Evaluator()
{
}
```

Evalulator.h

```
// Evaluator.h: interface for the Evaluator class.
//
//////////////////////////////////////////////////////////////////////
#if !defined(AFX_EVALUATOR_H__4EBC7D59_1D6A_4E34_9FD0_4CB5092B7331__INCLUDED_)
#define AFX_EVALUATOR_H__4EBC7D59_1D6A_4E34_9FD0_4CB5092B7331__INCLUDED_
#if _MSC_VER > 1000
#pragma once
#endif
#include "sheppard1.h"
class Evaluator
{
public:
Evaluator::Evaluator(int N,Point **PointSet,double **ValueSet,int *Marray);
        virtual ~Evaluator();
 EmbeddedSheppard *HyperPlaneEvaluator;
 int NumberOfHyperplanes;
 int M;
 double operator() ( Point &);
};
#endif
```

MainFrm.cpp

```
// MainFrm.cpp : implementation of the CMainFrame class
//
#include "stdafx.h"
#include "sheppard.h"
#include "MainFrm.h"
#ifdef _DEBUG
#define new DEBUG_NEW
#undef THIS_FILE
static char THIS_FILE[] = __FILE__;
#endif
/////////////////////////////////////////////////////////////////////////////
// CMainFrame

IMPLEMENT_DYNAMIC(CMainFrame, CMDIFrameWnd)
BEGIN_MESSAGE_MAP(CMainFrame, CMDIFrameWnd)
```

```
	//{{AFX_MSG_MAP(CMainFrame)
	ON_WM_CREATE()
	ON_COMMAND(ID_CALC, OnCalc)
	//}}AFX_MSG_MAP
END_MESSAGE_MAP()
static UINT indicators[] =
{
	ID_SEPARATOR,          // status line indicator
	ID_INDICATOR_CAPS,
	ID_INDICATOR_NUM,
	ID_INDICATOR_SCRL,
};
/////////////////////////////////////////////////////////////////////////////
// CMainFrame construction/destruction
CMainFrame::CMainFrame()
{
	// TODO: add member initialization code here
}
CMainFrame::~CMainFrame()
{
}
int CMainFrame::OnCreate(LPCREATESTRUCT lpCreateStruct)
{
	if (CMDIFrameWnd::OnCreate(lpCreateStruct) == -1)
		return -1;
	if (!m_wndToolBar.CreateEx(this, TBSTYLE_FLAT, WS_CHILD | WS_VISIBLE | CBRS_TOP
		| CBRS_GRIPPER | CBRS_TOOLTIPS | CBRS_FLYBY | CBRS_SIZE_DYNAMIC) ||
		!m_wndToolBar.LoadToolBar(IDR_MAINFRAME))
	{
		TRACE0("Failed to create toolbar\n");
		return -1;      // fail to create
	}
	if (!m_wndStatusBar.Create(this) ||
		!m_wndStatusBar.SetIndicators(indicators,
		  sizeof(indicators)/sizeof(UINT)))
	{
		TRACE0("Failed to create status bar\n");
		return -1;      // fail to create
	}
	// TODO: Delete these three lines if you do not want the toolbar to
	//  be dockable
	m_wndToolBar.EnableDocking(CBRS_ALIGN_ANY);
	EnableDocking(CBRS_ALIGN_ANY);
	DockControlBar(&m_wndToolBar);
	return 0;
}
BOOL CMainFrame::PreCreateWindow(CREATESTRUCT& cs)
{
	if( !CMDIFrameWnd::PreCreateWindow(cs) )
		return FALSE;
	// TODO: Modify the Window class or styles here by modifying
	//  the CREATESTRUCT cs

	return TRUE;
}
/////////////////////////////////////////////////////////////////////////////
```

```
// CMainFrame diagnostics
#ifdef _DEBUG
void CMainFrame::AssertValid() const
{
        CMDIFrameWnd::AssertValid();
}
void CMainFrame::Dump(CDumpContext& dc) const
{
        CMDIFrameWnd::Dump(dc);
}
#endif //_DEBUG
////////////////////////////////////////////////////////////////////////////
// CMainFrame message handlers
#include <fstream.h>
#include "sheppard1.h"
#include "Valuecalculator.h"
#include "RegularMesh.h"
#include "rectangularbox.h"
ValueCalculator *pCalc;
double ErrorAvaluation();
extern RectangularBox *Interpolator;
void CMainFrame::OnCalc()
{
 ValueCalculator Calc;
 RegularMesh MeshR(Calc.FlowRateMin,Calc.FlowRateMax,
            Calc.PressureMin,Calc.PressureMax,
                                Calc.QualityMin,Calc.QualityMax,
                                Calc.DiameterMin,Calc.DiameterMax,
                                100,10,100,50);
                                Interpolator=new RectangularBox(&MeshR);
 CString msg;
 msg.Format("SummError=%lg",ErrorAvaluation());
AfxMessageBox(msg);
}
FILE *BigErrors=fopen("bigerrors.txt","w");
double ErrorAvaluation()
{CString msg;
 bool NewDataSet=true;
 char buf[500];
 double SummaryError=0.0,FlowValue,CalculatedFlowValue,LocalError,BufArray[30],ParamArray[30],f;
 Point Pcurrent(3);
 FILE *ExpData=fopen("in.prn","r");
 int LineNumber,
         FlowRateNumber=4,
         PressureNumber=2,
         QualityNumber=3,
         FluxNumber=1,
         DiameterNumber=5;
int DataSetNumber=0;
 fgets(buf,500,ExpData);
 LineNumber=0;
 while (fgets(buf,500,ExpData)!=NULL)
 {if(NewDataSet)
  {
  NewDataSet=false;
  }
```

```
 if(strlen(buf) < 10)
 {NewDataSet=true;
  DataSetNumber++;if(DataSetNumber > 199) goto M100;
 }

 sscanf(buf,"%lg %lg %lg %lg %lg %lg %lg %lg %lg %lg %lg %lg %lg",BufArray,
          BufArray+1,BufArray+2,BufArray+3,BufArray+4,
          BufArray+5,BufArray+6,BufArray+7,BufArray+8,
          BufArray+9,BufArray+10,BufArray+11,BufArray+12);
  f=BufArray[FluxNumber];
  ParamArray[0]=BufArray[FlowRateNumber];
  ParamArray[1]=BufArray[PressureNumber];
  ParamArray[2]=BufArray[QualityNumber];
  ParamArray[3]=BufArray[DiameterNumber];
LineNumber++;
 FlowValue=f;
 ParamArray[0]=ParamArray[0]/400.0;
 ParamArray[2]=ParamArray[2]*20.0;
 CalculatedFlowValue=Interpolator-
>Value(ParamArray[0],ParamArray[1],ParamArray[2],ParamArray[3]);
 LocalError=fabs((FlowValue-CalculatedFlowValue)/FlowValue);
 fprintf(BigErrors,"Point: %lg %lg %lg %lg Value= %lg %lg Error= %lg\n",
ParamArray[0],ParamArray[1],ParamArray[2],ParamArray[3],f,CalculatedFlowValue,LocalError);
 SummaryError+=LocalError;
 }
M100: return SummaryError;
}
```

MainFrm.h

```
// MainFrm.h : interface of the CMainFrame class
//
/////////////////////////////////////////////////////////////////////////////
#if !defined(AFX_MAINFRM_H__82A22369_066E_11D4_941E_00C04F200EBC__INCLUDED_)
#define AFX_MAINFRM_H__82A22369_066E_11D4_941E_00C04F200EBC__INCLUDED_
#if _MSC_VER > 1000
#pragma once
#endif // _MSC_VER > 1000
class CMainFrame : public CMDIFrameWnd
{
	DECLARE_DYNAMIC(CMainFrame)
public:
	CMainFrame();
// Attributes
public:
// Operations
public:
// Overrides
	// ClassWizard generated virtual function overrides
	//{{AFX_VIRTUAL(CMainFrame)
	virtual BOOL PreCreateWindow(CREATESTRUCT& cs);
	//}}AFX_VIRTUAL
// Implementation
public:
	virtual ~CMainFrame();
#ifdef _DEBUG
	virtual void AssertValid() const;
```

```
        virtual void Dump(CDumpContext& dc) const;
#endif
protected: // control bar embedded members
        CStatusBar  m_wndStatusBar;
        CToolBar    m_wndToolBar;
// Generated message map functions
protected:
        //{{AFX_MSG(CMainFrame)
        afx_msg int OnCreate(LPCREATESTRUCT lpCreateStruct);
        afx_msg void OnCalc();
        //}}AFX_MSG
        DECLARE_MESSAGE_MAP()
};
/////////////////////////////////////////////////////////////////////////////
//{{AFX_INSERT_LOCATION}}
// Microsoft Visual C++ will insert additional declarations immediately before the previous line.
#endif // !defined(AFX_MAINFRM_H__82A22369_066E_11D4_941E_00C04F200EBC__INCLUDED_)
```

Point.cpp

```
// Point.cpp: implementation of the Point class.
//
//////////////////////////////////////////////////////////////////////
#include "stdafx.h"
#include "sheppard.h"
#include "Point.h"
#include <math.h>
#ifdef _DEBUG
#undef THIS_FILE
static char THIS_FILE[]=__FILE__;
#define new DEBUG_NEW
#endif
//////////////////////////////////////////////////////////////////////
// Construction/Destruction
//////////////////////////////////////////////////////////////////////
double Point::MinDistance=1.0e-10;
Point::Point(int n)
{Dim=n; X=new double[Dim];}
double Point::Distance(Point &B)
{double z=0.0,d,r;
 for(int i=0;i<Dim;i++) {d=X[i]-B.X[i]; z+=d*d;}
 if(z <= MinDistance*MinDistance) r=MinDistance;
 else r=sqrt(z);
 return r;
}
Point& Point::operator =(Point& A)
        {if(Dim!=A.Dim)
         {if(Dim!=0) delete []X;
         Dim=A.Dim; X=new double[Dim];
         }
        for(int i=0;i<Dim;i++) X[i]=A.X[i];return *this;
        }

Point::~Point()
{delete []X;}
void Point::SetValue(double *A)
```

```
{for(int i=0;i<Dim;i++) X[i]=A[i];}
void Point::SetValue(Point& A)
{for(int i=0;i<Dim;i++) X[i]=A.X[i];}
```

Point.h

```
// Point.h: interface for the Point class.
//
//////////////////////////////////////////////////////////////////////
#if !defined(AFX_POINT_H__82A22378_066E_11D4_941E_00C04F200EBC__INCLUDED_)
#define AFX_POINT_H__82A22378_066E_11D4_941E_00C04F200EBC__INCLUDED_
#if _MSC_VER > 1000
#pragma once
#endif
class Point
{
public:
   Point() {Dim=0;}
         Point(int);
   Point(double x1) {Dim=1;X=new double[1]; X[0]=x1;}
   Point(double x1,double x2) {Dim=2; X=new double[2];X[0]=x1;X[1]=x2;}
   Point(double x1,double x2,double x3)
    {Dim=3; X=new double[3]; X[0]=x1;X[1]=x2;X[2]=x2;}
   void TakeValue(double x) {X[0]=x;}
   void TakeValue(double x1,double x2) {X[0]=x1;X[1]=x2;}
   void TakeValue(double x1,double x2,double x3) {X[0]=x1;X[1]=x2;X[2]=x3;}
   void TakeValue(double x1,double x2,double x3,double x4) {X[0]=x1;X[1]=x2;X[2]=x3;X[3]=x4;}
   Point(Point &A)
       {Dim=A.Dim; X=new double[Dim]; for(int i=0;i<Dim;i++) X[i]=A.X[i];}
   Point& operator =(Point& A);
   void SetValue(double *);
   void SetValue(Point &A);
   double Distance(Point&);
         virtual ~Point();
   double *X;
   int Dim;
  static double MinDistance;
};
#endif
```

RectangularBox.cpp

```
// RectangularBox.cpp: implementation of the RectangularBox class.
//
//////////////////////////////////////////////////////////////////////
#include "stdafx.h"
#include "sheppard.h"
#include "RectangularBox.h"
#ifdef _DEBUG
#undef THIS_FILE
static char THIS_FILE[]=__FILE__;
#define new DEBUG_NEW
#endif
//////////////////////////////////////////////////////////////////////
// Construction/Destruction
//////////////////////////////////////////////////////////////////////
int IntervalSearch(double *X,int N,double x)
```

```
{int i,j;
 for(i=0;i<N-1;i++)
  {if(X[i+1] > x) {j=i;break;}
   j=i;
  }
 return j;
}
double RectangularBox::Value(double X1,double X2,double X3,double X4)
{int i1,i2,i3,i4;
 double V[17],x1,x2,x3,x4;
 i1=IntervalSearch(Mesh->MeshX,Mesh->N1,X1);
 x1=X1-Mesh->MeshX[i1];
 i2=IntervalSearch(Mesh->MeshY,Mesh->N2,X2);
 x2=X2-Mesh->MeshY[i2];
 i3=IntervalSearch(Mesh->MeshZ,Mesh->N3,X3);
 x3=X3-Mesh->MeshZ[i3];
 i4=IntervalSearch(Mesh->MeshD,Mesh->N4,X4);
 x4=X4-Mesh->MeshD[i4];
 V[1]=Mesh->MeshValue[i1][i2][i3][i4];
 V[2]=Mesh->MeshValue[i1+1][i2][i3][i4];
 V[3]=Mesh->MeshValue[i1+1][i2+1][i3][i4];
 V[4]=Mesh->MeshValue[i1][i2+1][i3][i4];
 V[5]=Mesh->MeshValue[i1][i2][i3+1][i4];
 V[6]=Mesh->MeshValue[i1+1][i2][i3+1][i4];
 V[7]=Mesh->MeshValue[i1+1][i2+1][i3+1][i4];
 V[8]=Mesh->MeshValue[i1][i2+1][i3+1][i4];
 V[9]=Mesh->MeshValue[i1][i2][i3][i4+1];
 V[10]=Mesh->MeshValue[i1+1][i2][i3][i4+1];
 V[11]=Mesh->MeshValue[i1+1][i2+1][i3][i4+1];
 V[12]=Mesh->MeshValue[i1][i2+1][i3][i4+1];
 V[13]=Mesh->MeshValue[i1][i2][i3+1][i4+1];
 V[14]=Mesh->MeshValue[i1+1][i2][i3+1][i4+1];
 V[15]=Mesh->MeshValue[i1+1][i2+1][i3+1][i4+1];
 V[16]=Mesh->MeshValue[i1][i2+1][i3+1][i4+1];
// dimensions: 1 -> 2 -> 3 -> 4;
//  number of corners:
// x2        x3
// ^        /
// |
//    16  15
//
//
//    13  14
//
//
// 12   11
//
// 9   10   -----> x1
//
//
//
//   x4 (Hdiameter dimension)
//
//
//
// x2        x3
```

```
//^        /
//|
//   8  7
//
//
//   5  6
//
//
//4  3
//
//1  2  -----> x1
 double edg1,edg2,edg3,edg4,edga1,edga2,edga3,edga4,
      plane1,plane2,planea1,planea2,
                      cube,cubea,
                      hypercube;
                      edg1=(V[1]*(b1-x1)+V[2]*x1)/b1;
                      edg2=(V[4]*(b1-x1)+V[3]*x1)/b1; plane1=(edg1*(b2-x2)+edg2*x2)/b2;
                      edg3=(V[5]*(b1-x1)+V[6]*x1)/b1;
                      edg4=(V[8]*(b1-x1)+V[7]*x1)/b1; plane2=(edg3*(b2-x2)+edg4*x2)/b2;
                        cube=(plane1*(b3-x3)+plane2*x3)/b3;
                      edga1=(V[9]*(b1-x1) +V[10]*x1)/b1;
                      edga2=(V[12]*(b1-x1)+V[11]*x1)/b1; planea1=(edga1*(b2-x2)+edga2*x2)/b2;
                      edga3=(V[13]*(b1-x1)+V[14]*x1)/b1;
                      edga4=(V[16]*(b1-x1)+V[15]*x1)/b1; planea2=(edga3*(b2-x2)+edga4*x2)/b2;
                        cubea=(planea1*(b3-x3)+planea2*x3)/b3;
                      hypercube=(cube*(b4-x4)+cubea*x4)/b4;
 return hypercube;
}
RectangularBox *Interpolator;
```

RectangularBox.h

```
// RectangularBox.h: interface for the RectangularBox class.
//
//////////////////////////////////////////////////////////////////////
#if
!defined(AFX_RECTANGULARBOX_H__03630AE5_C46F_4DD4_9B01_643F49C72526__INCLUDE
D_)
#define
AFX_RECTANGULARBOX_H__03630AE5_C46F_4DD4_9B01_643F49C72526__INCLUDED_
#if _MSC_VER > 1000
#pragma once
#endif // _MSC_VER > 1000
#include "regularmesh.h"
class RectangularBox
{
public:
        RectangularBox(RegularMesh *A){Mesh=A;
                          b1=Mesh->Step1;
                    b2=Mesh->Step2;
                    b3=Mesh->Step3;
                    b4=Mesh->Step4;
                   }
        double Value(double x1,double x2,double x3,double x4);
        virtual ~RectangularBox(){}
  RegularMesh *Mesh;
        double b1,b2,b3,b4;
```

```
};
#endif //
!defined(AFX_RECTANGULARBOX_H__03630AE5_C46F_4DD4_9B01_643F49C72526__INCLUDE
D_)
```

RegularMesh.cpp

```
// RegularMesh.cpp: implementation of the RegularMesh class.
//
//////////////////////////////////////////////////////////////////////
#include "stdafx.h"
#include "sheppard.h"
#include "RegularMesh.h"
#include "valuecalculator.h"
#ifdef _DEBUG
#undef THIS_FILE
static char THIS_FILE[]=__FILE__;
#define new DEBUG_NEW
#endif
//////////////////////////////////////////////////////////////////////
// Construction/Destruction
//////////////////////////////////////////////////////////////////////
extern ValueCalculator *pCalc;
RegularMesh::RegularMesh(double x1,double x2,double y1,double y2,double z1,double z2,double
d1,double d2, int n1,int n2,int n3,int n4)
{
 N1=n1;N2=n2;N3=n3;N4=n4;
  X1=x1,X2=x2;
            Y1=y1,Y2=y2;
                  Z1=z1,Z2=z2;
                  D1=d1,D2=d2;
                  double xt;
                  Step1=(X2-X1)/(N1-1.0);
                  Step2=(Y2-Y1)/(N2-1.0);
                  Step3=(Z2-Z1)/(N3-1.0);
                  Step4=(D2-D1)/(N4-1.0);
  MeshX=new double[N1+2];
  MeshY=new double[N2+2];
  MeshZ=new double[N3+2];
  MeshD=new double[N4+2];
  MeshValue=new double ***[N1+2];
  for(int i=0;i<=N1;i++)
  {MeshValue[i]=new double **[N2+2];
   for(int j=0;j<=N2;j++)
        {MeshValue[i][j]=new double *[N3+2];
          for(int k=0;k<=N3;k++) MeshValue[i][j][k]=new double[N4+2];
        }
  }
        xt=X1;
        for(i=0;i<N1;i++) {MeshX[i]=xt;xt+=Step1;}
        xt=Y1;
   for(i=0;i<N2;i++) {MeshY[i]=xt;xt+=Step2;}
        xt=Z1;
        for(i=0;i<N3;i++) {MeshZ[i]=xt;xt+=Step3;}
        xt=D1;
        for(i=0;i<N4;i++) {MeshD[i]=xt;xt+=Step4;}
  Point A(4);
```

```
FILE *Answer=fopen("mesh.txt","w");
 for(i=0;i<N1;i++)
         for(int i1=0;i1<N2;i1++)
                 for(int i2=0;i2<N3;i2++)
                         for(int i3=0;i3<N4;i3++)
                         {A.TakeValue(MeshX[i],MeshY[i1],MeshZ[i2],MeshD[i3]);
                          MeshValue[i][i1][i2][i3]=pCalc->Value(A);
                          fprintf(Answer,"%d %d %d %d %lg %lg %lg %lg Value=%lg\n",
                 i,i1,i2,i3,MeshX[i],MeshY[i1],MeshZ[i2],MeshD[i3],MeshValue[i][i1][i2][i3]);
                         }
fclose(Answer);
}
RegularMesh::~RegularMesh()
{
}
```

RegularMesh.h

```
// RegularMesh.h: interface for the RegularMesh class.
//
//////////////////////////////////////////////////////////////////////
#if
!defined(AFX_REGULARMESH_H__712D1F18_E97E_43CD_8CF1_7B091AF1B826__INCLUDED_)
#define AFX_REGULARMESH_H__712D1F18_E97E_43CD_8CF1_7B091AF1B826__INCLUDED_
#if _MSC_VER > 1000
#pragma once
#endif // _MSC_VER > 1000
class RegularMesh
{
public:
         RegularMesh(double,double,double,double,
                 double,double,double,double,
                 int,int,int,int);
         virtual ~RegularMesh();
  int Dim;
  double Step1,Step2,Step3,Step4;
  int N1,N2,N3,N4;
  double X1,X2,
         Y1,Y2,
                 Z1,Z2,
                 D1,D2;
  double *MeshX,*MeshY,*MeshZ,*MeshD;//[N1][N2][N3][N4];
  double ****MeshValue;
};
#endif //
!defined(AFX_REGULARMESH_H__712D1F18_E97E_43CD_8CF1_7B091AF1B826__INCLUDED_)
```

resource.h

```
//{{NO_DEPENDENCIES}}
// Microsoft Developer Studio generated include file.
// Used by sheppard.rc
//
#define IDD_ABOUTBOX                    100
#define IDR_MAINFRAME                   128
#define IDR_SHEPPATYPE                  129
#define ID_CALC                 32771
```

```
// Next default values for new objects
//
#ifdef APSTUDIO_INVOKED
#ifndef APSTUDIO_READONLY_SYMBOLS
#define _APS_3D_CONTROLS                1
#define _APS_NEXT_RESOURCE_VALUE        130
#define _APS_NEXT_COMMAND_VALUE         32772
#define _APS_NEXT_CONTROL_VALUE         1000
#define _APS_NEXT_SYMED_VALUE           101
#endif
#endif
```

Sheppard.cpp

```
// sheppard.cpp : Defines the class behaviors for the application.
//
#include "stdafx.h"
#include "sheppard.h"
#include "MainFrm.h"
#include "ChildFrm.h"
#include "sheppardDoc.h"
#include "sheppardView.h"
#ifdef _DEBUG
#define new DEBUG_NEW
#undef THIS_FILE
static char THIS_FILE[] = __FILE__;
#endif
/////////////////////////////////////////////////////////////////////////////
// CSheppardApp
BEGIN_MESSAGE_MAP(CSheppardApp, CWinApp)
	//{{AFX_MSG_MAP(CSheppardApp)
	ON_COMMAND(ID_APP_ABOUT, OnAppAbout)
		// NOTE - the ClassWizard will add and remove mapping macros here.
		//    DO NOT EDIT what you see in these blocks of generated code!
	//}}AFX_MSG_MAP
	// Standard file based document commands
	ON_COMMAND(ID_FILE_NEW, CWinApp::OnFileNew)
	ON_COMMAND(ID_FILE_OPEN, CWinApp::OnFileOpen)
	// Standard print setup command
	ON_COMMAND(ID_FILE_PRINT_SETUP, CWinApp::OnFilePrintSetup)
END_MESSAGE_MAP()
/////////////////////////////////////////////////////////////////////////////
// CSheppardApp construction
CSheppardApp::CSheppardApp()
{
	// TODO: add construction code here,
	// Place all significant initialization in InitInstance
}
/////////////////////////////////////////////////////////////////////////////
// The one and only CSheppardApp object
CSheppardApp theApp;
/////////////////////////////////////////////////////////////////////////////
// CSheppardApp initialization
BOOL CSheppardApp::InitInstance()
{
```

```
        AfxEnableControlContainer();
        // Standard initialization
        // If you are not using these features and wish to reduce the size
        //  of your final executable, you should remove from the following
        //  the specific initialization routines you do not need.
#ifdef _AFXDLL
        Enable3dControls();                     // Call this when using MFC in a shared DLL
#else
        Enable3dControlsStatic(); // Call this when linking to MFC statically
#endif
        // Change the registry key under which our settings are stored.
        // TODO: You should modify this string to be something appropriate
        // such as the name of your company or organization.
        SetRegistryKey(_T("Local AppWizard-Generated Applications"));
        LoadStdProfileSettings(); // Load standard INI file options (including MRU)
        // Register the application's document templates.  Document templates
        //  serve as the connection between documents, frame windows and views.
        CMultiDocTemplate* pDocTemplate;
        pDocTemplate = new CMultiDocTemplate(
                IDR_SHEPPATYPE,
                RUNTIME_CLASS(CSheppardDoc),
                RUNTIME_CLASS(CChildFrame), // custom MDI child frame
                RUNTIME_CLASS(CSheppardView));
        AddDocTemplate(pDocTemplate);
        // create main MDI Frame window
        CMainFrame* pMainFrame = new CMainFrame;
        if (!pMainFrame->LoadFrame(IDR_MAINFRAME))
                return FALSE;
        m_pMainWnd = pMainFrame;
        // Parse command line for standard shell commands, DDE, file open
        CCommandLineInfo cmdInfo;
        ParseCommandLine(cmdInfo);
        // Dispatch commands specified on the command line
        if (!ProcessShellCommand(cmdInfo))
                return FALSE;
        // The main window has been initialized, so show and update it.
        pMainFrame->ShowWindow(m_nCmdShow);
        pMainFrame->UpdateWindow();
        return TRUE;
}
/////////////////////////////////////////////////////////////////////////////
// CAboutDlg dialog used for App About
class CAboutDlg : public CDialog
{
public:
        CAboutDlg();
// Dialog Data
        //{{AFX_DATA(CAboutDlg)
        enum { IDD = IDD_ABOUTBOX };
        //}}AFX_DATA
        // ClassWizard generated virtual function overrides
        //{{AFX_VIRTUAL(CAboutDlg)
        protected:
        virtual void DoDataExchange(CDataExchange* pDX);    // DDX/DDV support
        //}}AFX_VIRTUAL
// Implementation
```

```
protected:
	//{{AFX_MSG(CAboutDlg)
		// No message handlers
	//}}AFX_MSG
	DECLARE_MESSAGE_MAP()
};
CAboutDlg::CAboutDlg() : CDialog(CAboutDlg::IDD)
{
	//{{AFX_DATA_INIT(CAboutDlg)
	//}}AFX_DATA_INIT
}
void CAboutDlg::DoDataExchange(CDataExchange* pDX)
{
	CDialog::DoDataExchange(pDX);
	//{{AFX_DATA_MAP(CAboutDlg)
	//}}AFX_DATA_MAP
}
BEGIN_MESSAGE_MAP(CAboutDlg, CDialog)
	//{{AFX_MSG_MAP(CAboutDlg)
		// No message handlers
	//}}AFX_MSG_MAP
END_MESSAGE_MAP()
// App command to run the dialog
void CSheppardApp::OnAppAbout()
{
	CAboutDlg aboutDlg;
	aboutDlg.DoModal();
}
/////////////////////////////////////////////////////////////////////////////
// CSheppardApp message handlers
```

Sheppard.h

```
// sheppard.h : main header file for the SHEPPARD application
//
#if !defined(AFX_SHEPPARD_H__82A22365_066E_11D4_941E_00C04F200EBC__INCLUDED_)
#define AFX_SHEPPARD_H__82A22365_066E_11D4_941E_00C04F200EBC__INCLUDED_
#if _MSC_VER > 1000
#pragma once
#endif // _MSC_VER > 1000
#ifndef __AFXWIN_H__
	#error include 'stdafx.h' before including this file for PCH
#endif
#include "resource.h"	// main symbols
/////////////////////////////////////////////////////////////////////////////
// CSheppardApp:
// See sheppard.cpp for the implementation of this class
//
class CSheppardApp : public CWinApp
{
public:
	CSheppardApp();
// Overrides
	// ClassWizard generated virtual function overrides
	//{{AFX_VIRTUAL(CSheppardApp)
	public:
	virtual BOOL InitInstance();
```

```
        //}}AFX_VIRTUAL
// Implementation
        //{{AFX_MSG(CSheppardApp)
        afx_msg void OnAppAbout();
                // NOTE - the ClassWizard will add and remove member functions here.
                //    DO NOT EDIT what you see in these blocks of generated code !
        //}}AFX_MSG
        DECLARE_MESSAGE_MAP()
};
/////////////////////////////////////////////////////////////////////////////
//{{AFX_INSERT_LOCATION}}
// Microsoft Visual C++ will insert additional declarations immediately before the previous line.
#endif //
!defined(AFX_SHEPPARD_H__82A22365_066E_11D4_941E_00C04F200EBC__INCLUDED_)
```

Sheppard1.cpp

```
// Sheppard1.cpp: implementation of the Sheppard class.
//
//////////////////////////////////////////////////////////////////////
#include "stdafx.h"
#include "sheppard.h"
#include "Sheppard1.h"
#ifdef _DEBUG
#undef THIS_FILE
static char THIS_FILE[]=__FILE__;
#define new DEBUG_NEW
#endif
#include <math.h>
//////////////////////////////////////////////////////////////////////
// Construction/Destruction
//////////////////////////////////////////////////////////////////////
typedef Point *pPoint;
int Sheppard::Nincrement=50;
Sheppard::Sheppard(int n,int d,double p)
{Dim=d; N=n; PointsTreated=new pPoint[N];F=new double[N];Ncurrent=0;P=p;
 for(int i=0;i<N;i++) PointsTreated[i]=new Point(d);
}
void Sheppard::AddPoint(Point &A,double f)
{F[Ncurrent]=f; (*PointsTreated[Ncurrent++])=A;
 if(Ncurrent==N)
  {N+=Nincrement;
  PointsTemper=new pPoint[N];
  Ftemper=new double[N];
  for(int i=0;i<Ncurrent;i++)
   {PointsTemper[i]=PointsTreated[i]; Ftemper[i]=F[i];}
  delete []PointsTreated;
  delete []F;
  PointsTreated=PointsTemper;
  F=Ftemper;
  }
}


Sheppard::~Sheppard()
{delete []PointsTreated;delete []F;}
double Sheppard::operator() (Point &X)
```

```
{double rc,rs,s,w,d;
 Point DD(3); Point &Z=DD;
  s=0.0;rc=0.0;rs=0.0;
  for(int i=0;i<Ncurrent;i++)
   {Z=(*PointsTreated[i]);
   d=X.Distance(Z);
   rc+=1.0/pow(d,P);
   rs+=F[i]/pow(d,P);
   }
  s=rs/rc;
  return s;
}
```

Sheppard1.h

```
// Sheppard1.h: interface for the Sheppard class.
//
//////////////////////////////////////////////////////////////////////
#if !defined(AFX_SHEPPARD1_H__82A22377_066E_11D4_941E_00C04F200EBC__INCLUDED_)
#define AFX_SHEPPARD1_H__82A22377_066E_11D4_941E_00C04F200EBC__INCLUDED_
#if _MSC_VER > 1000
#pragma once
#endif // _MSC_VER > 1000
#include <math.h>
#include "Point.h"
class Sheppard
{
public:
	Sheppard(int n,int d,double p);
   void AddPoint(Point &A,double f);
   double operator() ( Point &);
	double Distance(Point &A) {if(A.Dim < 4) return 0.0; return fabs(Diameter-A.X[3]);}
	virtual ~Sheppard();
   int Dim;
   int N,Ncurrent;
   double P;
   Point **PointsTreated,**PointsTemper;
   double *F,*Ftemper;
   static int Nincrement;
   double Diameter;
};
class EmbeddedSheppard: public Sheppard
{public: EmbeddedSheppard(int n,int d,double p,double Diam): Sheppard(n,d,p), DiameterValue(Diam) {}
 double DiameterValue;
};
#endif //
!defined(AFX_SHEPPARD1_H__82A22377_066E_11D4_941E_00C04F200EBC__INCLUDED_)
```

sheppardDoc.cpp

```
// sheppardDoc.cpp : implementation of the CSheppardDoc class
//
#include "stdafx.h"
#include "sheppard.h"

#include "sheppardDoc.h"
#ifdef _DEBUG
```

```
#define new DEBUG_NEW
#undef THIS_FILE
static char THIS_FILE[] = __FILE__;
#endif
/////////////////////////////////////////////////////////////////////////////
// CSheppardDoc
IMPLEMENT_DYNCREATE(CSheppardDoc, CDocument)
BEGIN_MESSAGE_MAP(CSheppardDoc, CDocument)
	//{{AFX_MSG_MAP(CSheppardDoc)
		// NOTE - the ClassWizard will add and remove mapping macros here.
		//    DO NOT EDIT what you see in these blocks of generated code!
	//}}AFX_MSG_MAP
END_MESSAGE_MAP()
/////////////////////////////////////////////////////////////////////////////
// CSheppardDoc construction/destruction
CSheppardDoc::CSheppardDoc()
{
	// TODO: add one-time construction code here
}
CSheppardDoc::~CSheppardDoc()
{
}
BOOL CSheppardDoc::OnNewDocument()
{
	if (!CDocument::OnNewDocument())
		return FALSE;
	// TODO: add reinitialization code here
	// (SDI documents will reuse this document)
	return TRUE;
}
/////////////////////////////////////////////////////////////////////////////
// CSheppardDoc serialization
void CSheppardDoc::Serialize(CArchive& ar)
{
	if (ar.IsStoring())
	{
		// TODO: add storing code here
	}
	else
	{
		// TODO: add loading code here
	}
}
/////////////////////////////////////////////////////////////////////////////
// CSheppardDoc diagnostics
#ifdef _DEBUG
void CSheppardDoc::AssertValid() const
{
	CDocument::AssertValid();
}
void CSheppardDoc::Dump(CDumpContext& dc) const
{
	CDocument::Dump(dc);
}
#endif //_DEBUG
/////////////////////////////////////////////////////////////////////////////
```

// CSheppardDoc commands

sheppardDoc.h

```
// sheppardDoc.h : interface of the CSheppardDoc class
//
/////////////////////////////////////////////////////////////////////////////
#if
!defined(AFX_SHEPPARDDOC_H__82A2236D_066E_11D4_941E_00C04F200EBC__INCLUDED_)
#define AFX_SHEPPARDDOC_H__82A2236D_066E_11D4_941E_00C04F200EBC__INCLUDED_
#if _MSC_VER > 1000
#pragma once
#endif // _MSC_VER > 1000
class CSheppardDoc : public CDocument
{
protected: // create from serialization only
	CSheppardDoc();
	DECLARE_DYNCREATE(CSheppardDoc)
// Attributes
public:
// Operations
public:
// Overrides
	// ClassWizard generated virtual function overrides
	//{{AFX_VIRTUAL(CSheppardDoc)
	public:
	virtual BOOL OnNewDocument();
	virtual void Serialize(CArchive& ar);
	//}}AFX_VIRTUAL
// Implementation
public:
	virtual ~CSheppardDoc();
#ifdef _DEBUG
	virtual void AssertValid() const;
	virtual void Dump(CDumpContext& dc) const;
#endif
protected:
// Generated message map functions
protected:
	//{{AFX_MSG(CSheppardDoc)
		// NOTE - the ClassWizard will add and remove member functions here.
		//    DO NOT EDIT what you see in these blocks of generated code !
	//}}AFX_MSG
	DECLARE_MESSAGE_MAP()
};
/////////////////////////////////////////////////////////////////////////////
//{{AFX_INSERT_LOCATION}}
// Microsoft Visual C++ will insert additional declarations immediately before the previous line.
#endif //
!defined(AFX_SHEPPARDDOC_H__82A2236D_066E_11D4_941E_00C04F200EBC__INCLUDED_)
```

sheppardView.cpp

```
// sheppardView.cpp : implementation of the CSheppardView class
//
#include "stdafx.h"
#include "sheppard.h"
```

```
#include "sheppardDoc.h"
#include "sheppardView.h"
#ifdef _DEBUG
#define new DEBUG_NEW
#undef THIS_FILE
static char THIS_FILE[] = __FILE__;
#endif
/////////////////////////////////////////////////////////////////////////////
// CSheppardView
IMPLEMENT_DYNCREATE(CSheppardView, CView)
BEGIN_MESSAGE_MAP(CSheppardView, CView)
	//{{AFX_MSG_MAP(CSheppardView)
		// NOTE - the ClassWizard will add and remove mapping macros here.
		//    DO NOT EDIT what you see in these blocks of generated code!
	//}}AFX_MSG_MAP
	// Standard printing commands
	ON_COMMAND(ID_FILE_PRINT, CView::OnFilePrint)
	ON_COMMAND(ID_FILE_PRINT_DIRECT, CView::OnFilePrint)
	ON_COMMAND(ID_FILE_PRINT_PREVIEW, CView::OnFilePrintPreview)
END_MESSAGE_MAP()
/////////////////////////////////////////////////////////////////////////////
// CSheppardView construction/destruction
CSheppardView::CSheppardView()
{
	// TODO: add construction code here
}
CSheppardView::~CSheppardView()
{
}
BOOL CSheppardView::PreCreateWindow(CREATESTRUCT& cs)
{
	// TODO: Modify the Window class or styles here by modifying
	//  the CREATESTRUCT cs
	return CView::PreCreateWindow(cs);
}
/////////////////////////////////////////////////////////////////////////////
// CSheppardView drawing
void CSheppardView::OnDraw(CDC* pDC)
{
	CSheppardDoc* pDoc = GetDocument();
	ASSERT_VALID(pDoc);
	// TODO: add draw code for native data here
}
/////////////////////////////////////////////////////////////////////////////
// CSheppardView printing
BOOL CSheppardView::OnPreparePrinting(CPrintInfo* pInfo)
{
	// default preparation
	return DoPreparePrinting(pInfo);
}
void CSheppardView::OnBeginPrinting(CDC* /*pDC*/, CPrintInfo* /*pInfo*/)
{
	// TODO: add extra initialization before printing
}
void CSheppardView::OnEndPrinting(CDC* /*pDC*/, CPrintInfo* /*pInfo*/)
{
```

```
	// TODO: add cleanup after printing
}
/////////////////////////////////////////////////////////////////////////////
// CSheppardView diagnostics
#ifdef _DEBUG
void CSheppardView::AssertValid() const
{
	CView::AssertValid();
}
void CSheppardView::Dump(CDumpContext& dc) const
{
	CView::Dump(dc);
}
CSheppardDoc* CSheppardView::GetDocument() // non-debug version is inline
{
	ASSERT(m_pDocument->IsKindOf(RUNTIME_CLASS(CSheppardDoc)));
	return (CSheppardDoc*)m_pDocument;
}
#endif //_DEBUG
/////////////////////////////////////////////////////////////////////////////
// CSheppardView message handlers
```

sheppardView.h

```
// sheppardView.h : interface of the CSheppardView class
//
/////////////////////////////////////////////////////////////////////////////
#if
!defined(AFX_SHEPPARDVIEW_H__82A2236F_066E_11D4_941E_00C04F200EBC__INCLUDED_)
#define AFX_SHEPPARDVIEW_H__82A2236F_066E_11D4_941E_00C04F200EBC__INCLUDED_
#if _MSC_VER > 1000
#pragma once
#endif // _MSC_VER > 1000
class CSheppardView : public CView
{
protected: // create from serialization only
	CSheppardView();
	DECLARE_DYNCREATE(CSheppardView)
// Attributes
public:
	CSheppardDoc* GetDocument();
// Operations
public:
// Overrides
	// ClassWizard generated virtual function overrides
	//{{AFX_VIRTUAL(CSheppardView)
	public:
	virtual void OnDraw(CDC* pDC); // overridden to draw this view
	virtual BOOL PreCreateWindow(CREATESTRUCT& cs);
	protected:
	virtual BOOL OnPreparePrinting(CPrintInfo* pInfo);
	virtual void OnBeginPrinting(CDC* pDC, CPrintInfo* pInfo);
	virtual void OnEndPrinting(CDC* pDC, CPrintInfo* pInfo);
	//}}AFX_VIRTUAL

// Implementation
public:
```

```
	virtual ~CSheppardView();
#ifdef _DEBUG
	virtual void AssertValid() const;
	virtual void Dump(CDumpContext& dc) const;
#endif
protected:
// Generated message map functions
protected:
	//{{AFX_MSG(CSheppardView)
		// NOTE - the ClassWizard will add and remove member functions here.
		//    DO NOT EDIT what you see in these blocks of generated code !
	//}}AFX_MSG
	DECLARE_MESSAGE_MAP()
};
#ifndef _DEBUG  // debug version in sheppardView.cpp
inline CSheppardDoc* CSheppardView::GetDocument()
  { return (CSheppardDoc*)m_pDocument; }
#endif
/////////////////////////////////////////////////////////////////////////////
//{{AFX_INSERT_LOCATION}}
// Microsoft Visual C++ will insert additional declarations immediately before the previous line.
#endif //
!defined(AFX_SHEPPARDVIEW_H__82A2236F_066E_11D4_941E_00C04F200EBC__INCLUDED_)
```

StdAfx.cpp

```
// stdafx.cpp : source file that includes just the standard includes
//	sheppard.pch will be the pre-compiled header
//	stdafx.obj will contain the pre-compiled type information
#include "stdafx.h"
```

StdAfx.h

```
// stdafx.h : include file for standard system include files,
//  or project specific include files that are used frequently, but
//      are changed infrequently
//
#if !defined(AFX_STDAFX_H__82A22367_066E_11D4_941E_00C04F200EBC__INCLUDED_)
#define AFX_STDAFX_H__82A22367_066E_11D4_941E_00C04F200EBC__INCLUDED_
#if _MSC_VER > 1000
#pragma once
#endif // _MSC_VER > 1000
#define VC_EXTRALEAN			// Exclude rarely-used stuff from Windows headers
#include <afxwin.h>	// MFC core and standard components
#include <afxext.h>	// MFC extensions
#include <afxdisp.h>	// MFC Automation classes
#include <afxdtctl.h>		// MFC support for Internet Explorer 4 Common Controls
#ifndef _AFX_NO_AFXCMN_SUPPORT
#include <afxcmn.h>			// MFC support for Windows Common Controls
#endif // _AFX_NO_AFXCMN_SUPPORT
//{{AFX_INSERT_LOCATION}}
// Microsoft Visual C++ will insert additional declarations immediately before the previous line.
#endif // !defined(AFX_STDAFX_H__82A22367_066E_11D4_941E_00C04F200EBC__INCLUDED_)
```

ValueCalculator.cpp

```
// ValueCalculator.cpp: implementation of the ValueCalculator class.
//
```

```
////////////////////////////////////////////////////////////////////
#include "stdafx.h"
#include "sheppard.h"
#include "ValueCalculator.h"
#ifdef _DEBUG
#undef THIS_FILE
static char THIS_FILE[]=__FILE__;
#define new DEBUG_NEW
#endif
////////////////////////////////////////////////////////////////////
// Construction/Destruction
////////////////////////////////////////////////////////////////////
#include <fstream.h>
#include "sheppard1.h"
extern ValueCalculator *pCalc;
ValueCalculator::ValueCalculator()
{CString msg;
 Point Pcurrent(3);
 FILE *ExpData=fopen("in.prn","r");
 FILE *TestFile=fopen("debug.txt","w");
 int LineNumber,
        FlowRateNumber=4,
        PressureNumber=2,
        QualityNumber=3,
        FluxNumber=1,
        DiameterNumber=5;
 DataSetNumber=0;
 bool NewDataSet=true;
 fgets(buf,500,ExpData);
 LineNumber=0;
 while (fgets(buf,500,ExpData)!=NULL)
 {if(NewDataSet)
  {DataSet[DataSetNumber]=new Sheppard(1000,3,2.0);
   NewDataSet=false;
  }
  if(strlen(buf) < 10)
  {NewDataSet=true;
   DataSetNumber++;if(DataSetNumber > 199) goto M100;
   fputs("New DataSet",TestFile);continue;
  }
  fputs(buf,TestFile);
 sscanf(buf,"%lg %lg %lg %lg %lg %lg %lg %lg %lg %lg %lg %lg %lg",BufArray,
        BufArray+1,BufArray+2,BufArray+3,BufArray+4,
        BufArray+5,BufArray+6,BufArray+7,BufArray+8,
        BufArray+9,BufArray+10,BufArray+11,BufArray+12);
  f=BufArray[FluxNumber];
  ParamArray[0]=BufArray[FlowRateNumber];
  ParamArray[1]=BufArray[PressureNumber];
  ParamArray[2]=BufArray[QualityNumber];
  ParamArray[3]=BufArray[DiameterNumber];
 ParamArray[0]=ParamArray[0]/400.0;
 ParamArray[2]=ParamArray[2]*20.0;
  DataSet[DataSetNumber]->Diameter=ParamArray[3];
if(LineNumber==0)
{PressureMin=PressureMax=ParamArray[1];
 FlowRateMin=FlowRateMax=ParamArray[0];
```

```
 QualityMin=QualityMax=ParamArray[2];
 DiameterMin=ParamArray[3];
}
else
{if(PressureMin>ParamArray[1]) PressureMin=ParamArray[1];
 if(PressureMax<ParamArray[1]) PressureMax=ParamArray[1];
 if(FlowRateMin>ParamArray[0]) FlowRateMin=ParamArray[0];
 if(FlowRateMax<ParamArray[0]) FlowRateMax=ParamArray[0];
 if(QualityMin>ParamArray[2]) QualityMin=ParamArray[2];
 if(QualityMax<ParamArray[2]) QualityMax=ParamArray[2];
 DiameterMax=ParamArray[3];
}
LineNumber++;
  Pcurrent.TakeValue(ParamArray[0],ParamArray[1],ParamArray[2]);
  DataSet[DataSetNumber]->AddPoint(Pcurrent,f);
 }
M100: fclose(TestFile);
pCalc=this;
    return;
}
const double Epsilon=1.0e-5;
FILE *MiddleF=fopen("middle.txt","w");
double ValueCalculator::Value(Point &A)
{double Diam,currentD,Value1,Value2,Result,r1,r2;
 Point Projection(3);
 Projection.TakeValue(A.X[0],A.X[1],A.X[2]);
 Diam=A.X[3];
 CString msg;
            if(Diam < DiameterMin) Diam=A.X[3]+Epsilon;A.X[3]=Diam;
            if(Diam > DiameterMax) Diam=A.X[3]-Epsilon;A.X[3]=Diam;;
            currentD=DiameterMin;
 int i,j;
 i=0;j=1;
 while(Diam > currentD)
  {currentD=DataSet[++i]->Diameter;
  j=i+1;
  if(i>=DataSetNumber) {msg.Format("bad i=%d",i);
                  i=DataSetNumber-1;j=i+1; goto MM;}
  }
 MM: if(Diam < DataSet[i]->Diameter) {i-=1;j-=1;}
 Value1=(*DataSet[i])(Projection);
 Value2=(*DataSet[j])(Projection);
 r2=DataSet[j]->Diameter-Diam;
 r1=Diam-DataSet[i]->Diameter;
 Result=r1*Value2/(r1+r2)+r2*Value1/(r1+r2);
 fprintf(MiddleF,"Diam=%lg i=%d j=%d  d1=%lg d2=%lg r1=%lg r2=%lg V1=%lg V2=%lg Res=%lg\n",
   Diam,i,j,DataSet[i]->Diameter,DataSet[j]->Diameter,r1,r2,Value1,Value2,Result);
 return Result;
}
ValueCalculator::~ValueCalculator()
{
}
```

ValueCalculator.h

```
// ValueCalculator.h: interface for the ValueCalculator class.
//
```

```
/////////////////////////////////////////////////////////////////////
#if
!defined(AFX_VALUECALCULATOR_H__074D14F4_A358_4BBD_A7F2_7537109021B1__INCLUD
ED_)
#define
AFX_VALUECALCULATOR_H__074D14F4_A358_4BBD_A7F2_7537109021B1__INCLUDED_
#if _MSC_VER > 1000
#pragma once
#endif // _MSC_VER > 1000
#include "sheppard1.h"
#include "point.h"
class ValueCalculator
{
public:
        ValueCalculator();
        virtual ~ValueCalculator();
  double PressureMin,PressureMax,
     FlowRateMin,FlowRateMax,
          QualityMin,QualityMax,
          DiameterMin,DiameterMax;
          int DataSetNumber;
 double s,f,BufArray[30],ParamArray[5];
 char buf[501];
 Sheppard *DataSet[200];
 double Value(Point &a);
};
#endif //
!defined(AFX_VALUECALCULATOR_H__074D14F4_A358_4BBD_A7F2_7537109021B1__INCLUD
ED_)
```