7-28-1994

A new parallel technique for the solution of sparse nonlinear equations

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DOI: 10.25148/etd.FI14060129

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FLORIDA INTERNATIONAL UNIVERSITY

Miami, Florida

A NEW PARALLEL TECHNIQUE FOR THE SOLUTION OF
SPARSE NONLINEAR EQUATIONS

A dissertation submitted in partial satisfaction of the

requirements for the degree of

DOCTOR OF PHILOSOPHY

in

COMPUTER SCIENCE

by

Maria Cereijo Martinez

1994

To: Dean Arthur W. Herriott
College of Arts and Sciences

This dissertation, written by Maria Cereijo Martinez, and titled A New Parallel Technique for the Solution of Sparse Nonlinear Equations, having been approved in respect to style and intellectual content, is referred to you for judgement.

We have read this dissertation and recommend that it be approved.

John Comfort

Nand Tripathi

Osama Mohammed

Gustavo Roig

David Barton, Major Professor

Date of Defense: July 28th, 1994

The dissertation of Maria Cereijo Martinez is approved.

Dean ~~Ar~~thur W. Herriott
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Dr. Richard L. Campbell
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Florida International University, 1994

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I dedicate this dissertation to my children Daniel, Stephanie, and Elizabeth.

ACKNOWLEDGMENTS

I would like to express my appreciation and gratitude to my committee for their help, guidance, and useful comments; To Dr. John Comfort for always being a part of my professional education, first as my mentor in Faculty Scholars and now participating in my guidance committee; To Dr. Osama Mohammed and Dr. Gustavo Roig for their participation and input to this project; To Dr. Nand Tripathi for teaching me about power systems and always willing to help and for providing the FPL data to test this project. A special thanks must go to my major professor, Dr. David Barton, for the advice, contribution, and dedication he has given me in this project.

I would like to give a special gratitude to my family for their love and support. To my parents I give my deepest appreciation; To my father for his confidence in me, his example, and his constant help; To my mother, whom I could not have done this without, I thank for always being there, and always willing to help especially with my children. To my husband I give a special thanks for without his encouragement, help and patience I would never have finished. Finally I would like to thank my children, for whom I dedicate this dissertation, for their love. I hope this will be an encouragement to them to always try their best at what they do.

ABSTRACT OF THE DISSERTATION

A NEW PARALLEL TECHNIQUE FOR THE SOLUTION OF SPARSE NONLINEAR EQUATIONS

by

Maria Cereijo Martinez

Florida International University, 1994

Professor David Barton, Major Professor

Solving nonlinear systems of equations is a central problem in numerical analysis, with enormous significance for science and engineering. A special case, sparse systems of equations, occurs frequently in various applications. Sparsity occurs in the analysis of many types of complex systems because of the local nature of the dependence or connectivity among system components.

One such system which may be modeled by a nonlinear sparse set of equations is the power system load flow analysis. This is a mathematical study performed by electrical utilities to monitor the electrical power system. The data from system components are used to create a set of nonlinear equations. These equations are then solved to find the voltage profile of the power network. With these data, control and security of the power system are achieved.

Solving problems of this type is very time consuming when the system is large. This dissertation proposes a highly parallel computer architecture for solving large sets of nonlinear sparse equations. The goal of this architecture is to reduce the processing time required to solve this type of problem. In particular, the load flow problem is analyzed and implemented on this architecture. For the FPL network, the speed is increased by a factor of about 2000.

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1 INTRODUCTION

The problem of solving a system of nonlinear equations is one that has been often studied in numerical analysis. As the size of the systems increases the manipulations become more complex, storage requirements increase, and the total time for solving the equations becomes extended. The problem becomes more complex when the equations are sparse, meaning that it is thinly populated, or in a matrix formulation where the number of non-zero elements are small as compared to zero terms. Several numerical techniques have been developed to optimize the solution of sparse systems of equations. The problem addressed in this research is the development of an original architecture with maximum parallelism for any such sparse system and the development of appropriate numerical procedures in the parallel environment.

The general form of a system of nonlinear equations is

$$\begin{aligned}f_1(x_1, x_2, \dots, x_n) &= 0, \\f_2(x_1, x_2, \dots, x_n) &= 0, \\&\vdots \\f_n(x_1, x_2, \dots, x_n) &= 0,\end{aligned}\tag{1.1}$$

where each function f_i maps n -dimensional space, R^n , into the real line R . A function, F , maps R^n into R^n by

$$F(x_1, x_2, \dots, x_n) = (f_1(x_1, x_2, \dots, x_n), f_2(x_1, x_2, \dots, x_n), \dots, f_n(x_1, x_2, \dots, x_n)). \tag{1.2}$$

Writing

$$x = (x_1, x_2, \dots, x_n), \tag{1.3}$$

we have

$$F(x) = 0. \tag{1.4}$$

In sparse systems, the derivative $\partial f_i/\partial x_j$ is zero for many of the pairs $i, j, (i = 1...n, j = 1...n)$. The connectivity, c_i , of each f_i is the number of non-zero values $\partial f_i/\partial x_j, j = 1...n$. For the systems under study the c_i are small. Interaction between variables can be thought of as local in nature. Thus, for a parallel implementation, the processors will need to communicate only with their nearest connections.

The system can be rewritten in the following way:

$$\begin{aligned}x_1 &= g_1(x_1, x_2, \dots, x_n), \\x_2 &= g_2(x_1, x_2, \dots, x_n), \\&\vdots \\x_n &= g_n(x_1, x_2, \dots, x_n),\end{aligned}\tag{1.5}$$

or

$$x = g(x).\tag{1.6}$$

1.1 Numerical Solutions

Fixed point iterative solutions can now be obtained to this problem [56]. A Gauss-Jacobi type solution is found by the iteration:

$$x_i^{m+1} = g_i(x_1^m, x_2^m, \dots, x_n^m).\tag{1.7}$$

Alternatively the Gauss-Seidel iteration :

$$x_i^{m+1} = g_i(x_i^{m+1}, \dots, x_{i-1}^{m+1}, x_i^m, \dots, x_n^m)\tag{1.8}$$

may be used. A more commonly used method is the Newton-Raphson Iteration which assures quadratic convergence but involves computing the inverse of the Jacobian matrix of partial derivatives at every step, making it more computationally intensive [24]. Suppose vector θ is the exact solution to equation 1.8, and the present approximation

x can be written $x = \theta + h$. Compute $f_i(x_i, \dots, x_n)$. and call the known values b_i . Hence

$$f_i(\theta_1 + h_1, \theta_2 + h_2, \dots, \theta_n + h_n) = b_i, \quad (1.9)$$

Taylor expansion yields

$$f_i(\theta_1, \theta_2, \dots, \theta_n) + \sum_{k=1}^n h_k (\partial f_i / \partial \theta_k) + (\text{higher order terms}) = b_i. \quad (1.10)$$

By definition the first term is zero. Neglecting higher order terms we get, $Jh = b$ and $h = J^{-1}b$, where $J_{ik} = \partial f_i / \partial x_k$ provided J is nonsingular. Thus an improved x is given by the iterative formula

$$x^{m+1} = x^m - J^{-1}f(x^m). \quad (1.11)$$

where J is the well known Jacobian matrix.

In Chapter 2 of this dissertation, a parallel software solution is designed that enables all of the f_i terms to be computed simultaneously in parallel. A Jacobi type algorithm is used to control the numerical programs as it preserves the sparse nature of the equations.

A parallel hardware design is given in Chapter 3. This parallel architecture is called PLF. The PLF architecture is based on a Multiple Instruction Multiple Data (MIMD) machine the INMOS Transputer.

In Chapter 4 a result of the simulations performed on the Transputer system is given.

1.2 Previous Work Done

Systems of sparse nonlinear equations have been analyzed by engineers and scientist for many years. Before computers were invented these problems had to be solved using primitive methods, such as pencil and paper. This limited the size of the problems

being solved and took a significant amount of time with a high level of error. The techniques used were ones such as the Jacobi and Gauss-Seidel methods.

With the invention of computers the techniques for solving these equations changed. Now larger problems could be solved and with a better degree of accuracy. The Newton-Raphson method was now the method most commonly used. To improve on the speed of solving these problems many techniques have been developed such as sparse matrix techniques [22]. The speedup achieved by these methods using sequential machines has reached its peak.

The development of parallel computer architectures has brought a possibility of improving the solution times for these problems. This will allow for larger problems to be solved at much faster rates. New techniques are now being used to solve these problems in parallel. Some of the methods involve using the Newton-Raphson method in parallel. This divides the system of equations into groups and solves each group separately in a different computer using the Newton-Raphson method [65, 60, 7]. Another technique is to try to find the steps that can be done in parallel while inverting the Jacobian matrix [73, 53]. Other approaches using relaxation techniques have been developed [29, 15, 14]. These techniques combine the Newton method with relaxation techniques, such as Jacobi, to increase the amount of parallelism exploited.

The aforementioned algorithms were tested mostly using vector computers, hypercube architectures [33], shared memory architectures, or on supercomputers. Some experiments have been done using transputers systems [13, 63]. All these methods have used architectures that use few processors. Most developments in parallel processing have been application specific.

In this research a massively parallel architecture is being developed to solve the set of sparse nonlinear equations. The algorithm used is based on the Jacobi method.

1.3 Application

The procedure, PLF, designed in the first three chapters can be applied to any system represented by sparse nonlinear equations and in this dissertation it is to the problem of power system load flow analysis. Chapter 5 examines the load flow analysis in detail.

The electrical power system is modeled in the computer using a technique called load flow analysis. This technique is also used to determine the security of the power network by studying the effects of outages or failures of system components. The load flow algorithm involves solving a large set of sparse nonlinear equations and is currently done on sequential computers using iterative methods. Conventional load flow analysis techniques employed to solve the power system model take too much time to run, thus the model employed does not adequately represent the power system network in fast enough time. Using a parallel algorithm and architecture, we are able to solve the power system load flow analysis in much shorter time, and thus obtain a more accurate representation of the power system.

An electrical power system consists of power stations, an electric power network, and distribution centers. The power stations are where the electricity is generated in bulk quantities. This electricity is transmitted over an electric power network to all the customers. The power network consists of transmission lines where the huge bulk of electric power moves on grids. This grid is divided into subnetworks to enable the electrical power to be delivered to the distribution network. The distribution network delivers the electric power to the customers.

An important requirement of the electrical utilities is the economic secure operation of its electrical power system. Such an objective requires the use of advanced systems analysis and control technologies, and uses very large complex hardware-software systems. It is incorporated into the security and control functions of the Energy Control Center (ECC) [17, 6].

A power system is in an emergency condition when its operational limits are violated [68]. The most severe and least predictable violations result from contingencies. Contingencies are disturbances in the power system such as transmission line critical outages, transformer outages, and generator outages. An important part of security revolves around the power systems ability to withstand the effects of contingencies. The probable results of certain outages are analyzed in real time using the current state of the power system by the ECC. To do this, the ECC calculates the current state of the system using a state estimation algorithm [64]. The effects of many contingencies are then tested using a power flow algorithm.

The load flow analysis is a technique that determines the state of the electric power network at a particular time. It uses real time information sent to the ECC and information stored in the database to build the network model. From this information, a set of nonlinear equations is developed and solved to determine the unknown information of the system. The most common numerical methods used are the Gauss-Seidel, the Newton-Raphson Iteration, and the Fast Decoupled Load Flow. [67].

As utilities expand, the number of power system components increases as well as the number of contingencies being tested. This creates a problem in terms of computing time. The latter part of this dissertation explains the power flow problem and its inherent parallelism and shows how the parallel architecture and algorithm developed here can be applied to speed up the solution of the problem.

In Chapter 6 of this dissertation a performance evaluation of the load flow analysis, as solved by the PLF system, is given.

2 PARALLEL SOFTWARE SOLUTION

The need for fast solutions of very large computational problems has led to the study of parallel algorithms. Technological advances have raised the possibility of massively parallel computation. Parallel techniques make possible different numerical procedures for solutions of certain problems. Some issues that were of great importance in solving numerical algorithms sequentially become irrelevant when they are solved in parallel.

There are other issues relating to the parallelization of algorithms that must be resolved. There is the need for task allocation, for the breakdown of total workload into smaller tasks, and for the sequencing of the tasks that are interdependent. There are also communication issues such as the communication of interim computations, carrying out communication efficiently, and estimating the impact on performance. Lastly there is the issue of synchronization of computations on different processors, these can be implemented either synchronously or asynchronously.

This chapter is concerned with the software solution of the problem of solving sparse nonlinear equations. In Section 2.1 this statement of the problem is given mathematically. The different numerical solutions for this problem are discussed in Section 2.2. The design of the parallel solution for solving the sparse nonlinear equations is given in Section 2.3.

2.1 Statement of Problem

The general mathematical problems being studied here are those which are represented by sets of nonlinear algebraic equations. Many physical systems such as transportation and electrical machines can be modeled by nonlinear equations. In particular, a subclass of these problems is that of sparse systems. Sparse systems are very important in the study of many different areas of science and engineering.

2.1.1 Nonlinear Equations

The general form of a system of nonlinear equations is:

$$\begin{aligned}f_1(x_1, x_2, \dots, x_n) &= 0, \\f_2(x_1, x_2, \dots, x_n) &= 0, \\&\vdots \\f_n(x_1, x_2, \dots, x_n) &= 0,\end{aligned}\tag{2.12}$$

where each function maps n -dimensional space R^n , into the real line R . The system can be represented by a function F mapping R^n into R^n by

$$F(x_1, x_2, \dots, x_n) = (f_1(x_1, \dots, x_n), \dots, f_n(x_1, \dots, x_n)),\tag{2.13}$$

where

$$x = (x_1, x_2, \dots, x_n).\tag{2.14}$$

So the equation becomes $F(x) = 0$.

A nonlinear system of the form $F(x) = 0$ can be transformed into an equivalent fixed point problem $G(x) = x$. That is

$$\begin{aligned}x_1 &= g_1(x_1, x_2, \dots, x_n), \\x_2 &= g_2(x_1, x_2, \dots, x_n), \\&\vdots \\x_n &= g_n(x_1, x_2, \dots, x_n).\end{aligned}\tag{2.15}$$

2.1.2 Sparsity

For a system to be sparse, thinly populated, the interaction between variables must be small compared to the size of the system. Using the nonlinear equations of 2.12, sparsity means that many of the $\partial f_i / \partial x_j$ are zero. Many types of systems are sparse, because of the local nature or connectivity that occurs among system components.

Some important areas that involve the solution of sparse nonlinear equations are partial differential equations, vibration analysis of structures, and control theory. An application of which is the power system loadflow analysis that is used in this dissertation.

2.2 Numerical Solutions

2.2.1 Jacobi Method

To solve the above type of equation an iterative fixed point process is applied to G [24]. To do this, we select $x^{(0)} = (x_1^{(0)}, \dots, x_n^{(0)})$, and generate the sequence of vectors $x^{(k)} = (x_1^{(k)}, \dots, x_n^{(k)})$ by

$$x^{(k)} = G(x^{(k-1)}) \text{ for each } k = 1, 2, \dots, t. \quad (2.16)$$

Component wise:

$$\begin{aligned} x_1^{(k)} &= g_1(x_1^{(k-1)}, \dots, x_n^{(k-1)}), \\ x_2^{(k)} &= g_2(x_1^{(k-1)}, \dots, x_n^{(k-1)}), \\ &\vdots \\ x_n^{(k)} &= g_n(x_1^{(k-1)}, \dots, x_n^{(k-1)}). \end{aligned} \quad (2.17)$$

If the sequence $x^{(k)}$ generated converges to x^* and G is continuous, then x^* is a fixed point of G and $x^* = G(x^*)$.

2.2.2 Gauss-Seidel Method

One possible way of improving the rate of convergence is to use the latest estimates $x_1^{(k)}, \dots, x_{i-1}^{(k)}$ to compute $x_i^{(k)}$ and is called the Gauss-Seidel method [25]. The general formula then becomes:

$$x_i^{(k+1)} = g_i(x_1^{(k+1)}, \dots, x_{i-1}^{(k+1)}, x_i^{(k)}, \dots, x_n^{(k)}) \quad (2.18)$$

This generally works better than Jacobi for sequential systems because newer estimates are used. There are systems for which the Jacobi method converges better than the Gauss-Seidel [76].

2.2.3 Newton-Raphson Iteration

Another method for solving the non-linear sets of equations $f_i(x_1, x_2, \dots, x_n) = 0$ for $i = 1, \dots, n$ is Newton-Raphson Iteration [8]. Suppose that a vector α is the exact solution to the system and that the present approximation x can be written $\alpha = x + h$. Taylor series expansion yields

$$f_i(x_1, x_2, \dots, x_n) + \sum h_k(\partial f_i / \partial x_j) + (\text{higher order terms}) = 0, \quad (2.19)$$

or

$$f_i(\alpha_1, \alpha_2, \dots, \alpha_n) = 0 \quad (2.20)$$

Neglecting the higher order terms we get, $Jh = -f$ and $h = -J^{-1}f$. J is the Jacobian which is obtained by taking the gradients of the different components, $J_{ij} = \partial f_i / \partial x_j$ and we assume J is nonsingular. The exact solution is obtained with the iterative formula

$$x^{k+1} = x^k - J^{-1}f(x^k). \quad (2.21)$$

This method assures quadratic convergence and yields a smaller number of iterations. The drawback is in finding the derivatives and that it involves the inverse of a matrix at every iteration step, thus becoming computationally far more intensive than the Gauss-Seidel or the Jacobi methods.

2.2.4 Other Methods

There are modifications to the above methods that can be used to solve a set of non-linear equations. The successive overrelaxation method, SOR, can be applied to the

Jacobi or Gauss-Seidel to improve the convergence rate [79]. At each iteration of the solution of x_i^{k+1} by the Jacobi or the Gauss-Seidel a new value is calculated by

$$x_i^{k+1} = x_i^k + w(x_i^{k+1} - x_i^k). \quad (2.22)$$

This w is known as an acceleration factor. Studies show that w must lie in the range $0 < w < 2$ for convergence [79]. The PLF algorithm developed here is based on a parallel Jacobi Successive Overrelaxation method.

The Newton-SOR method is another possibility [8]. It is Newton's method as primary iteration and the SOR as secondary iteration. This takes away the quadratic convergence of Newton-Raphson Iteration and is consequentially numerically intensive.

An incomplete Choleski-conjugate gradient algorithm is given in [1] to solve large sparse sets of simultaneous equations. It is used in the Newton-Raphson method when the Jacobian is symmetric. This improves on the computing time of the classical Newton-Raphson method.

2.2.5 Application to Sparse Systems

Although Newton's method is theoretically attractive, it may be difficult to use in practice for this formulation. For problems arising from partial differential equations and in control theory, in which the dimensions of the system may be thousands, this is a difficult task. Moreover, at each step, not only the n components of $f(x^k)$ but also the n^2 entries of $\partial f_i / \partial x_j$ are needed. Unless the partial derivatives $\partial f_i / \partial x_j$ have a simple functional form, it may be desirable to avoid their computation altogether.

The Jacobi method involves simple operations at each iteration but is very slow on sequential computers. This is eliminated in a parallel computer owing to the fact that all equations can be solved simultaneously. By using an acceleration factor, the number of iterations can be reduced one or two orders of magnitude compared to the Gauss-Seidel method [25]. In our case it reduced the number of iterations by a factor of two.

2.2.6 Convergence of Algorithm

Let the maximum norm, $\|A\|_\infty$, of a matrix A , be defined as $\max_i \sum_k |a_{ik}|$ where $A = (a_{ik})$. The Jacobi method converges for an initial sufficiently good approximation when $\|A\|_\infty < 1$ where $a_{ij} = \sup_x |\partial g_i / \partial x_j|$. [24].

In [79] the Jacobi method is proved to converge if A is irreducible and has weak diagonal dominance. Weak diagonal dominance is defined for $A = (a_{ik})$ as

$$|a_{ii}| \geq \sum_{j \neq i} |a_{ij}| \text{ for all } i, \quad (2.23)$$

and for at least one i

$$|a_{ii}| > \sum_j |a_{ij}|. \quad (2.24)$$

An irreducible matrix is a matrix $A = (a_{ik})$ of order N where $N = 1$ or if $N > 1$ then, given any two nonempty disjoint subsets S and T of W , where $W=1,2,\dots,N$, such that $S+T=W$, there exists $i \in S$ and $j \in T$ such that $a_{ik} \neq 0$.

The convergence of the Successive Overrelaxation method is proved in [79]. Writing the SOR method in matrix form

$$u^{n+1} = w(Lu^{n+1} + Uu^n + c) + (1 - w)u^n \quad (2.25)$$

$$u^{n+1} = Bu^n + (I - wL)^{-1}wc \quad (2.26)$$

where

$$B = (I - wL)^{-1}(wU + (1 - w)I). \quad (2.27)$$

Let $S(B)$ be the spectral radius of B . $S(B)$ is $|\lambda_1|$, where λ_1 is an eigenvalue of B with greatest absolute value. If $S(B) \leq 1$, then $0 \leq w \leq 2$. For convergence w must lie between 0 and 2.

2.3 PLF Iterative Solution

The solution of sets of sparse nonlinear equations will be performed on a specially designed parallel system PLF. A parallel Jacobi successive overrelaxation method

is implemented to run on this parallel hardware. This is called the PLF software solution. The next sections discuss this algorithm.

2.3.1 Graph Representation

A Directed Acyclic Graph (DAG) can be used to represent a parallel algorithm. This is a graph that has no positive cycles, that is no cycle consisting of only forward arcs [59]. Let $G = (N, A)$ be a DAG where N is the set of n nodes and A is the set of directed arcs $arc(i, j) \in A$. An arc (i, j) represents an operation corresponding to node j which uses results of the operation corresponding to node i . $i \in N$ is said to be a predecessor of node $j \in N$. The following are definitions used in creating a DAG:

- in-degree of i is number of predecessors of i
- out-degree of i is the number of nodes for which i is the predecessor
- input nodes are those nodes with in-degree zero
- output nodes are those nodes with out-degree zero
- positive path sequence $i_0, \dots, i_K$ of nodes such that $(i_k, i_{k+1}) \in A$ for $k = 0, \dots, K-1$ and the length of the path is K
- depth, D , of a DAG is the largest length of the positive paths

Let the result of the operation at node i be x_i . Functional dependencies are represented as follows:

$$x_i = f_i(x_j \mid j \text{ is a predecessor of } i) \quad (2.28)$$

when f_i is a function describing the operation of i th node. P_i is the processor assigned the responsibility of performing the corresponding operation.

The time that the operation is completed at node i is specified by a positive integer t_i . A processor can perform one operation at a time. That is if $i, j \in N, i \neq j$

and $t_i = t_j$ then $P_i \neq P_j$. Thus if two different nodes complete an operation at the same time then they are assigned different processors. If $(i, j) \in A$ then $t_j \geq t_i + 1$, that is an operation at j can only start after node i has finished. If the transmission of a message requires τ time then $t_j \geq t_i + \tau + 1$. From this a scheduled DAG for parallel execution is defined as

$$(i, P_i, t_i) \mid i \in N. \quad (2.29)$$

2.3.2 Description of Algorithm

The iterative algorithm $x = G(x)$ can be parallelized by letting each of n processors update a different component of x . At the k th stage the i th processor knows the value of $x_j^{(k)}$ on which g_i depends. It computes $x_i^{(k+1)}$ and communicates it to the other nodes.

A dependency graph is defined as a Directed Acyclic Graph, $G=(N,A)$, where a set of nodes N correspond to components of x . For nodes i and j let (i,j) be an arc of the dependency graph if and only if g_j depends on x_i , that is processor i needs to communicate the values of $x_i^{(k)}$ to processor j .

Assume iterations to be carried out for $t = 1, 2, \dots, T$ where T is some positive integer. Let us assign a parallel DAG to be an unfolding in time. Nodes are renamed $[i, t]$ where $i \in N$ and t is the iteration count. Arcs are of the form $([i, t], [j, t + 1]) \in A$. The parallel DAG for this algorithm is given in the Figure 1.

One node of the above graph represents one equation of each iteration. The in-degree of node i is the number of unknowns for that equation. The out-degree for a node is the number of nodes that have it as an unknown. Each out going arc represents the newly calculated value.

g_{ij} = equation set for node ij
 i = equation number
 j = iteration #
 n = max number of equations
 k = max number of iterations

Figure 1: Diagram for PLF

2.3.3 Time Complexity

Let $G = (N, A)$ be a DAG for a parallel algorithm. Let

$$(i, P_i, t_i) \mid i \in N$$

be a schedule. The time spent by a schedule is $\max_{i \in N} t_i$. If p is the number of processors used, the minimum of $\max_{i \in N} t_i$ taken over all possible schedules that use p processors is called the time complexity of G and is written T_p .

$$T_\infty = \min_{p \geq 1} T_p \quad (2.30)$$

T_p is a nonincreasing function of p bounded below by zero. The minimum number such that $T_p = T_\infty$ for all $p \geq p^*$ is p^* . Thus T_1 is the time needed for serial execution and T_∞ is equal to the depth of the DAG.

For the system PLF the number of processors, p , is equal to a number of sets of equations, n . The time spent on the schedule will depend on the speed of the slowest processor p_i . This is explained as follows. Each processor will do calculations and then output the results. It then reads in the values of the results of the processor it is dependent on. It will not proceed to evaluate its equations until it has received all the new values.

2.3.4 Speedup and Efficiency

Let $T_p(n)$ be termination time for problem size n and p processors. Let $T^*(n)$ be the optimal serial time to solve the problem. The speedup or speed advantage of a parallel algorithm is given by

$$S_p(n) = \frac{T^*(n)}{T_p(n)}. \quad (2.31)$$

The fraction of time a processor is employed or its efficiency is given by:

$$E_p(n) = \frac{S_p(n)}{p} = \frac{T^*(n)}{pT_p(n)}. \quad (2.32)$$

Ideally $S_p(n) = p$ and $E_p(n) = 1$.

2.3.5 Synchronization

It is necessary to coordinate the activities of different processors in any parallel algorithm. This can be done in two ways, synchronously or asynchronously.

The algorithm is synchronous if it is mathematically equivalent to one for which the times of computation, message transmission, and message reception are fixed and given beforehand. Synchronization is performed by dividing the algorithm into phases. During each phase, every processor performs some computation that depends on the results of computations of other processors in previous phases. In order to implement a synchronous algorithm in an inherently asynchronous system, a synchronization mechanism is needed. An algorithm that is superimposed on the original and by which every processor can detect the end of the phase is called a synchronizer. Synchronizers can either be local or global.

In global synchronization, the idea is to let each processor detect when all messages sent during a phase have been received and then start doing the computation of the next phase. Since there is no global clock, this is done through the use of timeouts or phase termination messages. With timeouts, the processors measure the length of any time interval by using a local clock. A phase termination is indicated when a processor sends to every other processor a message signaling that it has received all of its messages.

The main concept in local synchronization is that once a processor knows which message to expect at the end of each phase, then it starts a new phase after having received all these messages.

For asynchronous algorithms, the concept of phases is not used, and the coordination of processors is less strict. An asynchronous algorithm is one in which the times for computation, message transmission, and message reception can vary widely in different executions of the algorithm. The local algorithms do not wait for predetermined data to become available, but keep on computing trying to solve the problem

with whatever data are available.

In our problem, we have an n -processor system and an n -dimensional fixed point problem, that is, we want to find a vector $x = (x_1, x_2, \dots, x_n)$. that satisfies:

$$x_i = g_i(x_1, x_2, \dots, x_n) \text{ for } i=1,2,\dots,n \quad (2.33)$$

where f_i are given functions of n variables. Each processor P_i will update the variable x_i according to the above equation, starting from a set of initial values for variables. A local synchronous implementation of this problem is one in which a processor, P_i , does not carry out its k th update without first receiving the results of the $(k-1)$ updates from the processors whose variables appear in the function f_i . In an asynchronous implementation of this algorithm, what is required is that the k th update at processor i is carried out with knowledge of the results of some past update of every other processor, not necessarily the most recent update.

The PLF software system that has been developed uses the local synchronous implementation.

2.3.6 Termination of Algorithm

To terminate the PLF system a stopping algorithm is needed. This algorithm is described as follows. All the nodes of the system are connected in a spanning tree. Each node knows its parent, its children, if it is leaf or if it is the root. If a node is a leaf it will check to see if it has converged and send the appropriate message to its parent. The message is a one if it has converged, and zero if it has not. When a parent has received a one bit from all its children it checks to see if it has converged. If it has converged then a one is sent up the tree to its parent. This process continues up the tree on every iteration. When the root receives a one from all its children, it continues to receive for the height of the spanning tree. If it has received a one for each iteration for the height of the spanning tree then the system has converged. It then proceeds to send a STOP message to all its children. When a node receives a

STOP message it sends it down to its children and stops calculating. In Appendix A an algorithm is given to do this.

Each node in the system will run this algorithm. When the root node receives all ones from each of the children for the height of the tree then there is convergence. The root then initiates the STOP message down the tree.

3 PARALLEL HARDWARE SOLUTION

A massively parallel architecture has been developed to reduce the solution time for solving large sets of nonlinear sparse equations. The system, called PLF, consist of many thousands of powerful processors. One or more processors are coupled to form a processor unit. These processor units are linked by a communications network. The systems that can be modeled by this architecture are systems of sparse nonlinear equations, e.g. power system load flow analysis, and the equations of computational fluid dynamics and weather predications. The main processor used for this architecture is the INMOS T800 Transputer. The transputer is a 32-bit processor with 7.5 to 10 million instructions per second (MIPS) processing speed. Each transputer has four bidirectional serial communication links which can be used to communicate with other processors or controllers. Each link has a speed of up to 20 Megabits/second.

3.1 General Design Considerations

3.1.1 Computing Power

Computing power can be crudely measured by million instructions per second (MIPS). The effective computing power when a parallel machine is used to solve a problem largely depends on the parallelism and granularity of the algorithm employed and how well that matches the parallel machine. There is a design criterion on how much computing power each individual processor of the parallel machine should have. When each individual processor has small computation power, efficient use will require that the system have a potentially large number of processors or high parallelism. If the processors are too small, and the problem to be solved has large sequential sub tasks, then the performance will be low. For our problems, the processors must be powerful enough to handle floating point arithmetic efficiently. As many processors are required as sets of equations (2048) in the sparse system.

3.1.2 Loosely Coupled vs. Tightly Coupled Systems

Processes in loosely coupled multiprocessor systems communicate by exchanging messages. In tightly coupled systems, processors communicate through a shared main memory. In loosely coupled systems, processors communicate through message passing, and use their local memories to store results. If a processor is to access data in another processor's memory, it must send a message through the communication subsystem requesting the other processor to send these data.

Our design is a loosely coupled system. It consist of processors with large local memories in which they store their instructions and data. Processes that execute on different processor modules communicate by exchanging messages through a message transfer system. In our case, the message transfer system is a multistage network of switches. Loosely coupled systems are most efficient when interactions between tasks are minimal. In our application we have minimal interaction between processors.

3.1.3 Input/Output Considerations

When designing loosely coupled parallel systems, the input/output bandwidth for communication, internal and external, may become a bottleneck for the performance of the entire system.

Let PE be a processing element or processor. Let C be defined as computational bandwidth, the number of operations per second delivered by the PE. IO is input/output bandwidth, the number of words per second that the PE can communicate with the external environment. Let M be size of local memory, the number of words of local memory. A PE is said to be balanced in carrying out a computation if the I/O time equals the computation time.

Let TC represent the number of operations a PE must perform for a given computation and TIO the number of words the PE must exchange with the outside world. Then the required computation and I/O times are TC/C and TIO/IO respectively.

Therefore the PE is balanced for the given computation if and only if:

$$\frac{TC}{C} = \frac{TIO}{IO}. \quad (3.34)$$

For the application being studied less than 100 bytes of local memory is needed to keep intermediary results used in the computation.

3.2 Communications Subsystem

The communications subsystem linking processors, memories, and I/O controllers in a parallel processing system is one of its most important architectural features, and has a profound impact on system capabilities, performance, size, and cost. There are two basic architectural alternatives for the communications subsystem, the single bus and the network.

3.2.1 Bus Connected Systems

A high-bandwidth communications bus provides a satisfactory communication subsystem if each processor has its own cache memory and if the number of processors is no more than 50 [12], assuming present bus and memory technologies. For larger numbers of processors the bus bottleneck is eliminated by using a communications network instead of the bus to provide the desired connectivity and performance. In general, an interconnection network that will provide the desired connectivity and performance at minimum cost is required for communications in a parallel processing system with large numbers of processors.

The two basic types of interconnection networks for parallel processing systems are shared path networks and switching networks. The shared path network consists of a communication path that may be used by more than one pair of processors to exchange information. This shared path can be called a bus. The simplest such system is a single bus system.

To improve the performance of single bus system, buses can be used hierarchically in a parallel arrangement as in the C_m^* [18] system. This is a Multiple Instruction Multiple Data (MIMD) system designed at Carnegie Mellon University that is composed of a large number of computer modules grouped into clusters and connected by a hierarchy of buses. Mathematical and simulation model analysis have shown that this system has the limitations inherent in shared communications path system which make them unsuitable for massive parallelism.

3.2.2 Switching Networks

A network providing a separate path between any two system components at all times is a crossbar network. The hardware required to implement the switch is complex. The crossbar switch provides the highest performance, but is not effective for a large multiprocessor system because of its cost and its complexity.

A single stage interconnection network can be used to solve the problem of providing fast, reliable and efficient communications at a reasonable cost in large parallel processing systems. In a single stage interconnection, network data may have to be passed through the switches several times before reaching its final destination. The data will travel through a few nodes before reaching the final one. The single stage network can be viewed as an interconnected set of N input units and N output units. The way the input units are connected to the output units determines the functional characteristics of the network. There are different ways to do this that form the basis of most interconnection networks that have been proposed. A few of these are the mesh, the cube, the shuffle-exchange networks. Information on these networks can be found in [18, 51]. An example of these networks is shown in Figure 2.

The mesh network consist of $N = n^2$ nodes, each connected to four neighbours. The input unit i will be connected to output units $i+1$, $i-1$, $i+n$, $i-n$, (modulo N).

The cube network is defined by $m = \log_2 N$ interconnections. The connectivity of

Mesh Network N=16

Three-Dimensional Binary Cube

Shuffle-Exchange Network N=8

Figure 2: Single Stage Networks

this network can be represented by an m dimensional cube whose corners represent the system component addresses. The interconnections can be written as a function of the binary representation of the system component addresses. Let b' be the complement of bit b .

$$C_i(b_{m-1}b_{m-2}\dots b_{i+1}b_ib_{i-1}\dots b_1b_0) = b_{m-1}\dots b'_i\dots b_0 \quad (3.35)$$

Neighbor addresses differ in only one bit position.

The shuffle-exchange network consist of a shuffle function and an exchange function. The shuffle function is equivalent to intermixing two halves of a deck of cards.

$$S(b_{m-1}b_{m-2}\dots b_1b_0) = b_{m-2}b_{m-3}\dots b_1b_0b_{m-1} \quad (3.36)$$

The exchange function connects each system component to the component whose address differs from it in the low order bit position.

$$E(b_{m-1}b_{m-2}\dots b_1b_0) = b_{m-1}b_{m-2}\dots b_1b'_0 \quad (3.37)$$

Another way to solve the problem of fast reliable communication at an acceptable cost is to use multistage networks. In a multistage network, one pass of the multiple stages of switches is usually enough. Multistage interconnection networks are built from stages of the basic single stage networks.

In the design of PLF, a multistage network is used. The stages consist of crossbar switch combinations. This switch network chosen is non-blocking, to allow all nodes to communicate simultaneously. It is built using the INMOS C004. The C004 is a programmable link switch designed to provide a full crossbar switch between 32 link inputs and 32 link outputs. The design of this network is discussed in another section.

3.2.3 Network Control

The network control structure is implemented by switching algorithms that generate the control settings on the switching elements to ensure reliable data routings from

source to destination. It is also implemented by the communications protocols involved in the link control procedures that provide the handshaking process among switching points.

A network can be operated in circuit or packet switching mode. In circuit switching mode, once a path is established, the interchanges in the path remain in their specified states until the path is released. Thus a complete circuit is established from input to output for that path. Once a path is established, the only delay in the network is propagation delay. This is desirable when large blocks of data must be transferred, and when conflict-free connections that change infrequently can be set up. In the packet switching mode, a packet moves from stage to stage, releasing links and interchange paths immediately after using them. This involves overhead for routing, and setting switches, and waiting time delay in buffers at each stage. This is desirable when the communications among system components involve short messages, and when the paths through the network change frequently. Our network will use circuit switching, since, in our problem, the circuit does not change frequently once it is set up.

3.3 Review of Possible Parallel Architectures

Four types of parallel architectures were considered to be used for solving a set of sparse nonlinear equations in parallel.

- Pipeline processors,
- Single Instruction Multiple Data (SIMD) Machines,
- Multiple Instruction Multiple Data (MIMD) Machines,
- Dataflow Machines.

A pipelined processor is a processor with pipelined arithmetic units, whose operands can be input in a streamed fashion as into a pipe. Typical computers relying on

pipelining for their speed are the C-MP CRAY and CDC CYBER. The Connection Machine [10], is a Single Instruction Multiple Data (SIMD) computers consist of many identical processors doing the same calculation on different sets of data at the same time. The INMOS Transputer and Dataflow Machine are Multiple Data Multiple Instruction (MIMD) computers that perform separate calculations on different sets of data in parallel. Dataflow machines are a different form of parallel processing where data sets are processed in parallel if they are not dependent on each other .

3.3.1 Pipeline Computers

One such computer is the supercomputer (i.e. CDC Cyber). A few supercomputers can be connected in such a way that different equations can be run on each for different sections of the system [65, 78]. These methods reduce the network of equations into many smaller decoupled subnetworks. Each computer would then solve a section of the problem separately and in parallel. Once each computer has finished solving the results are joined and the necessary adjustments made. Presently most numerical problems are solved using these supercomputers.

3.3.2 SIMD Machines

A class of computer considered were the Single Instruction Multiple Data (SIMD) machines. These computers perform an instruction on a set of data in parallel. The SIMD computer that was considered to be used was Thinking Machine Corporation's the Connection Machine.

The Connection Machine system from Thinking Machine Corporation implements data level parallelism. It combines a large number of processors with the communications capability necessary to match data topologies. The Connection Machine executes instructions that operate on a whole set of data elements at once [10].

The Connection Machine operates by receiving instructions from the front end

computer. A microcontroller receives the instructions, expands them to machine instructions, and broadcasts them one at a time to all processors. It can include up to 65,536 physical processors and can be configured to an even larger number of logical processors. Each physical processor has 4096 bits of memory, which can total up to 32 megabytes for the entire machine.

The simplest form of communication between the processors is between nearest neighbors. Each processor is wired to the north, east, west, and south neighbors by a communications network called the NEWS grid. Information is passed one bit at a time. General intercommunication and dynamic reconfiguration is performed by the router. Full messages can be sent from any processor to any other and can be any length. Each of the 65,536 physical processors is connected to 16 other physical processors in a 16-dimension hypercube. This provides large numbers of direct paths to distant parts of the system.

The Connection Machine can have a floating point accelerator. It can operate on single precision (32 bit) or double precision(64 bit) floating point numbers. It supports IEEE standard floating-point formats and operations [11].

This machine is not suitable for our application because it performs the same operation on different data sets and our application requires different operations on data sets.

3.3.3 MIMD Machines

The computer used to develop the architecture for the present problem is the INMOS Transputer [39, 37, 36]. It is used to build an architecture that is Multiple Data Multiple Instruction (MIMD) type. This means that different instructions are working on different data at the same time independent of each other.

The transputer is a microcomputer with its own local memory and four links for connecting one transputer to another. The transputer is programmed to implement

a set of concurrent processes. A resident operating system shares the processor time among the concurrent processes and performs interprocess communication.

The transputer can be programmed in most high level languages. To gain the most benefit from the transputer architecture, the whole system is programmed in the parallel language Occam. Occam provides all the advantages of a high level language, the maximum program efficiency and the ability to use the special features of the transputer.

The transputer system uses point to point communication links. Every transputer has four standard links that can be connected to a link of any other transputer. This allows for networks of almost any size and topology to be constructed. The links for the IMS T808 transputer are standard, full duplex, serial links that provide concurrent message passing capability to other transputer devices at up to 20 Mbits/sec. The IMST808 processor does floating point arithmetic.

Each INMOS link provides two channels, one in each direction. Communication via any link may occur concurrently with that on other links and program execution. Synchronization of processes at each link is handled by the operating system. Each link consists of a serial input and serial output that can carry both data and link information. A message is transmitted as a series of bytes. The sending transputer waits for an acknowledgement, signifying that the receiving transputer is ready to receive another byte. The receiving transputer transmits an acknowledgement as soon as it starts to receive a data byte, so that transmission can be continuous. This protocol synchronizes the communication of each byte of data, ensuring that slow and fast transputers can communicate.

Each transputer in a system uses its own local memory. This memory consist of 2K bytes and supports multiport access for the processor and each of the four links. Memory bandwidth is proportional to the number of transputers in the system.

3.3.4 Dataflow Architecture

The concept of dataflow architectures come from dataflow graphs [4, 69, 16]. A dataflow graph is a directed graph in which the nodes represent primitive functions and the arcs represent data dependencies between functions. Dataflow architectures are language based architectures in which dataflow program graphs are the base language.

A dataflow program graph is made up of operators called actors connected by arcs that are used to show how data is moved. An actor has input and output arcs that move tokens from one actor to another. When a token is present on an input arc and there is no token on any of the output arcs the actor is enabled or fired. This means taking one token from each input arc, doing the specified operation and placing tokens labeled with the result value on the output arcs.

Two different approaches have been studied for the dataflow model: static dataflow and dynamic or tagged-token dataflow. The static dataflow provides a fixed amount of storage per arc. The dynamic dataflow provides dynamic allocation of token storage out of a common pool and requires that tokens carry tags to indicate their logical position in the arcs.

This system was not used in our implementation of the problem because of its lack of a dynamic switching network that needs to be updated with every new problem. The Dataflow Machine was not appropriate, to this problem, but the idea of token passing is very similar to the design of the PLF system.

3.4 PLF Architecture

PLF is the parallel architecture developed by the author for the solution of sparse nonlinear equations. PLF is a high level MIMD (Multiple Instruction Stream and Multiple Data Stream) system with distributed memory. It is an asynchronous multi-processor system composed of n nodes, each with its own memory, that communicate

via a circuit switched communications network. It is divided into three parts (as seen in Figure 3). They are the Control Unit (CU), the Processing Units (PUs), and the Switching Network (SN). The Control Unit consist of a Sun Computer with a Transputer residing in it. The Control Unit performs the initialization of the Switching Network and the setting up of the switch. A Processing Unit consist of at most three Transputers that have up to eight connections to the Switching Network. This allows us to represent equations with eight unknowns or equations that have a connectivity of eight (i.e. eight receiving and eight sending messages). The Processing Unit does the processing for a small set of equations and connects to the Switching Network. The Switching Network handles communication with the other Processing Units. It is a circuit switching, multistage network.

The goal of this architecture is to model any set of sparse nonlinear equations with connectivity of eight or less. It provides a uniform parallel environment so that communication between any two processors is similar to that between any others. Therefore, the network topology is transparent to the application processes and can handle any set of such equations.

The communication links between any two processors will represent the connectivity of the equations in the system. This is accomplished by the Switching Network. This network will consist of thousands of switching units. It consists of a circuit switching network that, once it has been set up, is not changed for the duration of the calculations.

When in use, there is an initialization phase for the system, performed by the Control Unit, that consists of three steps. The first step is the configuration of the system or assigning to PU_j , a particular set of equations s_j . The second step is to load the code to the Processing Units for each equation set. Finally the last step is to establish connection through the switch to the other Processing Units.

The Processing Unit is responsible for solving the equations assigned to it, and

Figure 3: PLF System Overview

communicating its data and status via the Switching Network simultaneously with other Processing Units.

3.4.1 Control Unit

The Control Unit consist of an INMOS T800 Transputer connected to five INMOS C004s. The C004 is a programable crossbar switch with 32 inputs and 32 outputs. The Control Unit is shown in Figure 4. The Transputer resides inside a Sun Computer.

The Control Unit is responsible for the initialization of the Switching Network, that is, for setting up the circuits, and keeping track of the current status of the network. It sends the signals to set up the circuit.

Figure 4: Control Unit

A table of the interconnections of the system being simulated is input to the Control Unit. This table has an entry for all connections of this system. An entry is an ordered pair (i,j) signifying there is to be a connection between PU_i and PU_j . Each Processing Unit has four input ports and four output ports.

An algorithm has been developed to set up these connections between the Processing Units. Each Processing Unit has four ports connected to the input side of the switch and four ports connected to the output side of the switch. As connections are made, there can occur conflicts where two Processing Units that are to communicate with each other but have only output ports available. The algorithm sets up the connections and resolves these conflicts. Conflicts are resolved by looking at the

previously made connections until one is found that has available ports and then changing them.

The following algorithm sets up the connection between PU_i and PU_j that is given in a table as entry $Connections(i, j)$. This algorithm creates a table called *tableofconnections* for the system. The four input ports to the PU_i is $ipor_{i,k}$ and the output ports are numbered $opor_{i,k}$ for $k = 1, 2, 3, 4$. An algorithm for setting up the network is given in Appendix B.

The algorithm *make – port – available*(X, T) is called when there is no available port to make a connection. X is a Processing Unit and T is input or output. This is called when a X has no available T ports, $ipor_{i,k}$ or $opor_{j,k}$. If this is true, there have been four calls to X on its T ports. We have to make a call to X from another Processing Unit and we can have at most eight calls to X , because of system design at most three of the opposite port (non T) from X are in use. So upon entry to this algorithm there is an available non T port on X .

A connection is defined as $T – stream$ in the direction T port to non T port . There are four $T – stream$ connections from X on entry. This algorithm constructs a set S which is the set of processing Units reachable from X by any finite sequence of $T – stream$ connections from X . S is not null since it will have at least five members, X and its immediate friends. In constructing set S loops such as ($A \rightarrow B \rightarrow C \rightarrow A$) must be avoided. However the set of Processing Units is finite and so is the set of connections and a connection needs to be crossed only once.

Lemma 1: There are no $T – stream$ connections from the members of S to Processing Units outside S .

Proof: (That is how S is constructed).

Lemma 2: There is a member of S (called Y) with an available T port.

Proof: Suppose not- then all the T ports on members of S are used. None are connected outside S .
 (Lemma 1) - so all are connected inside S - so all *non* - T ports on the members of S are used since there are four of each on every Processing Unit.
 But X is in S and has an available *non* - T port.
 This contradiction proves Lemma 2.

Lemma 3: X is not Y

Proof: All the T ports on X are used.

Lemma 4: There is at least one path along T - *stream* connection between X and Y .

Proof: That is how S was constructed and X is not Y .

Choose one of the paths indicated in Lemma 4 and reverse it. This is possible using the available *non* - T port on X and the available T port Y . All the Processing Units on the path have a T and a *non* - T port devoted to the path which can be used to reconstruct it in the opposite direction. Now X has an available T port, and this concludes *make - port - available*.

The Switch Setup algorithm is performed once at the initialization of the system. It will set the Switching Network and make it available for communication when the system starts solving the equations. It will need to be run again if there is a change in the communication links of the Processing Unit.

Figure 5: Processing Unit

3.4.2 Processing Unit

Several Processing Units are shown in Figure 5. The choice of unit is determined by the number of unknowns of the equation set s_j . This also determines the number of connections to the Switching Network.

These units are built from Transputers. Each Transputer has four bidirectional links. For a Processing Unit that has seven or eight connections three Transputers are required. Two are called Communicators(COM) and are used to shift data to the third which is the Processing Element(PE). This allows for each Processing Unit to have eight incoming or outgoing messages at the same time or to communicate simultaneously with eight other Processing Units. Each Processing Unit can receive

and send data without having to wait for a channel to be available. This means that each equation set in the system can have eight unknowns.

For a Processing Unit that has five or six connections only two Transputers are needed one Communicator and Processing Element . Each Transputer has three links to the switch and one link to each other. For four or fewer connections on a Processing Unit only one Transputer is used, PE. Depending on the number of unknowns of an equation, the size of the Processing Unit will vary from worst case of three Transputers to best case of one Transputer.

Once each Processing Unit has its equations, it knows to which other Processing unit it needs to communicate. It was given data by the Control Unit which it stored in its local memory. As soon as the circuit switching network is set up, the Processing Unit can start calculations and transmissions of results. Each Processing Unit is responsible for the handling of the calculations for a certain equation set of the system. For each Processing Unit in the network, an iterative process is followed that, given a set of estimated values for the unknowns of the equations, calculates a new value for each unknown from the estimated values. A new set of values for the variables are then obtained for the Processing Unit, and used to calculate still another set of values. Each calculation of a new set of values is called an iteration. This process is repeated until the changes at the Processing Unit are less than a specified minimum value.

3.4.3 Switching Network

The Switching Network (SN) is a circuit-switching network. It is a three-stage Clos network [45, 46, 9]. The structure of the network is shown in the Figure 6. Each box in the figure is a $n \times m$ crossbar switching component. The switches have three columns: the input switches, the intermediary switches and the output switches. The links between the switches are bidirectional. The leftmost column will be the output

side of the processors and the rightmost column is the input side of the processors. The links between the processors and the input switches are called the input c-links. The links between the processors and the output switches are called the output c-links. The links between the input switches and the intermediary switches are called the input s-links and the links between the intermediary switches and the output switches are called the output s-links.

The input switches are $n \times m$ switches, the output switches are $m \times n$ switches, and the intermediary switches are $r \times r$ switches. $N(m, n, r)$ is the notation used to denote such a network. Two important properties of a $N(m, n, r)$ network are proven in [3, 9].

1. If $m \geq n$, then for every partitioning of the set of all processors into pairs, there exist connection configurations where all the pairs talk simultaneously, i.e., there is no bottleneck in the switches.
2. When $m \geq 2n - 1$, the network is non-blocking, meaning that there is always a path available between any idle input c-link and any idle output c-link, independently of the connection sequence, i.e., there is no need to prearrange a special connection configuration to avoid bottleneck.

The connections between the processors and the input switches and the connections from the output switches to the processors are static. At the hardware level the switching components are normally passive, the connections have to be made by the Control Unit during the initialization phase. The circuits between the processors are bidirectional. Whenever a path from processor i to j is setup, a path from j to i is set up also.

In our system for a 2048 by 2048 equation set with connectivity of eight and one equation per Processing Unit, the Switching Network is represented in Figure 7. The input switches are 16×32 . The output switches are 32×16 . There are 512 input

Figure 6: Three Stage Clos Network

Figure 7: Switching Network

switches and the same number of output switches. The middle stage is 512×512 switches. There are 32 of these switches.

The switches are made using C004s. A C004 is a crossbar switch consisting of 32 inputs and 32 outputs. Therefore each input and output switch is made from one C004. The middle stage is made from a non-blocking network of C004s, as shown in Figure 8. Each input of this switch is made from a 16×32 switch. The output is a 32×16 switch. There are 32 input switches and 32 output switches. The intermediary switches are 32×32 switches and there are 32 of these.

In essence, the SN is a three stage nonblocking Clos network, where the middle stage is made up of another three stage nonblocking network. Our particular network

Figure 8: Middle Stage 512x512

is implemented using 4608 C004s. By using Algorithm 1 to set up the switch, any Processing Unit can communicate with eight others. $32 \geq 2 * 16 - 1$ so the network is non-blocking. For the middle network, again $m = 32$ and $n = 16$ and therefore it is non-blocking. There will be no bottleneck in the system.

4 PERFORMANCE EVALUATION

The operation of the PLF algorithm in parallel was simulated using the Transputer hardware currently available at the University. The purpose was to verify that interprocess communication time does not overwhelm the computation time and to demonstrate that the algorithm will perform at the speed of its slowest member and that the speed is independent of the number of nodes.

4.1 Design Configuration

The PLF system is designed to solve sparse non-linear sets of equations,

$$x_i = g_i(x_1, x_2, \dots, x_n) \text{ for } i = 1, \dots, 2048. \quad (4.38)$$

The maximum number of equations was chosen as 2048, because that is enough equations to model the Florida power network. The maximum number of unknowns per equation was chosen as eight, because this system can be modeled with eight connections per node. For each equation to have eight unknowns the PLF system needs three Transputers to model them. The network has a possible of 2048 equations, so the PLF system consists of 6152 INMOS Transputers [35].

A 3-stage Clos circuit switching network $N(16,512,16)$, with the middle stage being another 3-stage Clos circuit switching network $N(16,32,16)$ is used to interconnect the Processing Units. This network consist of 4608 INMOS COO4 dynamic reconfigurable switches (32x32) [38]. This network is non-blocking, so there are connections available for all of the eight lines. All communication links are serial links and have a speed of 20 Megabits/second. The links in the circuit switching network are also serial links with the same speed. Experiments have shown that the effective one-directional transfer rate is 8 Mega bits/second. The circuit switching network can provide a link between any Processing Unit and eight other Processing Units simultaneously. It also allows for eight processors to receive data at the same time.

4.2 Analysis and Experiments

Many experiments have been done to simulate the PLF system. These were programmed using Occam. Figure 9 shows the connections of the Transputer system that was constructed. There are 24 Transputers used in the simulation. Eight of them are T800 and 16 are T414. The connections between link 0 and link 3 of each machine go through a C004. Connections 1 and 2 form a hardwire chain. Two of the T800 reside in an INMOS B014 inside a SUN computer system.

4.2.1 Simulations

The Transputer network was connected so as to simulate different system scenarios. The three types of Processing Units were built. The first Processing Unit type is the one with one Processing Element and four input/output lines, that represents equations with up to four unknowns. The second type is one Processing Element with three input/output lines connected to a Communicator with three input/output lines. This represents equations with five or six unknowns. The third type is two Communicators connected to a Processing Element, each with three input/output lines and two input/output lines from the bus. Equations with seven or eight unknown can be represented by this configuration. One Transputer is used to simulate each Processing Element, and one to simulate the Communicator. Computational intensive arithmetic (i.e. sine, cosine,..) was performed on each Transputer to simulate computations at a node.

These test are summarized in Table 1. The amount of data transfered is two floating point numbers – 64 bits output and 64 input after each calculation. There are 32 operations performed at each Processing Element. The calculations involved adding and multiplying sines and cosines.

Figure 9: Connections of Transputers

buses	communicators	tics
12	10	67131
18	4	67131
21	1	64614
22	0	61171

tic = 63×10^{-6} secs

Time for 10000 iterations

Table 1: Number of Buses

Table 1 shows that the number of Processing Units does not change the time of execution of the program. The program will run at approximate 67,000 tics for 10,000 iterations. A tic is 63×10^{-6} secs. The amount of arithmetic done was kept the same for each test. A Communicator is a Transputer that is used to pass information forward but does no calculations on the data. This allowed for the simulation of a bus with six connections and eight connections. The data has to travel through two Transputers before going out to the switch when a Communicator is used. This explains the slow down in time.

Table 2 shows what happens when the calculation becomes more complex and when the amount of data transfered increases. These calculations were performed on a system with 22 PEs and no Communicators. It was done with 10,000 iterations. An observation made was that the time for computation was governed by the slowest Transputer. The Transputer with the most calculations set the time for computations.

4.2.2 Transfer Rate

Other tests done were to determine the rate of transfer of data from one Transputer to the next and the reduction of this rate when data went thru a C004. One circuit

transfers	calculations	transfer time	computation time	total time
2	2	13625	10235	23860
2	16	31097	79829	110926
2	8	21112	40059	61171
4	8	27693	40059	67752
16	8	67219	40059	107278

Table 2: Computation and Transfer Rates

was built to find the time for two Transputers to communicate. This was found to be .25937 tics to transfer 128 bits (two floating point numbers) both ways. Another circuit was built to find the time for data to pass from one Transputer to the next through a C004. This time was .27656 tics to transfer 128 bits. These two circuits are shown in Figure 10. There is a slow down of 7% for data transfer thru a C004. This gives a transfer rate of 8 mega bits per second from one Transputer to the next.

The interprocess communication time is less by a factor of two than the computation time. The input/output at the Transputer uses significant amounts of CPU time when small amounts of data are transmitted, so the 20 megabits/ sec bandwidth is not achieved.

4.3 Results

4.3.1 Circuit Setup Time

The circuit setup for a set of nonlinear equations is done once for a problem. The time for circuit setup is dependent on the number of equations in the system. It does not effect the performance of the system during its normal operation. Given that the number of equations for a particular problem is n , then each node is numbered in sequence by the Control Unit from PU_1 to PU_n . The Control Unit is given the network setup. It then does the setting up of the Switching Network.

7800 Transfer - .25937 tics
 C004 Transfer - .27656 tics

Figure 10: Transfer Time

4.3.2 Communication Time

After the links are set up, the calculation begins. The Processing Units simultaneously run the PLF algorithm to solve for each pair of equations. When a particular Processing Unit has finished calculating its equation, it must send the newly calculated data to the nodes it has set up on its sending lines. This data must first travel through one or two levels of Transputers, then the Switching network and finally back up to a Communicator Transputer to the Processing Transputer.

In the worst case, the Processing Unit consist of two layers of Transputers. Let τ_{PU} be the transfer time through the Processing Unit. It was measured to be 16.34×10^{-6} secs. Let τ_{SN} be the transfer time of the data through the Switching Network. The circuit switching Clos network or the Switching Network consist of five layers of COO4s so the transfer time of the data through this circuit is $5 \times 1.08 \times 10^{-6}$ secs. The data transfer time from sending to receiving is $2(\tau_{PU}) + \tau_{SN} = 38.08 \times 10^{-6}$ secs.

After sending the data a Processing Unit can read its incoming lines to see if there is any new data. When data has arrived it starts calculating again.

5 POWER FLOW

The electric utilities are responsible for systemwide coordination of the electrical power generation, transmission, distribution and interconnections. This is done at a central location, Energy Control Center (ECC). Power plants are responsible for generating the large amounts of electric power. They exchange data and control signals with the ECC, which is then responsible for the coordination of the overall interconnection levels. Interconnections consist of the transmission lines and transformers that transfer the electric power from power plants to distribution centers which provide it to the customers. Through continuous exchange of information, decision, and control signals, the entire control process is finely tuned.

A typical modern control center is computerized. Large digital computers in the ECC make it possible to track the changing conditions in the power system by representing the system by a mathematical model in the computer. This real time model attempts to portray the current system as accurately as possible. It is used to assess the security of the system by simulating outages or contingencies and to observe the consequences of possible correction measures. The contingencies are generator outages, transmission line outages, and transformer outages. The system model must be calibrated using real-time measurements before any contingencies can be analyzed.

As utilities expand, and the requirement for better performance increases, these programs take longer times to run, and thus do not represent the up to the minute state of the power system. Steady-state analysis for a large number of contingencies needs to be done quickly enough to provide timely alert messages. It becomes necessary to improve on the current technologies and algorithms. The development of computer systems made of many processing elements can make it feasible to design faster algorithms to use in the control sequence.

A parallel load flow algorithm has been developed using the PLF software de-

scribed previously, to run on the PLF parallel computer architecture. The network will be partitioned into segments that will run in parallel, and take the fullest advantage of the parallelism of the hardware. The object of this dissertation is to reduce the processing time required to solve the power system load flow problem, and have it represent the real time power system accurately.

5.1 Examination of the Problem

The power system of an electrical utility company consists of generators, transmission lines, transformers, shunt capacitors, shunt admittances, and loads. Generators are located at power stations, where electricity is generated in bulk quantities. The substations are distribution centers where the electric power is distributed to customers or users. Shunt capacitors and shunt inductors are used to support the voltages in the system to maintain them at acceptable levels. Transformers are used to step up the voltages before sending power through the transmission lines, and to step down the voltages at the distribution centers. The transmission lines transfer the power from the power stations to the distribution centers, forming an electric power network. Nodes or buses are where these elements are modeled and connected.

For each bus, certain values are telemetered and sent to a central location, the ECC (Energy Control Center). At the ECC, a collection of computer aided analysis procedures determine the model of the power system network. These programs are supported by a database that contains the description of the network in terms of its parameters. The building of this model is done in three steps. The first step is the determination of the network topology and it is done by combining the database with the telemetered data. The next step in the process is the solution of the complex bus voltages and states of the network. This solution is done by a state estimator. Finally the load flow analysis then determines the actual power flow patterns in the given power system. This is done by writing power flow equations for each bus in

the system and solving the unknowns (i.e. voltages) in the power system.

Power companies use very elaborate computers and programs for making load flow studies. A typical system is capable of handling more than 2000 buses, 3000 lines, and 500 transformers. Programs can be expanded for larger systems provided the available computer facilities are adequate.

The model of the power system can be used to test the security of the system or its ability to withstand contingencies. Once the model of the system is built, contingency analysis can be performed. The core of this analysis is the load flow algorithm.

In most applications, the solution of the load flow problem is desired in as fast a time as possible. This means the solution of the power flow problem before the conditions of the analysis have changed. Digital computer methods have the disadvantage of lengthy solution time that increases very rapidly with system size. In recent years, there has been growing interest in using computer systems comprised of several processors for the solution of power system problems. Because of developments in computer technology, parallel processing can be used to aid in the solution of the load flow problem.

The application of parallel processing to power system analysis is motivated solely by the need for faster computation. There is no inherent parallelism in the mathematical structure of the power system problems. Therefore a parallel or near parallel formulation has to be found that is amenable to a particular algorithm. A parallel machine has to be used that is computationally efficient and suitable to the parallel algorithm.

Three areas have been analyzed in order to develop a parallel technique for solving the load flow for the power system. The first is how to partition the power network, the second is which algorithm has the most inherent parallelism, and the third is what type of computer to use.

5.1.1 Partition of the Power Network

There are several possibilities to divide the power system network. One such way is for the network to be studied as one system and modeled mathematically as one entity. This is the way it is currently done with the algorithms used solving the network as one big unit sequentially.

Another possibility is to partition the network into several sections. Each network section can be modeled separately. The following questions would need to be answered if this approach were to be used.

- How many sections should the network be divided into?
- Where should the network be divided?
- What size should each network section be?
- How will the coordinating processor handle the tie line information?

Finally, the power network can be partitioned by its buses. Each bus can be modeled by its set of equations. Each bus knows the information of its neighbors. This is the way this research has handled the partitioning of the network.

5.1.2 Find the Parallelism in the Algorithms

The next problem that has to be considered is what numerical procedure to use to solve the load flow analysis. The currently used algorithms are the Newton-Raphson, Gauss-Seidel, and Fast Decoupled . As described in Chapter 2 this present work uses the Jacobi type algorithm to solve the numerical equations.

5.1.3 Possible Architectures

Finally, the computer architecture that will be used has to be decided. Previously, different architectures have been examined to solve the load flow problem. These will be referred to in the next Section 5.3.

5.2 Mathematical Formulation of Load Flow

Load Flow Analysis consists of calculating the unknown bus voltages, the unknown power generations and the power flows of a given power system for given bus voltages, generations and loads. The objectives are to determine the real and reactive power flows in the transmission lines of a system, based on certain assumptions regarding loads and generations, and to compute the voltages at all system buses. Thus the problem can be stated : given load demands at various load buses and assumed generation levels at specified supply voltage, find the overall voltage profile of the power network, the real and reactive flows on transmission lines and transformers, bus voltage magnitudes and phase angles, line currents, line losses and other related steady state variables.

The load flow problem is at the core of power system analysis [17, 26, 52]. It is used as an integral part of other activities such as:

- Keeping voltages and power flows within tolerances specified for the system. Check that no transmission lines are overloaded and there are no voltage problems.
- Testing for inter-utility power transfer limits. Planning to meet contracts for supplying power to neighboring power systems.
- Planning studies for additions or expansions. Check effect of new generation sites, projected load growth and new transmission line locations.
- Determining the specific load flow pattern that results in optimum dispatch. Selection of the most economic operation of the generators in the system.
- Contingency analysis of the system. Test for the effect of line and generator outages. Rerouting of power in case of emergencies. Analyze the effectiveness of corrective measures to alleviate emergencies.

The power system cannot be modeled by an electrical network, because loads are complex powers not impedances, generators behave like power sources and not as voltage supplies and Kirshoff's Laws cannot be used. Therefore, the problem becomes a mathematical problem of solving a large number of nonlinear equations.

5.2.1 Formulation of the Problem

The components of the power system which are of interest are: power generators, transformers, transmission lines, shunt capacitors and inductors, and loads. Single-line diagrams are used to show the electrical interconnections and locations for generators, transformers, transmission lines, loads, circuit breakers, reactors, and some switches. Power system information is recorded on these diagrams. A bus in a single-line diagram is like a node in a circuit diagram. Points on a bus are separated by negligible impedance and therefore have the same voltage. Figure 11 is an example of a one line diagram showing buses, generators, loads, transmission lines and shunt capacitors [21]. Two equations can be written for every bus of the system. The system variables used in these equations are of the following type:

- Demand variables. Given values of real and reactive load demand.
- Control or Input variables. These are voltage magnitudes at generation buses, real power generation at all but one generation bus (the slack bus), switch status of capacitors and inductor banks, and tap settings of regulating transformers.
- State variables. Those whose knowledge will enable the computation of all other relevant quantities. These are the complex bus voltages.
- Output variables. Real and reactive line power flows, reactive generation, slack bus real generation, injected bus complex currents, and line current magnitudes.

Figure 11: One-line diagram

Complex variables are used, and the engineering convention that j , rather than i , represents $\sqrt{-1}$. The following standard notation is used:

$$z = x + jy \quad (5.39)$$

$$|z| = \sqrt{x^2 + y^2} \quad (5.40)$$

The angular orientation or phase $\angle z$ of z in reference to the real axis is

$$\angle z = \arctan \frac{y}{x}. \quad (5.41)$$

Let $\mathbf{V}$ (voltage) and $\mathbf{I}$ (current) correspond to the complex numbers $Ve^{j\alpha}$ and $Ie^{j\beta}$ and $*$ is the complex conjugate. The complex power flowing into the network is defined as

$$S = \mathbf{VI}^* \quad (5.42)$$

Therefore the following can be written:

$$S = (Ve^{j\alpha})(Ie^{j\beta})^* \quad (5.43)$$

$$S = VIe^{j(\alpha-\beta)} \quad (5.44)$$

The complex power S can be written as $S = P + jQ$, where P is called the active power or real power and Q is called the reactive power. The units of S are Voltamperes written as VA, the units of P are Watts written as W, and the units of Q are Voltamperes-reactive written as Var.

In power system analysis, it is common to normalize or scale dimensioned quantities [30]. This is referred to as the per unit system. The per unit scaling equation is

$$\text{Per unit value} = \frac{\text{Actual value}}{\text{Base value}} \quad (5.45)$$

The base value and the actual value have the same units so the per unit value is dimensionless. The base value is real and the actual value is complex, so the phase of the per unit value is always the same as that of the actual value. The "pu" subscript is used to imply per unit. Two values are chosen for any of the following V_{base} , I_{base} , Z_{base} , or S_{base} . Then the others are calculated using the following formulae

$$V_{\text{base}} I_{\text{base}} = S_{\text{base}} \quad (5.46)$$

$$Z_{\text{base}} = \frac{V_{\text{base}}}{I_{\text{base}}} \quad (5.47)$$

A transmission line is represented by its Π equivalent model. Figure 12 is a representation of the network elements of a transmission line represented by its Π equivalent. The following notations and definitions correspond to the above variables that make up the equations:

$$\begin{aligned} P_i &= \text{real power at bus } i \\ &= \text{real power generated minus real power load at bus } i \\ Q_i &= \text{reactive power at bus } i \\ &= \text{reactive power generated minus reactive power load at bus } i \end{aligned}$$

Figure 12: Representation of network elements

$$S_i = P_i + jQ_i$$

= Complex power at bus i

$$V_i = \text{voltage magnitude at bus } i$$

$$\delta_i = \text{voltage phase or angle at bus } i$$

$$k_i = \text{set of buses connected to bus } i$$

$$R_{ij} = \text{transmission line series resistance}$$

$$X_{ij} = \text{transmission line series reactance}$$

$$G_{ij} = \frac{R_{ij}}{R_{ij}^2 + X_{ij}^2}$$

$$G_{ii} = \sum_{j \in k(i)} (G_{Sij} + G_{ij})$$

$$G_{Sij} = \text{shunt capacitance}$$

$$B_{ij} = \frac{-X_{ij}}{R_{ij}^2 + X_{ij}^2}$$

$$B_{ii} = B_{Si} + \sum_{j \in k(i)} (B_{Sij} + B_{ij})$$

$$B_{Si} = \text{net device shunt susceptance at bus } i$$

$$Y_{ij} = G_{ij} + jB_{ij}$$

$$\begin{aligned}
&= \text{inverse of line series impedance} \\
Y_{Sij} &= G_{Sij} + jB_{Sij} \\
&= \text{shunt capacitance in parallel with shunt conductance} \\
t &= \text{transformer tap ratio} \\
Y_{eij} &= \text{Branch admittance for transformer branch} \\
Y_{Tij} &= tY_{eij} \\
Y_{TSij} &= (t^2 - t)Y_{eij} \text{ for } i < j \\
&= Y_{Sij} \text{ for transformer branch} \\
Y_{TSji} &= (1 - t)Y_{eij} \text{ for } i < j \\
&= Y_{Sji} \text{ for transformer branch}
\end{aligned}$$

Given these definitions, the complex power at a bus can be written in terms of complex voltages[17] :

$$S_i = V_i I_i^* \quad (5.48)$$

$$I_i = V_i Y_{ii} - \sum_{j \in k(i)} V_j Y_{ij} \quad (5.49)$$

$$\begin{aligned}
S_i &= V_i^2 G_{ii} - V_i \sum_{j \in k(i)} V_j [G_{ij} \cos(\delta_i - \delta_j) + B_{ij} \sin(\delta_i - \delta_j)] \\
&\quad j(-V_i^2 B_{ii} - V_i \sum_{j \in k(i)} V_j [G_{ij} \sin(\delta_i - \delta_j) - B_{ij} \cos(\delta_i - \delta_j)]) \quad (5.50)
\end{aligned}$$

This can be separated into real and imaginary components:

$$P_i = V_i^2 G_{ii} - V_i \sum_{j \in k(i)} V_j [G_{ij} \cos(\delta_i - \delta_j) + B_{ij} \sin(\delta_i - \delta_j)] \quad (5.51)$$

$$Q_i = -V_i^2 B_{ii} - V_i \sum_{j \in k(i)} V_j [G_{ij} \sin(\delta_i - \delta_j) - B_{ij} \cos(\delta_i - \delta_j)] \quad (5.52)$$

The power flow equations are written in terms of phase differences between connecting buses. One of the buses, the slack bus, is normalized with phase zero and is numbered as bus number one. This bus is a generator bus and is the last quantity of

power calculated since it depends on and must take up the yet unknown line losses. This is because the amount of generation is dependent on system losses which are functions of the problem solution.

The three types of buses in the system are as follows:

1. Slack bus. The one bus of the system on which the real and reactive power are allowed to swing and for which the voltage magnitude and angle are specified.

This bus is numbered as one. For this bus the following can be written:

$$\delta_1 = 0 \quad (5.53)$$

$$V_1 = 1 \quad (5.54)$$

2. Load bus. Any bus where the injected real and reactive power are specified. P_i is the negative of the real load at the bus and Q_i is the negative of the reactive load at the bus. Most buses in a typical power flow program are of this type.

The two equations are:

$$P_i = V_i^2 G_{ii} - V_i \sum_{j \in k(i)} V_j [G_{ij} \cos(\delta_i - \delta_j) + B_{ij} \sin(\delta_i - \delta_j)] \quad (5.55)$$

$$Q_i = -V_i^2 B_{ii} - V_i \sum_{j \in k(i)} V_j [G_{ij} \sin(\delta_i - \delta_j) - B_{ij} \cos(\delta_i - \delta_j)] \quad (5.56)$$

3. Voltage controlled bus. Any bus where the voltage magnitude and the injected real power are specified. V_i is the specified voltage value and P_i is the real power generated at bus i minus the real power load at that bus. It is the non-slack generation buses. Buses to which generators switched shunt capacitors are connected. It can also be a bus which has a tap changing transformer connected to it.

$$P_i = V_i^2 G_{ii} - V_i \sum_{j \in k(i)} V_j [G_{ij} \cos(\delta_i - \delta_j) + B_{ij} \sin(\delta_i - \delta_j)] \quad (5.57)$$

Table 1 summarizes the bus types for a real power system such as FPL

	bus type	knowns	unknowns	approximate number
1	slack	$V_i = 1.0$ $\delta_i = 0$	P_i Q_i	1
2	load	P_i Q_i	V_i δ_i	85%
3	voltage controlled-generator	P_i V_i	δ_i Q_i	10%
3	voltage controlled-transformer	$P_i = 0$ $Q_i = 0$ V_i	δ_i t	5%

Table 3: Summary of bus types

5.2.2 Three Bus Example

For the three bus system described in Figure 13, the load flow equations will be written and examined in detail.

Bus 1 equations (slack bus)–

$$\delta_1 = 0$$

$$V_1 = 1$$

Bus 2 equations (generation bus)–

$$V_2 = .95$$

$$P_2 = 2.0$$

$$P_2 = 2(.95)^2 - .95(\cos(\delta_2) - 10 \sin(\delta_2)) - .95V_3(\cos(\delta_2 - \delta_3) - 9 \sin(\delta_2 - \delta_3))$$

Bus 3 equations (load bus)–

$$P_3 = -4.0$$

$$P_3 = 1.5V_3^2 - V_3(0.5 \cos(\delta_3) - 7 \sin(\delta_3)) - .95V_3(\cos(\delta_3 - \delta_2) - 9 \sin(\delta_3 - \delta_2))$$

Figure 13: Three bus system

$$Q_3 = -1.5$$

$$Q_3 = 15V_3^2 - V_3(0.5 \sin(\delta_3) + 7 \cos(\delta_3)) - .95V_3(\sin(\delta_3 - \delta_2) + 9 \cos(\delta_3 - \delta_2))$$

The procedure for solving the load flow problem is as follows. First, a set of $2n + m - 1$ equations that correspond to all voltage magnitudes and phases at all the n load buses and m voltage controlled buses of the system are written. Next, solve for the voltage magnitudes and phases of the state variables. Finally, solve for the output variables. The first step is to write two equations per load bus and one equation per voltage controlled bus. This was shown in the above formulation and example.

5.2.3 Jacobi and Gauss-Seidel Methods

The Jacobi and Gauss-Seidel methods can be applied to the equation $I_k = \frac{P_k - jQ_k}{V_k^*}$ to solve for V_k^{i+1} .

$$\frac{P_k - jQ_k}{\hat{V}_k^*} = \sum_{n=1}^N \hat{V}_n Y_{kn} \quad (5.58)$$

For all buses, except the slack bus, the following equation is applied first for the Gauss-Seidel:

$$V_k^{i+1} e^{j\delta_k^{i+1}} = \frac{1}{Y_{kk}} \left[\frac{P_k - jQ_k}{V_k^i e^{-j\delta_k^i}} + \sum_{n=1}^{k-1} Y_{kn} V_n^{i+1} e^{j\delta_n^{i+1}} + \sum_{n=k+1}^N Y_{kn} V_n^i e^{j\delta_n^i} \right] \quad (5.59)$$

The equation is the same for the Jacobi except the i iteration is used through out the formula and not $i + 1$.

For a voltage controlled bus the following equation is then calculated.

$$\begin{aligned} Q_k^{i+1} = & -V_k^2 B_{kk} - V_k \\ & \left[\sum_{n=1}^{k-1} V_n^{i+1} [G_{kn} \sin(\delta_k^{i+1} - \delta_n^{i+1}) - B_{kn} \cos(\delta_k^{i+1} - \delta_n^{i+1})] \right. \\ & \left. + \sum_{n=k+1}^N V_n^i [G_{kn} \sin(\delta_k^i - \delta_n^i) - B_{kn} \cos(\delta_k^i - \delta_n^i)] \right] \end{aligned} \quad (5.60)$$

Q_k is checked to see if it is within its limits, $Q_{kmax} \geq Q_k \geq Q_{kmin}$. If it is within the limits then Q_k is used to calculate V_k^{i+1} . If it is not within limits it is set to the appropriate limit and V_k^{i+1} calculated using this value.

The calculated value for V_k will not agree with the estimated value V_{k-1} . By substituting the conjugate of the calculated value of V_k for V_k^* to calculate another value for V_k , agreement would be reached to a good degree of accuracy after several iterations and would be the correct value for V_k with the estimated voltages and without regard to power at the other buses. The process is repeated at each bus consecutively throughout the network, except at the slack bus, to complete the first iteration. Then the entire process is carried out repeatedly until the amount of correction in voltage at every bus is less than some predetermined precision. The algorithm starts at bus one, and calculates the unknowns for the other buses consecutively using the new values as it proceeds until the solution converges.

Convergence to an erroneous solution may occur if the bus voltages are widely different from the correct values. Erroneous convergence is usually avoided if the original values are of reasonable magnitude and do not differ too widely in phase. Any unwanted solution is usually detected easily by inspection of the results, since the voltages of the system do not normally have a range in phase wider than 45° and the difference between nearby buses is less than about 10° , and often very small.

Experience with the Gauss-Seidel method of solution of power-flow problems has shown that an excessive number of iterations are required before the voltage corrections are within an acceptable precision, if the corrected voltage at the bus merely replaces the best previous value as the computations proceed from bus to bus. The number of iterations required is reduced considerably if the correction in voltage at each bus is multiplied by some constant that increases the amount of correction to bring the voltage closer to the value it is approaching. The multipliers that accomplish this improved convergence are called the acceleration factors. The difference between the newly calculated voltage and the best previous voltage at the bus is multiplied by the appropriate acceleration factor to obtain a better correction to be added to the previous value. The acceleration factor for the real component of the correction may differ from that of the imaginary component. Poor choice of factors may result in less rapid convergence or make convergence impossible.

$$V_k^{i+1} = V_k^i + \sigma \Delta V_k^{i+1} \quad (5.61)$$

$$\sigma \geq 1 \quad (5.62)$$

$$\Delta V_k^{i+1} = V_k^{i+1} - V_k^i \quad (5.63)$$

The factor σ is called the acceleration factor and for the power flow problem it is chosen to be 1.6 [30].

5.2.4 Jacobi Example

This example uses the Jacobi to solve Figure 13 of Example 1. For bus three we can solve for $V_3^1 e^{j\delta_3^1}$ as follows by solving for the real part of the complex voltage V_{3r} and the imaginary part V_{3i} .

$$\begin{aligned}V_{3r}^1 &= \frac{1}{(1.5)^2 + (15)^2}[-4 * 1.5 + 1.5 * -15 - .75 - 128] \\V_{3r}^1 &= .6919 \\V_{3i}^1 &= \frac{1}{(1.5)^2 + (15)^2}[-4 * 15 + 1.5 * 1.5 + 23.325 - 21.75] \\V_{3i}^1 &= -.2472\end{aligned}$$

For V_2^1 the real part is given, and the the reactive power must be found, Q_2^1 .

$$\begin{aligned}Q_2^1 &= -.95^2 * (-18.3) - .95[10 + 9] \\Q_2^1 &= -1.5 \\V_{2i}^1 &= \frac{1}{(2)^2 + (18.3)^2}[(.95 * -18.3 + 1.5 * 2)/.95 - 18.3 - 20 - 18.3 + 18] \\V_{2i}^1 &= -.1025\end{aligned}$$

This is the first iteration for the system. The equations are solved again with the new values.

5.2.5 Newton-Raphson Iteration

One method for solving the equations is by applying Newton-Raphson iteration. In the load flow problem, it is convenient to deal with V , δ , P , and Q . Given that n is the number of load buses and m is the number of voltage controlled buses, the following vectors are defined. The slack bus is numbered one, the voltage controlled

buses are numbered 2 to m , and the load buses are numbered $m + 1$ to $m + n$.

$$x = \begin{bmatrix} \delta_2 \\ \vdots \\ \delta_{m+n} \\ V_{m+1} \\ \vdots \\ V_{m+n} \end{bmatrix} ; b = \begin{bmatrix} P_2 \\ \vdots \\ P_{m+n} \\ Q_{m+1} \\ \vdots \\ Q_{m+n} \end{bmatrix}$$

The Jacobian matrix now can be expressed in block form

$$J = \begin{bmatrix} \frac{\partial P}{\partial \delta} & \frac{\partial P}{\partial V} \\ \frac{\partial Q}{\partial \delta} & \frac{\partial Q}{\partial V} \end{bmatrix} \quad (5.64)$$

The individual terms in the four blocks are derived from the following

$$\frac{\partial P_i}{\partial \delta_i} = V_i \sum_{j \in k(i)} V_j (G_{ij} \sin(\delta_i - \delta_j) - B_{ij} \cos(\delta_i - \delta_j)) \quad (5.65)$$

$$\frac{\partial P_i}{\partial \delta_j} = -V_i V_j (G_{ij} \sin(\delta_i - \delta_j) - B_{ij} \cos(\delta_i - \delta_j)) \quad (5.66)$$

$$\frac{\partial P_i}{\partial V_i} = 2V_i G_{ii} - \sum_{j \in k(i)} V_j (G_{ij} \cos(\delta_i - \delta_j) + B_{ij} \sin(\delta_i - \delta_j)) \quad (5.67)$$

$$\frac{\partial P_i}{\partial V_j} = V_i (G_{ij} \cos(\delta_i - \delta_j) + B_{ij} \sin(\delta_i - \delta_j)) \quad (5.68)$$

$$\frac{\partial Q_i}{\partial \delta_i} = -V_i \sum_{j \in k(i)} V_j (G_{ij} \cos(\delta_i - \delta_j) + B_{ij} \sin(\delta_i - \delta_j)) \quad (5.69)$$

$$\frac{\partial Q_i}{\partial \delta_j} = V_i V_j (G_{ij} \cos(\delta_i - \delta_j) + B_{ij} \sin(\delta_i - \delta_j)) \quad (5.70)$$

$$\frac{\partial Q_i}{\partial V_i} = -2V_i B_{ii} - \sum_{j \in k(i)} V_j (G_{ij} \sin(\delta_i - \delta_j) - B_{ij} \cos(\delta_i - \delta_j)) \quad (5.71)$$

$$\frac{\partial Q_i}{\partial V_j} = -V_i (G_{ij} \sin(\delta_i - \delta_j) - B_{ij} \cos(\delta_i - \delta_j)) \quad (5.72)$$

For each iteration the following steps are performed.

1. Define

$$\Delta y^i = \begin{bmatrix} \Delta P_j^i \\ \Delta Q_j^i \end{bmatrix} = \begin{bmatrix} b_j \end{bmatrix} - \begin{bmatrix} f_j(x^i) \end{bmatrix}$$

2. Calculate the Jacobian matrix.

3. Solve for

$$\begin{bmatrix} \frac{\partial P^i}{\partial \delta^i} & \frac{\partial P^i}{\partial V^i} \\ \frac{\partial Q^i}{\partial \delta^i} & \frac{\partial Q^i}{\partial V^i} \end{bmatrix} \begin{bmatrix} \Delta \delta_j^i \\ \Delta V_j^i \end{bmatrix} = \begin{bmatrix} \Delta P_j^i \\ \Delta Q_j^i \end{bmatrix}$$

4. Compute

$$x^{i+1} = \begin{bmatrix} \delta_j^{i+1} \\ V_j^{i+1} \end{bmatrix} = \begin{bmatrix} \delta^i \\ V^i \end{bmatrix} + \begin{bmatrix} \Delta \delta^i \\ \Delta V^i \end{bmatrix}$$

Starting with x^0 , the above steps are repeated until convergence is obtained or until the number of iterations exceeds a maximum. The convergence criterion is stated in terms of a threshold value. The real and reactive mismatch thresholds are specified as ϵ_P and ϵ_Q . The power mismatch is the difference between specified and computed bus power injections or Δy^i . Convergence is assumed if the real elements of Δy^i are all less than ϵ_P , and the reactive elements of Δy^i are all less than ϵ_Q .

5.2.6 Newton-Raphson Example

Calculate x^{i+1} for $i = 0$ for the system in Figure 13, in Example 1, using the Newton-Raphson method. Start with $\delta_2^0 = 0$, $\delta_3^0 = 0$, and $V_3^0 = 1$ as initial values.

$$\Delta y^0 = \begin{bmatrix} \Delta P_j^0 \\ \Delta Q_j^0 \end{bmatrix} = \begin{bmatrix} 2 - (-.095) \\ -4 - (.05) \\ -1.5 - (-.55) \end{bmatrix} = \begin{bmatrix} 2.095 \\ -4.05 \\ -0.95 \end{bmatrix}$$

The Jacobian is calculated to be

$$J = \begin{bmatrix} 18.05 & -8.55 & .95 \\ -8.55 & 15.55 & 1.55 \\ .95 & -1.45 & 14.45 \end{bmatrix}$$

Multiplying the first matrix and the inverse of the Jacobian gives

$$\begin{bmatrix} \Delta\delta_2 \\ \Delta\delta_3 \\ \Delta V_3 \end{bmatrix} = \begin{bmatrix} 18.05 & -8.55 & .95 \\ -8.55 & 15.55 & 1.55 \\ .95 & -1.45 & 14.55 \end{bmatrix}^{-1} \begin{bmatrix} 2.095 \\ -4.05 \\ -.95 \end{bmatrix}$$

The new values for x^{i+1} are

$$x^1 = \begin{bmatrix} \delta_j^1 \\ V_j^1 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} + \begin{bmatrix} .0024 \\ -.2500 \\ -.0910 \end{bmatrix} = \begin{bmatrix} .0024 \\ -.2500 \\ 0.909 \end{bmatrix}$$

5.2.7 Fast Decoupled Load Flow

Fast power flow algorithms have been developed to give solutions in less time. These algorithms are based on a simplification of the Jacobian matrix. Attention is given to the exploitation of the loose physical interaction between real and reactive power flows in a power system, by mathematically decoupling $\frac{\partial P}{\partial \delta}$ and $\frac{\partial Q}{\partial V}$. The fast decoupled load flow method is suitable for routine accurate load flows and for outage-contingency evaluation studies performed on-line or off-line.

The fast decoupled load flow is a derivation from the Newton method [67]. It starts with a simplification of the Jacobian whereby the off-diagonal blocks $\frac{\partial P}{\partial V}$ and $\frac{\partial Q}{\partial \delta}$ are set to zero. The result is a block diagram of the Jacobian

$$J = \begin{bmatrix} \frac{\partial P}{\partial \delta} & 0 \\ 0 & \frac{\partial Q}{\partial V} \end{bmatrix}$$

This reduces to two sets of decoupled equations:

$$\frac{\partial P}{\partial \delta} \Delta\delta_j^i = \Delta P_j^i \quad (5.73)$$

$$\frac{\partial Q}{\partial V} \Delta V_j^i = \Delta Q_j^i \quad (5.74)$$

Further reduction in computer time is obtained by additional simplification of the Jacobian matrix. These simplifications come from the characteristics of a typical load

flow problem. First, line and transformer resistances tend to be much smaller than the corresponding reactances, therefore $|G_{ij}| \ll |B_{ij}|$, $i, j = 1, \dots, N$. Second, phase differences across a line or transformer $(\delta_i - \delta_j)$ are small because of thermal and stability limits. As a result $\cos(\delta_i - \delta_j) \approx 1.0$ and $\sin(\delta_i - \delta_j) \approx 0$. From these facts the block diagonal terms are simplified as follows

$$\frac{\partial P_i}{\partial \delta_i} = V_i \sum_{j \in k(i)} -B_{ij} \quad (5.75)$$

$$\frac{\partial P_i}{\partial \delta_j} = V_i B_{ij} \quad (5.76)$$

$$\frac{\partial Q_i}{\partial V_i} = -V_i(2B_{ii} + \sum_{j \in k(i)} B_{ij}) \quad (5.77)$$

$$\frac{\partial Q_i}{\partial V_j} = V_i B_{ij} \quad (5.78)$$

With the above modifications, J_1 and J_2 are constant matrices and do not have to be recalculated during successive iterations. The result is an iterative sequence of solutions of the form:

$$\delta_j^{k+1} = \delta_j^k + (B')^{-1} \frac{\Delta P_j^k}{V_j^k} \quad (5.79)$$

$$V_j^{k+1} = V_j^k + (B'')^{-1} \frac{\Delta Q_j^k}{V_j^k} \quad (5.80)$$

The advantage of the fast decoupled load flow is that the Jacobian is replaced by two constant matrices B' and B'' . These matrices are each half the size of the Jacobian matrix. Their inversion is performed only once, thus computational times and memory storage are reduced. Another advantage is that the region of convergence is larger for the decoupled load flow method than the Newton-Raphson method. The major disadvantage is that there is an increase in the number of iterations required for convergence over the Newton-Raphson method and that it is not so accurate.

5.2.8 Fast Decoupled Example

Solve one iteration of the system in Figure 13, of example 1, using the fast decoupled load flow.

The decoupled matrices are:

$$\begin{aligned}B' &= \begin{bmatrix} 18.05 & -8.55 \\ -9 & 16 \end{bmatrix} \\B'' &= \begin{bmatrix} 14 \end{bmatrix} \\(B')^{-1} &= \begin{bmatrix} .0755 & .0404 \\ .0425 & .0852 \end{bmatrix} \\(B'')^{-1} &= \begin{bmatrix} .0714 \end{bmatrix}\end{aligned}$$

The first iteration yields:

$$\begin{aligned}\begin{bmatrix} \delta_2^1 \\ \delta_3^1 \end{bmatrix} &= \begin{bmatrix} 0 \\ 0 \end{bmatrix} + \begin{bmatrix} .0755 & .0404 \\ .0425 & .0852 \end{bmatrix} \begin{bmatrix} 2.095 \\ -4.05 \end{bmatrix} \\&= \begin{bmatrix} -.0052 \\ -.2561 \end{bmatrix} \\V_3^1 &= 1 - .95 \div 14 \\&= .9321\end{aligned}$$

5.2.9 Comparison of methods

The most commonly used method for solving the load flow is Newton-Raphson Iteration. It has the fastest convergence rate and the most accurate results. Its disadvantages are that a Jacobian has to be calculated at each iteration. The Gauss-Seidel takes the most iterations to converge but the calculations for each step are simpler. The Fast Decoupled algorithm is the fastest. For this reason it is used the most for contingency analysis. It has the disadvantage that the results are not so accurate.

<i>Newton-Raphson</i>			<i>Gauss Seidel</i>			<i>Fast Decoupled</i>		
δ_2	δ_3	V_3	δ_2	δ_3	V_3	δ_2	δ_3	V_3
.0000	.0000	1.0000	.0000	.0000	1.0000	.0000	.0000	1.0000
.0024	-.2500	.9090	-.8810	-.2850	.8960	-.0052	-.2561	.9321
-.0284	-.3116	.8500	.1211	-.2379	.8450	-.0154	-.2862	.8679
-.0202	-.3131	.8425	-.2965	-.3160	.8630	-.0180	-.3034	.8544
-.0185	-.3123	.8424	.1805	-.2760	.8380	-.0182	-.3083	.8470
-.0185	-.3123	.8424	-.0674	-.3176	.8519	-.0184	-.3107	.8444

Table 4: Comparison of methods

Table 4 shows the results for the three methods used to solve the system of Figure 13.

5.2.10 Control of Load Flow Variables

In the load flow problem, automatic manipulation of some of the control variables is performed to insure convergence to a solution that satisfies the inequality constraints [17]. The inequality constraints are due to the physical properties of the power system elements. The generator operating characteristics require it to stay within certain limits. Constraining the real power generated is simple, since it is a known and fixed value. The reactive power generated is an unknown variable and must be kept within its minimum and maximum limits. At these buses containing generators the reactive power generation is computed after the initial load flow. If the generator's reactive power is outside its specified limits, then the bus is treated as a load bus with the reactive power set to its limit and the voltage set floating, requiring V_i and Q_i to exchange roles as knowns and unknowns. When Q_i is within its limits then it is changed back to an unknown.

During the solution of the load flow problem, the transformer taps are adjusted

to ensure voltage at a voltage controlled bus remains within limits. If the voltage is outside its limits, then the transformer tap settings nearest to the bus are increased or decreased until the voltage falls within the limits. The admittance values for the bus, Y_{ij} , are updated with the new tap position, and a new iteration of the solution is performed.

At the slack bus, if real power generation is outside its limits, the amount of power will be distributed among the remaining units and more load flow iterations are performed. If the reactive power generation violates its limit then either the slack bus can be changed to a different generator bus, or the voltage of the slack bus can be adjusted to a different constant (subject to its physical constraints), or reactive generation or load can be adjusted by switching of capacitor or inductor banks.

5.3 Review of Previous Research

A description of research done on the load flow problem and parallel processing techniques to solve it are given below. Most research done in this area has involved decomposing the network into sections and solving each network concurrently. The Electric Power Research Institute (EPRI) has sponsored projects mainly on the effect of array processors in the solution of the load flow. Other research projects are also given below. According to my study, an INMOS Transputer based load flow analysis, decomposed by each bus, has never been developed.

5.3.1 Solutions by Decomposition

Methods that reduce a large network of equations to many smaller decoupled subnetworks were studied at the University of Tokyo [65, 78]. They propose a decomposed parallel processing technique to solve the nonlinear simultaneous equations of the load flow analysis.

In this method, a given system is decomposed into multiple subsystems by re-

moving the interconnecting or tie lines. The voltage magnitudes and phase angles at the interconnecting nodes are fixed. The load flows in all subsystems are computed concurrently using local processors. The interconnecting lines are then re-connected. Variations in voltage magnitudes and phases that are produced are calculated by a coordinating processor using the interconnecting voltage sensitivities with respect to injection powers. The effect of the variations of interconnecting voltages on the voltage magnitudes and phases at non- interconnecting nodes in each subsystem is calculated using a local processor in each subsystem. This process is iterated until power and voltage constraints at all nodes are satisfied.

The first step in solving each subsystem is done using the Newton-Raphson algorithm in each processor in parallel. If the solution obtained does not satisfy the power equations for interconnecting nodes a correction equation is derived by calculating the Jacobian matrix also in parallel by the local processors. The matrix formed by the correction equations of each processor is called a mixed sensitivity matrix. The correction equations are used to reduce the power mismatch at interconnecting nodes as much as possible without increasing the power and voltage mismatches at non-interconnecting nodes of each subsystem. The correction equations are transmitted from the local processor to a coordinating processor. The coordinating processor then solves the interconnected system using the Newton-Raphson algorithm. After all values are modified each subsystem again solves individually with these new values. This process continues until a desired solution is obtained.

Calculations were performed using HITAC M-280 at the Computer Center of University of Tokyo. Conclusions obtained were that the proposed method and the Newton-Raphson method have the same convergence characteristics, the computing time is smaller than that of the Newton-Raphson method and is little effected by the number of subsystems.

Another decomposed load-flow algorithm can be found in [61]. This decomposed

load flow is based on the fast decoupled load flow algorithm [67]. The solution is achieved by partitioning the system into a number of subsystems that are connected by tie lines. The B' and B'' matrices of the Fast Decoupled Algorithm are calculated for each area with reference to its own slack node with no consideration of the tie lines. This technique minimizes the amount of data needed to be transferred between the central program and the subsystem programs since there is no need for transmission of data related to buses connected to fictitious slack buses.

Data must be transferred at each iteration between the processors and the coordinating processor. The active and reactive power mismatches are transferred from each local processor to the coordinating processor. The new voltage magnitudes and phases are passed from the coordinating processor to each local processor. To minimize the data transferred it is shown that a fictitious slack bus for each area should be created. This slack bus should be a bus that has the least ties with other ones of the fictitious slack buses of the subsystems.

Computation times, storage comparison and data transfer times are given in this article. The solution using this approach is obtained in half the time required by the regular decoupled load flow. Increasing the number of tie lines and areas increases the time required for the solution of the coordinating problem while reducing the time required in each subsystem.

In [60], another decomposed algorithm is given that uses the Newton-Raphson algorithm. It shows a way to reorganize the Jacobian matrix and then to decompose it into different sections. Results for each area are then calculated on separate processors, in parallel, using the Newton-Raphson algorithm.

Once each processor has done its calculations, then those columns of the Jacobian which are related to nodes connected to tielines are transmitted to the coordinating processor. The coordinating processor does its calculations and transmits the relevant subvectors to the appropriate area. This procedure continues until a solution is

obtained.

Results show computation times between the decomposed simulator and the centralised simulator using a Perkin Elmer 3230 minicomputer. The size of each network and the amount of data needed to be transferred between the coordinating processor and the area simulators is also presented. It was found that the algorithm was well suited to parallel processing implementation using minicomputers interconnected by a fast communication medium or on a parallel microprocessor system.

In [7], a simulator is described that uses a decomposition technique to solve the load flow. This method exploits the physical configuration of the system yielding the natural uncoupling points. The technique is based on branch tearing, where a given network is decomposed at its loosely coupled branch points. Each cluster is solved on a different processor and the results combined by a central processor.

A two level architecture is given in this paper. A common bus is used to interconnect all processing nodes that form the first level. The second level is created by clustering the nodes into sets that can communicate on a local bus. Each processing node contains a processor, support hardware, local access memory and dual-port memory. The dual port memory is accessible to any processor via the common bus. The system built is based on the INTEL Multibus. An IBM-XT host microcomputer is the central processor used for coordination.

The decomposed load flow algorithms that have been studied are well suited for MIMD machines. Each processor does its calculations on the different subsystems in parallel. It has the advantage that each subsystem is small so that the processing time is less for each processor than for the system if solved as a whole. Another advantage is that for system expansion the processing time should not increase if additional local processors are added. It has the disadvantage that a coordinating processor is needed which adds additional time in message passing from the local processors to the coordinating processor and each is idle while the other performs

its calculations. Also, a good method has to be used to subdivide the system into different sections. Therefore, the objectives for this type of algorithm would be to have low overall solution time, full utilization of the subsystem computers, and low interprocessor data transfer.

5.3.2 Other Solutions

In an actual power system, all of the generators and loads are running in parallel. Using this viewpoint, a prototype of a multiprocessor system is given in [71] to solve the load flow problem in parallel. The method uses the Gauss-Seidel iterative algorithm. In this method, each node can calculate its own equations at one time and parallel processing is used. No inverse matrix calculation is needed and it requires a small amount of data for the calculation.

The architecture proposed consists of several Local Processor Units (LPUs), a Main Processor Unit(MPU), a Control Bus and a Transfer Bus. Each LPU corresponds to each node or bus in the power system. A transfer bus corresponds to a node connection, and data will be transferred only between two nodes which are connected by the transfer bus. For large systems a common bus is used for data transfer. This increases the time for transferring data between nodes.

The results of comparing the multiprocessor system with a sequential machine (COSMO-700-II) is given in this paper. As the power system becomes larger, it is shown that the total time for the multiprocessor system becomes less than in the COSMO-700-II. Some of the problems found were that as the system became larger the number of LPUs needed increased, and that the Gauss iterative method requires many iterations to converge.

In [73], an algorithm is proposed to solve the load flow problem using elemental-schemes. Elemental operations refer to operations performed on individual elements of a matrix. This exploits the parallelism existing when considering elemental operations

and does not require natural clusters to exist. The algorithm is applied to the Fast Decoupled Load Flow and the results are provided in the paper.

The algorithm takes a given system and groups the factorization operations into blocks, where each block consists of the inversion of a diagonal element and the update operations involving this inverted element. Precedence rules are obtained from a simple directed path graph. Forward elimination and backward substitution that are part of the Fast Decoupled Load Flow algorithm are done similarly to the factorization.

The main problem with this kind of parallelism is the need to find efficient precedence rules among elemental computations that allow parallel execution without excessive overhead. This was shown in the results that are provided in this paper using two or three processors, efficiency was less for more processors because of increased overhead.

In [70], a method to develop asynchronous procedures is given. The algorithms used for the load flow solution used at the time of this article are synchronous, and cannot be broken into parallel processes for concurrent execution without inserting a number of synchronization points. The resulting delays and communication overheads grow with the number of processors. They develop concepts useful in thinking about asynchronous procedures, discuss a model after which they may be patterned, introduce some new convergence results and present some illustrations of how to construct asynchronous procedures. The Gauss-Seidel, modified for asynchronous processing, was run, and simulated results of the different states of the network given. The error shown is the average difference between the actual state of the network and the calculated state. As a processor is added, the error of the system decreases.

A general load flow algorithm of the Gauss iterative type (given in [81]) is well suited for parallel processing. A Jacobi or Gauss-Seidel type iteration is performed between a set of arbitrarily designated unique incoming branches at each bus and the

other branches connected to the bus. This load flow algorithm directly uses complex voltage and power values, and is based on the electric power transmission system and the power transmission line rather than the network-analysis based ideas used in the conventional load flow algorithm.

5.3.3 EPRI Research

The Electrical Power Research Institute (EPRI) has sponsored projects to investigate new advanced computers and computational approaches, to demonstrate how they can be used to analyze power flows more quickly. In October 1980 in Dallas, utility engineers and computer staff, consultants, researchers, and EPRI staff gathered to exchange information on utility-related research and experiences with parallel processing [20]. Presentations in this conference introduced the concept of parallel processing and discussed its potential uses in power system planning and operations. Two utilities, Bonneville Power Administration and Northeast Utilities Service Company, gave their experience with array processors. The array processor worked up to ten times faster than the serial computers. However, they required assembly language programming to achieve such speed. The performance of a combination host computer and array processor approximately equaled that of serial computers, because of the time required for communication between the two machines.

A few projects sponsored by EPRI were spin offs from the above conference. In one of these projects, the objective was to develop a power flow computer program for use with an array processor computer [58]. Advantages and disadvantages of using array processors for solving on-line problems were to be evaluated.

A complete AC power flow code based on the fast decoupled algorithm was developed for the Floating Point Systems AP-120B array processor and its host computer. This program was able to solve a simple 118 bus power flow problem five times faster than a large computer alone could. The problem is that analyzing an isolated power

flow is not a cost-effective task for an AP-120B. The data transfer time between host and array processor, together with the large input/output requirements, cause the array processor to be idle during most of the run. The array processor would be beneficial in the evaluation of the effect of many outages applied in sequence to a power system. In this problem, the array processor can solve a base case power flow plus the full AC power flow for a list of contingencies without returning control to or communicating with the host computer. It would be capable of evaluating at least 100 contingencies per minute for a 1000 bus power system.

In 1985 EPRI sponsored another research in the parallel solution of algebraic equations [53]. The approach taken was to use parallel processing to solve large sets of sparse simultaneous linear algebraic equations by breaking a single computation into a set of parallel computations that uses basic mathematical operations such as addition and multiplication. The researchers developed a new algorithm designed to subdivide matrices further than other methods. They used the program evaluation and review technique to determine the critical path for the required calculations, and developed a scheduling algorithm for a set of parallel processors that would minimize total computation time.

The algorithm developed uses an iterative approach to subdivide the matrix. The method repeatedly selects a set of partitions and schedules the use of the processors for each set until the results show no improvement over the previous iteration. The scheduling algorithm includes the computation time of the individual processors, and the communication time between processors. The major result from this project was that, when using the multiple factoring algorithm, the precedence requirements in the parallel solution are not the limiting factor. The algorithm overhead required by the extra control statements is responsible for most of the loss in efficiency. This is a function of how well the programs are written and the characteristics of the microprocessors used.

Another project sponsored by EPRI investigated the use of an array processor for solving the power flow problem [19]. The objectives were to implement the Bonneville Power Administration power flow code on the Floating-Point Systems array processor, and to evaluate the ability of this processor to solve the power flow computations and power system network problems efficiently.

The Newton-Raphson solution algorithm portion of the power flow was redesigned. The solution code was run on a VAX 11/780 supermini computer, then on the VAX 11/780 using a model FPS-164 array processor, and again on the VAX 11/780 using a larger model FPS-264 array processor. The results obtained were that running the power flow program on the FPS-164 (including input/output) did not increase the run speed significantly. Using the faster model FPS-264 the total run, including input/output took one-fourth of the time of the original code.

A concurrent processing scheme based on commercially available microprocessors was the approach taken for power system analysis in [54]. Existing programs were run on a specially developed computer architecture. The objectives were to investigate the feasibility of using a concurrent processor architecture to solve the power system analysis problems, and to identify the most adequate computer architecture and estimate its cost effectiveness using the EPRI transmission system reliability methods program as a benchmark.

The project was implemented on a VAX 11/780 and on an IBM personal computer based on the Intel 8086 and 8087 microprocessors. Implementation and testing of a power system reliability program and its test cases demonstrated that a system of microcomputers has a cost effective advantage of a least five to one. Contingency analysis was suggested as a good application for this approach.

5.4 Load Flow Solution

The parallel machine, PLF, described in the first sections will be used in solving of the load flow analysis problem. As previously stated, load flow is mathematically represented as a set of nonlinear sparse equations. The goal is to be able to solve these equations in a much faster time than done now. The next sections explain how the PLF is used to solve the load flow problem. The convergence of this system is also demonstrated.

5.4.1 Parallel Machine Configuration

For the particular problem being studied, the PLF system proceeds as follows. The Control Unit will have the information of the power system. It will treat each Processing Unit as being a bus in the system. This unit will set up the Switching Network according to the model of the power system being analyzed.

Each Processing Unit is numbered in ordered. The following bus information is given to each Processing Unit.

- type of bus-load , slack, generation , etc.
- bus number and name
- number of the buses connected to it-branches
- known values-voltages, loads, taps, etc.
- known values of buses connected to it-voltages,loads, taps, etc.

Each Processing Unit stores this information in its local memory. When the signal is sent, each Processing Unit starts to set up its communication lines. Each Processing Unit can simultaneously set up a sending line with another Processing Unit if they are connected.

Once the circuit is set up and a node has all the information it needs, it can start its calculations. Depending on what type of bus it is representing, each Processing Unit will solve a different equation or set of equations. When a result is obtained, the Processing Unit sends the answer out through its sending circuits and reads incoming values from the receiving lines.

5.4.2 Convergence of the System

A general load flow algorithm of the Jacobi type is constructed in [82]. A region of convergence is defined for this algorithm using the concept of generalized block diagonal dominance for sets of quadratic algebraic equations. The PLF system uses the same type of algorithm and equations therefore will also converge.

The rate of convergence of this algorithm is shown in the plot of Figure 13. The number of iterations is plotted against the log 10 of the magnitude of the largest error at each iteration.

Figure 14: Rate of Convergence

6 LOADFLOW PERFORMANCE EVALUATION

A software simulation of PLF was developed in order to demonstrate the feasibility of the system and evaluate the dynamic performance of the system. The simulation was written in FORTRAN since most power flow analysis at the time are written in FORTRAN. It is run on a Sun Computer. The simulation is capable of running a Newton Raphson power flow, Gauss-Seidel power flow , and the Parallel Load Flow (PLF) .

The test cases used were the following: 6-bus test case, 14-bus IEEE, 30-bus IEEE, 57-bus IEEE, 118-bus IEEE, and 1883-bus FPL test data [57]. The data were divided as given in the next section.

6.1 Software Simulation

This section explains the simulation for the analysis of the load flow. It shows how the data of a bus is represented at each Processing Unit. The information needed by each Processing Unit and the data that is shared is explained.

6.1.1 Data Input

Each bus has certain data that needs to be known to that Processing Unit only. This we will call the bus data record. It is the information that has to do with each bus independently of other buses. This data is input to each Processing Unit and has the following format:

- busno: the number given to each bus
- busname: the name given to each bus
- pload: load real power to be held constant and entered as MW

- qload: load reactive power to be held constant and entered as MVAR

Each Processing Unit that is to represent a generator or plant bus must be specified in a generator data record. The generator data record has the following format:

- genbusno: the number of the bus where the generator is at
- pgen: generator real power output entered in MW
- qmax: maximum generator reactive power output entered in MVAR
- qmin: minimum generator reactive power output entered in MVAR
- vsched: regulated voltage set point entered in p.u.

For each line or branch to be represented in the load flow a line data record is needed. This data is later distributed to each Processing Unit that needs it. The line data record has the following format:

- frombus: branch "from bus" number
- tobus: branch "to bus" number
- r: branch resistance entered in p.u.
- x: branch reactance entered in p.u.
- bcap: total branch charging susceptance entered in p.u.
- linetype: the type of line either "line" if branch is a line or "tran" for a transformer branch. If it is a transformer then a transformer record follows immediately with the transformer tap information.

The transformer data record follows immediately after the line data record for the transformer branch. The format for the transformer branch data is the following:

- tapbus: this is the tapped side of the transformer
- nontapbus: this is the nontap side of the transformer and the
- impedance side bus
- tapratio: transformer off-nominal turns ratio entered in p.u.

Each bus in the network that has a switch shunt admittance device must have a switched shunt data record. The format for the switched shunt data record is the following:

- capbusno: the bus number where the device is located
- cap: switch shunt admittance entered in MVAR.

6.1.2 Data Types

Once entered the data is distributed to each Processing Unit that needs it. The following information is needed at each Processing Unit:

- ties: the number of buses connected to this Processing Unit or the number of branches at the bus.
- connect: the bus numbers for each bus that has a line to it. This is a pointer table to the buses connected at that bus.
- busno: the number for the bus.
- busname: the name for the bus.
- psched: load real power for the bus.
- qsched: load reactive power for the bus.
- qqmax: if the bus is a generator this is the maximum reactive power.

- qqmin: if the bus is a generator this is the minimum reactive power.
- volt: the complex voltage set to $1.0+j0.0$ if it is a non-generator bus or vsched if it is a generator bus.
- bustype: the type of bus either line, generator, transformer, or swing bus.
- vmag: real part of voltage or its magnitude.
- phase: imaginary part of volt or its phase.
- voltto: the voltage at the bus of the branch connected to that bus.
- tapinfo: the tap information.
- tranconnect: the buses that have transformers connected to that bus. A pointer to the transformers connected to that bus.

Each bus on the average has two to three branches connected to it. Therefore, for each Processing Unit, the length of a record will be one or two data items. There are three types of data. Constant bus information once entered is not changed. The bus data that are calculated change with each iteration. The bus data of connecting branches vary with each iteration.

6.1.3 Data Calculated

Once all the processors have the data they need, the equations for each bus need to be calculated. The calculations can be divided into two sets of equations.

The first step each process must take is to determine what bus type it is. For each bus type, different input data must be calculated. Depending on what components are connected to a bus the calculations will vary. The five basic components are considered in the following sections.

Fixed Bus Data	Varying Bus Data	Varying Branch Data
ties	volt	voltto
connect	phase	vmag
busno	vmag	phase
psched		
qsched		
qgen		

Table 5: Data Type Per Bus

6.1.4 Generators

A specified amount of real power, P_G , is generated at a specified terminal voltage magnitude V_{sched} . The generator also has production or consumption of reactive, Q_G depending on the excitation level (field currents). Limitations on these quantities are given:

$$qmin \leq q \leq qmax,$$

$$vmin \leq volt \leq vmax.$$

The reactive limits are determined by excitation system limitations. These quantities are known to each bus. Terminal voltage limits are functions of service quality considerations and are usually a few percentage points off rated terminal voltage. These quantities are known at each processor.

6.1.5 Transformers

The impedance for a transformer branch has to be calculated from the data the processor has. Each bus has the tap ratio, if it is the tap side or non tap side, its

resistance and its reactance. The following calculations are done per bus.

$$Y_{ij} = tapY_{ij}$$

$$Y_{Sij} = -tap(1 - tap)Y_{ij}$$

$$Y_{Sji} = (1 - t)Y_{ij}$$

where i is the tap side bus and j is the non tap side bus.

6.1.6 Transmission Lines

The impedance of a transmission line for each bus must also be calculated. Each processor knows its line series resistance and its reactance. The following calculations are done at each bus for all its transmission branches.

$$Y_{ij} = \frac{1}{\frac{R_{ij}}{R_{ij}^2 + X_{ij}^2} - j \frac{X_{ij}}{R_{ij}^2 + X_{ij}^2}} \quad (6.81)$$

6.1.7 Load

The load at each bus is a complex mix of small devices, appliances, lights, or larger components like furnaces, motors, and so on. A detailed knowledge of the load composition is not necessary. Real power consumption and its associated power factor is what is of interest at the bulk power level. This is the same as specifying real and reactive power consumption. Therefore, these two values are specified at each load bus.

6.1.8 Shunt Capacitors and Inductors

These devices are used for voltage control in the system. If real and reactive demand is high in a system, voltages will tend to decrease to unacceptable levels. Capacitors are switched on to increase reactive production and increase bus voltages. Under low real and reactive demand levels, line charging capacitance may be enough to increase

buses	lines	generators	transformers	capacitance
6	11	3	0	0
30	41	6	4	2
57	80	7	17	3
118	179	21	9	14
1883	2004	222	149	59

Table 6: Test Case

voltages above its limits. Switching inductors on will create reactive load that will tend to reduce voltages to acceptable levels under valley load conditions.

6.2 Results

The Newton-Raphson load flow, Gauss-Seidel load flow and the PLF were run for the different scenarios. A six bus, 30 bus-IEEE, 57 bus-IEEE, 118 bus-IEEE and 1883 bus FPL systems were used for test cases. The data was broken down as shown in the Table 6:

Each test case was run to find the time of convergence, number of iterations, and the time to construct the Y matrix. Table 7 shows the time for the convergence of the Newton Raphson and the PLF. The results show that an increase in the number of nodes of a system does not effect the solution time for the PLF system.

The times that are shown in the table are the times that it took each of the above algorithms to converge. The number shown is in seconds. It is the average or mean taken over running each case 25 times.

An advantage of the PLF architecture is that the Y matrix does not have to be constructed. Each node figures its own impedance and does not need that value of the other nodes. This is a big savings in time when the number of buses increases.

buses	N-R	PLF
6	1.07	.020
30	13.25	.023
57	31.29	.027
118	55.49	.028
1883	180.40	.033

Table 7: Time for Convergence

Unit of time is in seconds.

procedure	precision	case 1	case 2	case 3	case 4
Newton-Raphson	.001	3	3	4	3
Newton-Raphson	.00001	6	6	7	6
PLF	.001	19	18	19	17
PLF	.00001	25	27	31	28

Table 8: 30 Bus - Number of Iterations

For the 1883 FPL test case it takes .43 seconds to calculate the entire Y matrix. For the PLF architecture it is the time for three multiplications and 3 additions.

For each case the data was changed to run different scenarios of the same number of buses. The number of iterations for each to converge were taken and the results are given below.

In conclusion, as the number of buses in the system increases, the time for convergence for the Newton-Raphson and for the Gauss-Seidel algorithm increases. The time for convergence for the PLF is maintained constant since the calculations are done in parallel. It does not matter how many buses are added as the calculation

procedure	precision	case 1	case 2	case 3	case 4
Newton-Raphson	.001	3	4	4	3
Newton-Raphson	.00001	8	8	9	8
PLF	.001	18	19	20	18
PLF	.00001	47	47	53	46

Table 9: 57 Bus - Number of Iterations

procedure	precision	case 1	case 2	case 3	case 4
Newton-Raphson	.001	4	5	5	5
Newton-Raphson	.00001	10	10	11	11
PLF	.001	19	20	20	18
PLF	.00001	45	49	50	51

Table 10: 118 Bus - Number of Iterations

procedure	precision	case 1	case 2
Newton-Raphson	.001	10	12
Newton-Raphson	.00001	23	28
PLF	.001	78	87
PLF	.00001	158	167

Table 11: FPL Test Case - Number of Iterations

per node does not change. Each bus still has the same equation and the number of connections is still at an average of five.

7 CONCLUSION

The PLF system is a new technique for solving a class of sparse non-linear equations. It consist of software and a parallel architecture used to solve this type of problem.

The software used to solve these equations is based on the Jacobi iterations. A successive overrelaxation method that uses an acceleration factor on the Jacobi iterations, reduce the number of iterations needed for convergence.

The architecture of PLF is a Multiple Instruction Multiple Data (MIMD) machine based on the INMOS Transputer and C004. It consist of Processing Units that perform the calculations. A Switching Networks that provides the communication of the data. The Control Unit sets up the network.

The Processsing Unit consist of a set of T800 Transputers. These Transputers have four input/output links. The architecture can be improved with new generation of Transputer that have more links.

The switching Network consist of a three stage Clos network made with C004s. With the new generation of C004s there can be an improvement. The network can also be simplified by joining the Processing Units to each other. This depends on the specific problem being analyzed but it will decrease the communication time.

This architecture has been used to test for the solution of the load flow analysis. This network can be used to perform other power network analysis. Each bus has been represented by a Processing Unit. The switching network will represent the connectivity of the power network.

After testing a few networks, the proposed PLF system has proven to increase processing speed by a factor of 2000 as compared to present day techniques. Adding more nodes to this system does not effect the overall processing speed since each will perform in parallel.

7.1 Future Research

There are other topics that are left for future research. Fault tolerance is an issue that has not been discussed here but is easily fitted into this architecture. Any node can be replicated by having more than one node solve for one equation.

Nonsparse systems of equations can also be run using this system. The Processing Unit would need to be modified to allow for more incoming data. The effects of this would have to be tested.

Other possibility of methods for solving the equations can also be developed. There might be other algorithms suited to run on this architecture.

This system can be incorporated into an open system environment. It can be used as a workstation and connected to a network of other workstations.

Larger systems can be developed for other applications. More nodes would have to be added. By adding more nodes the computation bandwidth and the communication bandwidth increase. The size of the problem is therefore not bounded by the computer architecture.

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A STOPPING ALGORITHM

ALGORITHM SYSTEM TERMINATION

* Convergence is 1 and nonconvergence is 0

PAR i=1 to numnodes

conv(i)=0

* Do until convergence of system

Do Until STOP

* Read in new values for children

For j=1 to numchild

Read child(j)

End For

* Perform calculations

If (converged) then conv(i)=1

* Check if ther is node convergence

For j=1 to numchild

conv(i) = conv(i) .and. child(j)

End For

* Send message to parent

Send conv(i) to Parent Node

* Read Parent to see if it is a stop

Read Parent Node

End Do

End PAR

B SWITCH SETUP

ALGORITHM SWITCH SETUP

```
tableofconnections is null
connection is False
For  $i = 1, n$ 
    While  $j = 1, 8$  Or connection Do
        If Connection( $i, j$ ) in tableofconnections
            then connection
        While  $k = 1, 4$  Or not portavailable Do
            If oport $_{i,k}$  available
                then portavailable
        End While
        If not portavailable
            then make – port – available( $PU_i$ , output).
        While  $k = 1, 4$  Or not portavailable Do
            If ipor $t_{j,k}$  available
                then portavailable
        End While
        If not portavailable
            then make – port – available( $PU_j$ , input).
        Add To tableofconnections connection
        oport $_{i,k}$  with ipor $t_{j,k}$ 
    End While
End For
```

C ALGORITHMS

This section includes the parts of the algorithms used to test the PLF in Fortran.

Program Loadflow

```
*
*   MARIA CEREIJO MARTINEZ
*
*   A NEW PARALLEL TECHNIQUE FOR THE SOLUTION OF THE
*   LOAD FLOW ANALYSIS
*
*   A PROGRAM WRITTEN FOR THE ABOVE DISSERTATION FOR THE
*   REQUIREMENTS OF A DOCTOR OF PHILOSOPHY IN COMPUTER SCIENCE
*
*   FLORIDA INTERNATIONAL UNIVERSITY
*   MIAMI, FLORIDA
*
*   MARCH 1993
*
*   THIS PROGRAM CALCULATES THE POWER SYSTEM LOAD FLOW ANALYSIS.
*   GAUSS-SEIDEL OR NEWTON-RAPHSON ALGORITHMS CAN BE RUN.
*   A SIMULATION OF A PARALLEL ALGORITHM, PLF, CAN ALSO RUN.
*
i = 1
do while (i .ne. 0)
  print *, 'Menu of Options'
  print *
  print *, '0--quit'
  print *, '1--print input data'
  print *, '2--build Jacobian matrix'
  print *, '3--run Gauss-Seidel loadflow'
  print *, '4--run Newton-Raphson loadflow'
  print *, '5--run Plf'
  print *, '6--print output data'
  print *
  print *, 'enter option number'
  read *, i
  PRINT THE INPUT DATA TO A FILE
  if (i .eq. 1)
    call Outputdata
  BUILD THE JACOBIAN MATRIX
  if (i .eq. 2)
    call Buildjacobian
  RUN A GAUSS SEIDEL TYPE ALGORITHM
  if (i .eq. 3)
    call GaussSeidel
  RUN A NEWTON RAPHSON TYPE ALGORITHM
  if (i .eq. 4)
    call NewtonRaphson
  RUN THE SIMULATION OF PARALLEL ALGORITHM
  if (i .eq. 5)
    call Plf
  PRINT SOLUTION TO A FILE
  if (i .eq. 6 )
    call Printsolution
end do
stop
end
```

```

Subroutine Ymatrix
* THIS SUBROUTINE WILL CALCULATE THE YMATRIX
do 900 i=1, numbuses
  do 901 j=1,ties(i)
    y(i,j)=cmplx(0,0)
901  continue
    y(i,21)=cmplx(0,0)
    do 902 k=1,ties(i)
      g=rr(i,k)/(rr(i,k)*rr(i,k)+xx(i,k)*xx(i,k))
      b=-xx(i,k)/(rr(i,k)*rr(i,k)+xx(i,k)*xx(i,k))
      j=connect(i,k)
      tempy=cmplx(g,b)
      if (tranconnect(i,k) .eq. j)then
        if(tapinfo(i,k) .eq. 'tap') then
          y(i,k)=y(i,k)-(tempy/trandata(i,k))
          tempy=cmplx(g,b+bbcap(i,k)+capbus(i))
          y(i,21)=y(i,21)+
c          (((1-trandata(i,k))/(trandata(i,k))**2)*tempy)+
c          (cmplx(g,b)/trandata(i,k))
        else
          y(i,k)=y(i,k)-(tempy/trandata(i,k))
          tempy=cmplx(g,b+bbcap(i,k)+capbus(i))
          y(i,21)=y(i,21)+
c          (((trandata(i,k)-1)/trandata(i,k))*tempy)
c          +(cmplx(g,b)/trandata(i,k))
        end if
      else
        y(i,k)=y(i,k)-tempy
        tempy=cmplx(g,b+bbcap(i,k)+capbus(i))
        y(i,21)=y(i,21)+tempy
      end if
    continue
902  continue
900  continue
end

```

```

Subroutine Buildjacobian
* THIS SUBROUTINE CALCULATES THE JACOBIAN MATRIX
do 400 i=1, numbuses
  sumvy(i)=cmplx(0,0)
  do 410 j=1,ties(i)
    dpdvr(i,j)=0
    dpdvi(i,j)=0
    dqdvr(i,j)=0
    dqdvi(i,j)=0
    vy=voltto(i,j)*y(i,j)
    sumvy(i)=sumvy(i)+vy
    do 3 jj=1,numbuses
      if (busno(jj) .eq. connect(i,j)) then
        if (bustype(i) .eq. 'load' .or.
c         bustype(i) .eq. 'genhighvar' .or.
c         bustype(i) .eq. 'genlowvar') then
c         if (bustype(jj) .eq. 'load' .or.
c         bustype(jj) .eq. 'genhighvar' .or.
c         bustype(jj) .eq. 'genlowvar') then
          dpdvr(i,j)=real(vy*(conjg(volt(i))))
          dpdvi(i,j)=aimag(conjg(vy)*volt(i))
          dqdvr(i,j)=aimag(conjg(vy)*volt(i))
          dqdvi(i,j)=-real(vy*(conjg(volt(i))))
        else if (bustype(jj) .eq. 'genreg') then
          dpdvi(i,j)=aimag(conjg(vy)*volt(i))
          dqdvi(i,j)=-real(vy*(conjg(volt(i))))
        end if
      else if (bustype(i) .eq. 'genreg') then
        if (bustype(jj) .eq. 'load' .or.
c         bustype(jj) .eq. 'genhighvar' .or.
c         bustype(jj) .eq. 'genlowvar') then
          dpdvi(i,j)=aimag(conjg(vy)*volt(i))
          dpdvr(i,j)=real(vy*(conjg(volt(i))))
        else if (bustype(jj) .eq. 'genreg') then
          dpdvi(i,j)=aimag(conjg(vy)*volt(i))
        end if
      end if
    end if
  continue
3  continue
410 sumvy(i)=sumvy(i)+volt(i)*y(i,21)
  p(i)=real(volt(i)*conjg(sumvy(i)))
  q(i)=aimag(volt(i)*conjg(sumvy(i)))
  vm2=vmag(i)*vmag(i)
  if (bustype(i) .eq. 'load' .or.
c   bustype(i) .eq. 'genhighvar' .or.
c   bustype(i) .eq. 'genlowvar') then
    dpdvr(i,21)=p(i)+real(y(i,21))*vm2
    dpdvi(i,21)=-q(i)-aimag(y(i,21))*vm2
    dqdvr(i,21)=q(i)-aimag(y(i,21))*vm2
    dqdvi(i,21)=p(i)-real(y(i,21))*vm2
  else if (bustype(i) .eq. 'genreg') then
    dpdvi(i,21)=-q(i)-aimag(y(i,21))*vm2
  end if
400 continue
end

```

```

Subroutine NewtonRaphson
* THIS SUBROUTINE IS A NEWTON-RAPHSON ALGORITHM. IT CALLS
* JACOBIAN THEN DOES A GAUSSIAN ELIMINATION TO SOLVE
* THE SYSTEM.
  pmaxmismatch=0
  qmaxmismatch=0
  novarlimiting='false'
  iter=0
  do while (iter .le. 75 .and. (pmaxmismatch .ge. .0001 .or.
c   qmaxmismatch .ge. .0001 .or. novarlimiting .eq. 'false'))
    iter=iter+1
    pmaxmismatch=0
    qmaxmismatch=0
    do 580 i=1, numbuses
      delmag(i)=0
      delphase(i)=0
      deltap(i)=0
      deltaq(i)=0
580   continue
      call buildjacobian
      do 500 i=2, numbuses
        deltap(i)=psched(i) - p(i)
        if (abs(deltap(i)) .gt. pmaxmismatch) then
          pmaxmismatch = abs(deltap(i))
          maxpbus=busno(i)
        end if
        if (bustype(i) .eq. 'load' .or.
c         bustype(i) .eq. 'genhighvar' .or.
c         bustype(i) .eq. 'genlowvar') then
          deltaq(i)=qsched(i) - q(i)
          if (abs(deltaq(i)) .gt. qmaxmismatch) then
            qmaxmismatch= abs(deltaq(i))
            maxqbus=busno(i)
          end if
        end if
500   continue
        if (pmaxmismatch .lt. .01 .and.
c         qmaxmismatch .lt. .01) go to 595
*   DO GAUSSIAN ELIMINATION
        do 590 i=1,numbuses
          if (bustype(i) .ne. 'swing') then
            j=21
            if (bustype(i) .eq. 'load' .or.
c             bustype(i) .eq. 'genhighvar' .or.
c             bustype(i) .eq. 'genlowvar') then
              detd=dpdvi(i,21)*dqdvvr(i,21)-dqdvvi(i,21)*dpdvvr(i,21)
              d11=dqdvvr(i,21)/detd
              d12=-dpdvvr(i,21)/detd
              d21=-dqdvvi(i,21)/detd
              d22=dpdvvi(i,21)/detd
            else if (bustype(i) .eq. 'genreg') then
              d11=1/dpdvi(i,21)
              d12=0
              d21=0
              d22=0
            end if
            tdeltap=d11*deltap(i)+d12*deltaq(i)
            tdeltaq=d21*deltap(i)+d22*deltaq(i)
            deltap(i)=tdeltap
            deltaq(i)=tdeltaq
          do 588 k=1, numbuses

```

```

do 59 kk=1,ties(i)
  if (busno(k) .eq. connect(i, kk)) then
    tdpdvi=d11*dpdvi(i, kk)+d12*dqdv(i, kk)
    tdpdvr=d11*dpdvr(i, kk)+d12*dqdv(i, kk)
    tdqdv=d21*dpdvi(i, kk)+d22*dqdv(i, kk)
    tdqdv=d21*dpdvr(i, kk)+d22*dqdv(i, kk)
    dpdvi(i, kk)=tdpdvi
    dpdvr(i, kk)=tdpdvr
    dqdv(i, kk)=tdqdv
    dqdv(i, kk)=tdqdv
  end if
59      continue
588      continue
do 58 j=1,ties(i)
  if (connect(i, j) .lt. busno(i)) then
    tdpdvi=dpdvi(i, j)
    tdpdvr=dpdvr(i, j)
    tdqdv=dqdv(i, j)
    tdqdv=dqdv(i, j)
    do 60 jj=1, numbuses
      if (busno(jj) .eq. connect(i, j)) then
        c      deltap(i)=deltap(i)-
        (tdpdvi*deltap(jj)+tdpdvr*deltap(jj))
        c      deltaq(i)=deltaq(i)-
        (tdqdv*deltap(jj)+tdqdv*deltap(jj))
      end if
60      continue
do 589 k=j,ties(i)
  do 89 kk=1,numbuses
    if (busno(kk) .eq. j) then
      c      dpdvi(i, k)=dpdvi(i, k)-
      (tdpdvi*dpdvi(kk, k)+tdpdvr*dqdv(kk, k))
      c      dpdvr(i, k)=dpdvr(i, k)-
      (tdpdvi*dpdvr(kk, k)+tdpdvr*dqdv(kk, k))
      c      dqdv(i, k)=dqdv(i, k)-
      (tdqdv*dpdvi(kk, k)+tdqdv*dqdv(kk, k))
      c      dqdv(i, k)=dqdv(i, k)-
      (tdqdv*dpdvr(kk, k)+tdqdv*dqdv(kk, k))
    end if
89      continue
589      continue
  end if
58      continue
end if
590      continue
* DO BACK SUBSTITUTION
do 510 i=numbuses, 1, -1
  delphase(i)=deltap(i)
  delmag(i)=deltaq(i)
  if (i .lt. numbuses) then
    do 520 j=i+1, numbuses
      do 52 jj=1,ties(i)
        if (connect(i, jj) .eq. busno(j)) then
          c      delphase(i)=delphase(i)-
          (dpdvi(i, jj)*delphase(j)+dpdvr(i, jj)*delmag(j))
          c      delmag(i)=delmag(i)-
          (dqdv(i, jj)*delphase(j)+dqdv(i, jj)*delmag(j))
        end if
52      continue
520      continue
    end if
end if

```

```

510      continue
      do 530 i=1,numbuses
        phase(i)=phase(i)+delphase(i)
        vmag(i)=vmag(i)*(1+delmag(i))
        volt(i)=cplx(vmag(i)*cos(phase(i)),vmag(i)*sin(phase(i)))
        do 53 j=1,numbuses
          do 54 jj=1,ties(j)
            if(connect(j,jj) .eq. busno(i)) then
              voltto(j,jj) = volt(i)
            end if
          continue
        continue
      53      continue
530      continue
595      if (pmaxmismatch .lt. .01 .and.
c        qmaxmismatch .lt. .01) then
        novarlimiting='true'
        do 596 i=1,numgen
          jj= genbusno(i)
          do 95 j=1,numbuses
            if (busno(j) .eq. jj) then
              if (bustype(j) .ne. 'swing') then
                qgen(i)=q(j)+qload(j)
                if (qgen(i) .gt. qmax(i)) then
                  qsched(j)=qmax(i) - qload(j)
                  if (bustype(j) .ne. 'genhighvar') then
                    novarlimiting='false'
                    write(35,*)'gen ',i,' is at max var limit'
                    bustype(j)='genhighvar'
                  end if
                else if(qgen(i) .lt. qmin(i)) then
                  qsched(j)=qmin(i)-qload(j)
                  if(bustype(j) .ne. 'genlowvar') then
                    novarlimiting='false'
                    write(35,*)'gen ',i,' is at min var limit'
                    bustype(j)='genlowvar'
                  end if
                else if(qgen(i) .ge. qmin(i) .and.
c                  qgen(i) .le. qmax(i)) then
                  bustype(j)='genreg'
                end if
              end if
            end if
          continue
        95      continue
596      continue
      end if
    end do
  end

```



```

Subroutine Plf
*   THIS SUBROUTINE WILL RUN THE GAUSS-SEIDEL ALGORITHM IN
*   PARALLEL USING THE PARALLEL DATA.
  iter=0
  pmaxmismatch=0
  qmaxmismatch=0
  novarlimiting='false'
  do while (iter .le. 150 .and. (pmaxmismatch .ge. .0001 .or.
c qmaxmismatch .ge. .0001 .or. novarlimiting .eq. 'false'))
    iter=iter+1
    pmaxmismatch=0
    qmaxmismatch=0
    perrorbus=0
    qerrorbus=0
    do 600 i=1, numbuses
      if (bustype(i) .ne. 'swing') then
        oldv=volt(i)
        pq=cmplx(psched(i),qsched(i))
        templ=conjg(pq/volt(i))
        soffdia=cmplx(0,0)
        ic=99999
        do 610 j=1,ties(i)
          if(ic .ne. connect(i,j)) then
            soffdia=soffdia+(voltto(i,j)*y(i,j))
            ic=connect(i,j)
          end if
610      continue
        templ=templ-soffdia
        e=templ/y(i,21)
        changevnew=e-oldv
*       THIS IS AN ACCELERATOR FACTOR
        e=oldv+1.6*changevnew
        emag=sqrt(real(e)*real(e)+aimag(e)*aimag(e))
        ephase=atan(aimag(e)/real(e))
*       IF THE BUS IS A GENERATOR BUS THEN THE VOLTAGE MAGNITUDE
*       IS SET TO THE SCHEDULED MAGNITUDE AND A NEW REACTIVE
*       POWER IS CALCULATED
        if (bustype(i) .eq. 'genreg') then
          emag=vmag(i)
          e=cmplx(emag*cos(ephase),emag*sin(ephase))
          templ=y(i,21)*e
          templ=templ+soffdia
          templ=conjg(templ)
          templ=templ*e
          qsched(i)=aimag(templ)
        end if
        volt(i)=e
        vmag(i)=emag
        phase(i)=ephase
      end if
*     UPDATE THE VOLTTO MATRIX. THIS WOULD BE THE COMMUNICATION
*     TO CONNECTING NODES.
      do 660 k=1,ties(i)
        do 663 kk=1,numbuses
          if (busno(kk) .eq. k) then
            do 666 kkk=1,ties(kk)
              if (connect(kk,kkk) .eq. busno(i)) then
                voltto(kk,kkk)=volt(i)
              end if
666          continue
            end if
          end if

```

```

663         continue
660     continue

600     continue
*   CALCULATE THE POWER AT EACH BUS
    do 621 i=1,numbuses
        pv(i)=0
        ic=99999
        do 620 j=1,ties(i)
            if(ic .ne. connect(i,j)) then
                pv(i)=pv(i)+voltto(i,j)*y(i,j)
                ic=connect(i,j)
            end if
620     continue
        pv(i)=pv(i)+volt(i)*y(i,21)
        p(i)=real(volt(i)*conjg(pv(i)))
        q(i)=aimag(volt(i)*conjg(pv(i)))
621     continue
        do 625 i=2,numbuses
            deltap=psched(i) - p(i)
            if(abs(deltap) .gt. pmaxmismatch) then
                pmaxmismatch=abs(deltap)
                perrorbus=busno(i)
            end if
            deltaq=qsched(i) - q(i)
            if(abs(deltaq) .gt. qmaxmismatch) then
                qmaxmismatch=abs(deltaq)
                qerrorbus=busno(i)
            end if
625     continue
*   IF THE BUS IS A GENERATOR BUS CHECK THE REACTIVE
*   POWER IS WITHIN LIMITS
        if (pmaxmismatch .lt. .01 .and.
            c   qmaxmismatch .lt. .01) then
                novarlimiting='true'
                do 622 i=2,numbuses
                    if (bustype(i).eq.'genreg'.or.bustype(i).eq.'genlowvar'
                    c   .or. bustype(i) .eq. 'genhighvar') then
                        qqgen(i)=q(i)+qload(i)
                        if(qqgen(i) .gt. qqmax(i)) then
                            qsched(i)=qqmax(i)-qload(i)
                            if (bustype(i) .ne. 'genhighvar') then
                                novarlimiting='false'
                                bustype(i)='genhighvar'
                            end if
                        else if(qqgen(i) .lt. qqmin(i)) then
                            qsched(i)=qqmin(i)-qload(i)
                            if (bustype(i) .ne. 'genlowvar') then
                                novarlimiting='false'
                                bustype(i)='genlowlimit'
                            end if
                    c   else if(qqgen(i).ge.qqmin(i).and.
                        qqgen(i).le.qqmax(i)) then
                            bustype(i)='genreg'
                        end if
                    end if
622     continue
                end if
                end do
            end
end

```

This section includes the Occam Programs used to simulate the PLF on the Transputers.

```
cat > M1.occ << !
PROTOCOL FPN IS REAL32 :
#include "hostio.inc"
PROC M1 (CHAN OF SP fs, ts, CHAN OF FPN tPO, fPO, VAL INT MNUM)
  #USE "hostio.lib"
  #USE "snglmath.lib"
  INT t1, t2:
  TIMER clock:
  REAL32 id, od

  SEQ
    od:=2.0(REAL32)
    clock ? t1
    tPO ! od
    fPO ? id
    clock ? t2
    t2 := t2 - t1
    so.write.int(fs, ts, t2, 0)
    so.write.nl(fs, ts)
    clock ? t1
    tPO ! od
    fPO ? id
    clock ? t2
    t2 := t2 - t1
    so.write.int(fs, ts, t2, 0)
    so.write.nl(fs, ts)
    so.exit(fs, ts, sps.success)
:
!

cat > S84X.occ << !
PROTOCOL FPN IS REAL32 :
#include "hostio.inc"
PROC S84X (CHAN OF FPN tPI, fPI, tPO, fPO, tRI, fRI, tRO, fRO, VAL INT
MNUM)
  #USE "hostio.lib"
  #USE "snglmath.lib"
  REAL32 id, od :

  SEQ
    od:=2.0(REAL32)
    fPI ? id
    tPO ! od
    fPO ? id
    tPI ! od

    fPI ? id
    tPO ! od
    fPO ? id
    tPI ! od
:
!
cat > S84.occ << !
PROTOCOL FPN IS REAL32 :
#include "hostio.inc"
PROC S84 (CHAN OF FPN tPI, fPI, tPO, fPO, tRI, fRI, tRO, fRO, VAL INT
MNUM)
  #USE "hostio.lib"
  #USE "snglmath.lib"
  REAL32 id, od :
```

```

SEQ
  od:=2.0(REAL32)
  fPI ? id
  SEQ k = 0 FOR 100000
    PAR
      SEQ j = 0 FOR 2
        tRO ! od
      SEQ j = 0 FOR 2
        fRO ? id
    tPI ! id

  fPI ? id
  SEQ k = 0 FOR 100000
    PAR
      SEQ j = 0 FOR 2
        tPO ! od
      SEQ j = 0 FOR 2
        fPO ? id
    tPI ! id

```

```

:
!

```

```

cat > S82.occ << !
PROTOCOL FPN IS REAL32 :
#include "hostio.inc"
PROC S82 (CHAN OF FPN tPI, fPI, tPO, fPO, tRI, fRI, tRO, fRO, VAL INT
MNUM)
  #USE "hostio.lib"
  #USE "snlmath.lib"
  REAL32 id, od :
  SEQ
    od:=2.0(REAL32)
    SEQ k = 0 FOR 100000
      PAR
        SEQ j = 0 FOR 2
          fRI ? id
        SEQ j = 0 FOR 2
          tRI ! od

      SEQ k = 0 FOR 100000
        PAR
          SEQ j = 0 FOR 2
            fPI ? id
          SEQ j = 0 FOR 2
            tPI ! od

```

```

:
!

```

```

occam -T8 -e M1 ; occam -T8 -e S84 ; occam -T8 -e S82 ; occam -T8 -e S84X

```

```

ilink M1.t8h hostio.lib convert.lib snlmath.lib

```

```

ilink S84.t8h snlmath.lib
ilink S82.t8h snlmath.lib
ilink S84X.t8h snlmath.lib

```

```

iconf joe

```

```

cat > M1.occ << !
PROTOCOL FPN IS REAL32 :
#include "hostio.inc"
PROC M1 (CHAN OF SP fs, ts, CHAN OF FPN t.1, f.1, VAL INT MNUM)
  #USE "hostio.lib"
  #USE "snlmath.lib"
  INT t1, t2:
  TIMER clock:

  PROC calculate(VAL INT ca)
    REAL32 d :
    SEQ i = 0 FOR ca
      d:=SIN(1.74832(REAL32))
    :

  PROC talk(CHAN OF FPN to, from, VAL INT out, in)
    REAL32 id, od :
    SEQ
      od:=7.5021(REAL32)
    PAR
      SEQ j = 0 FOR out
        to ! od
      SEQ j = 0 FOR in
        from ? id
    :

  -- This machine is a BUS
  --
  SEQ
    clock ? t1
    SEQ k = 0 FOR 10000
      SEQ
        calculate(2)
        talk(t.1,f.1,2,2)
      clock ? t2
      t2 := t2 - t1
      so.write.int(fs, ts, t2, 0)
      so.write.nl(fs, ts)
      so.exit(fs, ts, sps.success)
    :
  !

cat > S84.occ << !
PROTOCOL FPN IS REAL32 :
#include "hostio.inc"
PROC S84 (CHAN OF FPN t.2, f.2, t.1, f.1, t.3, f.3, t.0, f.0, VAL INT
MNUM)
  #USE "hostio.lib"
  #USE "snlmath.lib"

  PROC calculate(VAL INT ca)
    REAL32 d :
    SEQ i = 0 FOR ca
      d:=SIN(8.5279(REAL32))
    :

  PROC talk(CHAN OF FPN to, from, VAL INT out, in)
    REAL32 id, od :
    SEQ
      od:=7.4194(REAL32)
    PAR

```

```

        SEQ j = 0 FOR out
            to ! od
        SEQ j = 0 FOR in
            from ? id
    :

PROC export(CHAN OF FPN from, to1, to2, to3, VAL INT C0, C1, C2)
    REAL32 id, od1, od2, od3 :
    SEQ
        od1:=6.4582(REAL32)
        od2:=6.4582(REAL32)
        od3:=6.4582(REAL32)
        SEQ j = 0 FOR 2
            from ? id
    PAR
        IF
            (C0=1)
                SEQ j = 0 FOR 2
                    to1 ! od1
        IF
            (C1=1)
                SEQ j = 0 FOR 2
                    to2 ! od2
        IF
            (C2=1)
                SEQ j = 0 FOR 2
                    to3 ! od3
    :

PROC import(CHAN OF FPN fr1, fr2, fr3, to, VAL INT C0, C1, C2)
    REAL32 id1, id2, id3, od :
    SEQ
        od:=9.5471(REAL32)
    PAR
        IF
            (C0=1)
                SEQ j = 0 FOR 2
                    fr1 ? id1
        IF
            (C1=1)
                SEQ j = 0 FOR 2
                    fr2 ? id2
        IF
            (C2=1)
                SEQ j = 0 FOR 2
                    fr3 ? id3
    SEQ j = 0 FOR 2*((C0+C1)+C2)
        to ! od
    :

PROC beabus (VAL INT C0, C1, C2, C3, CAL)

    SEQ kk = 0 FOR 10000
    SEQ
        calculate(2*CAL)
    PAR
        IF
            (C0 > 0)
                talk(t.0,f.0,2,C0)           -- on port 0
        IF
            (C1 > 0)

```

```

        talk(t.1,f.1,2,C1)          -- on port 1
    IF
        (C2 > 0)
        talk(t.2,f.2,2,C2)          -- on port 2
    IF
        (C3 > 0)
        talk(t.3,f.3,2,C3)          -- on port 3
:
PROC beacommunicator(VAL INT PIPENO, C0, C1, C2)
    SEQ kk = 0 FOR 10000
    IF
        PIPENO = 0          -- Comm talks Bus on Comm port 0 to Bus port 3
        PAR
            export(f.0, t.1, t.2, t.3, C0, C1, C2)
            import(f.1, f.2, f.3, t.0, C0, C1, C2)

        PIPENO = 1          -- Comm talks Bus on Comm port 1 to Bus port 2
        PAR
            export(f.1, t.2, t.3, t.0, C0, C1, C2)
            import(f.2, f.3, f.0, t.1, C0, C1, C2)

        PIPENO = 2          -- Comm talks Bus on Comm port 2 to Bus port 1
        PAR
            export(f.2, t.3, t.0, t.1, C0, C1, C2)
            import(f.3, f.0, f.1, t.2, C0, C1, C2)

        PIPENO = 3          -- Comm talks Bus on Comm port 3 to Bus port 0
        PAR
            export(f.3, t.0, t.1, t.2, C0, C1, C2)
            import(f.0, f.1, f.2, t.3, C0, C1, C2)
:
SEQ
    -- decide how to configure this machine
    IF
        (MNUM = 1)
        beabus(6,6,2,2,4)          -- 0 and 1 to Comms 2 and 9, 4
connections
        (MNUM = 2)
        beacommunicator(2,1,1,1)  -- This Comm inputs on port 2 from bus

        (MNUM = 9)
        beacommunicator(3,1,1,1)  -- This Comm inputs on port 3 from bus

        (MNUM = 3) OR (MNUM = 5) OR (MNUM = 7) OR (MNUM = 13)
        beabus(2,6,2,2,4)          -- 1 to Comm, 4 connections

        (MNUM = 4) OR (MNUM = 6) OR (MNUM = 8) OR (MNUM = 14)
        beacommunicator(2,1,1,1)  -- These Comms input on port 2 from bus

        (MNUM > 9) AND (MNUM <> 13) AND (MNUM <> 14)
        beabus(2,2,2,2,4)          -- Nothing to Comm, 4 connections
:
!
cat > S43.occ << !
PROTOCOL FPN IS REAL32 :

```

```

#include "hostio.inc"
PROC S43 (CHAN OF FPN t.1, f.1, t.3, f.3, t.0, f.0, VAL INT MNUM)
  #USE "hostio.lib"
  #USE "snlmath.lib"

  PROC calculate(VAL INT ca)
    REAL32 d :
    SEQ i = 0 FOR ca
      d:=(6.391(REAL32))
    :

  PROC talk(CHAN OF FPN to, from, VAL INT out, in)
    REAL32 id, od :
    SEQ
      od:=7.5021(REAL32)
      PAR
        SEQ j = 0 FOR out
          to ! od
        SEQ j = 0 FOR in
          from ? id
      :

  -- This machine is a BUS
  SEQ kk = 0 FOR 10000
    SEQ
      calculate(6)
      PAR
        talk(t.0,f.0,2,2)
        talk(t.1,f.1,2,2)
        talk(t.3,f.3,2,2)
      :
    !

  sed "s/S84/S44/g" < S84.occ > SSS.occ
  sed "s/SIN//g" < SSS.occ > S44.occ

  occam -T8 -e M1 ; occam -T8 -e S84 ; occam -e S44 ; occam -e S43

  ilink M1.t8h hostio.lib convert.lib snlmath.lib

  ilink S84.t8h snlmath.lib
  ilink S44.t4h snlmath.lib
  ilink S43.t4h snlmath.lib

  iconf net

  rm S* ; rm M*

```



```

cat > M1.occ << !
PROTOCOL FPN IS REAL32 :
#include "hostio.inc"
PROC M1 (CHAN OF SP fs, ts, CHAN OF FPN t.p2, f.p2, INT MNUM)
  #USE "hostio.lib"
  #USE "snglmath.lib"
  REAL32 ddout1, ddin1:
  INT t1, t2:
  TIMER clock:
  INT CA, PDO, PUO, RRO, RROWO:
  INT PDI, PUI, RRI, RROWI:
  SEQ
    CA :=3
    PDI :=4
    PDO :=4
    PUO :=4
    PUI :=4
    RRO :=4
    RRI :=4
    RROWO:=4
    RROWI:=4
    clock ? t1
    SEQ kk = 0 FOR 10000
      SEQ
        SEQ j = 0 FOR CA -- calculation routine
          ddout1 := 2.0(REAL32)
        PAR
          SEQ j2 = 0 FOR PDO -- down pipe
            t.p2 ! ddout1
            SEQ k2 = 0 FOR PDI
              f.p2 ? ddin1
            clock ? t2
            t2 := t2 - t1
            so.write.int(fs, ts, t2, 0)
            so.write.nl(fs, ts)
            so.exit(fs, ts, sps.success)
          :
        !
cat > S84.occ << !
PROTOCOL FPN IS REAL32 :
#include "hostio.inc"
PROC S84 (CHAN OF FPN t.p3, f.p3, t.p2, f.p2, t.p1, f.p1, t.p4, f.p4, INT
MNUM)
  #USE "hostio.lib"
  #USE "snglmath.lib"
  REAL32 ddout1, ddin1, ddout2, ddin2, ddout3, ddin3, ddout4, ddin4:
  INT CA, PDO, PUO, RRO, RROWO:
  INT PDI, PUI, RRI, RROWI:
  INT COMM:
  REAL32 x:
  SEQ
    COMM :=1
    CA :=3
    PDI :=4
    PDO :=4
    PUO :=4
    PUI :=4
    RRO :=4
    RRI :=4
    RROWO:=4

```

```

RROWI:=4
x:=2.0(REAL32)

IF      -- dicide how to configure this machine
(MNUM = 1) OR (MNUM = 3)
  PDI := 12
(MNUM = 2) OR (MNUM = 4)
  SEQ
    COMM:= 2
    PUO := 12
MNUM > 2
  SKIP

IF      -- COMM = 1 this is a bus, COMM <> 1 a communicator
COMM = 1
  SEQ kk = 0 FOR 10000
  SEQ
    SEQ j = 0 FOR CA      -- calculation routine
    SEQ
      ddout1 := SIN(x)
      ddout2 := 2.0(REAL32)
      ddout3 := 2.0(REAL32)
      ddout4 := 2.0(REAL32)
    PAR
      SEQ j2 = 0 FOR PDO      -- down pipe
      t.p2 ! ddout1
      SEQ k2 = 0 FOR PDI
      f.p2 ? ddin1
      SEQ j3 = 0 FOR PUO      -- up pipe
      t.p3 ! ddout2
      SEQ k3 = 0 FOR PUI
      f.p3 ? ddin2
      SEQ jj2 = 0 FOR RRO      -- round ring
      t.p1 ! ddout3
      SEQ kk2 = 0 FOR RRI
      f.p1 ? ddin3
      SEQ jj3 = 0 FOR RROWO      -- round ring other way
      t.p4 ! ddout4
      SEQ kk3 = 0 FOR RROWI
      f.p4 ? ddin4
    COMM <> 1
    SEQ
      ddout1 := 2.0(REAL32)
      ddout2 := 2.0(REAL32)
      ddout3 := 2.0(REAL32)
      ddout4 := 2.0(REAL32)
      SEQ kk = 0 FOR 10000
      PAR
        SEQ
          SEQ k3 = 0 FOR PUI      -- read up pipe
          f.p3 ? ddin2
          PAR
            SEQ j2 = 0 FOR PDO      -- write down pipe
            t.p2 ! ddout1
            SEQ jj2 = 0 FOR RRO      -- write round ring
            t.p1 ! ddout3
            SEQ jj3 = 0 FOR RROWO -- write round ring other way
            t.p4 ! ddout4
          SEQ
            PAR
              SEQ k2 = 0 FOR PDI      -- read down pipe

```

```

        f.p2 ? ddin1
        SEQ kk2 = 0 FOR RRI      -- read round ring
        f.p1 ? ddin3
        SEQ kk3 = 0 FOR RROWI   -- read round ring other way
        f.p4 ? ddin4
        SEQ j3 = 0 FOR PUO      -- write up pipe
        t.p3 ! ddout2
:
!
cat > S43.occ << !
PROTOCOL FPN IS REAL32 :
#include "hostio.inc"
PROC S43 (CHAN OF FPN t.p2, f.p2, t.p1, f.p1, t.p4, f.p4, INT MNUM)
    #USE "hostio.lib"
    #USE "snglmth.lib"
    REAL32 ddout1, ddin1, ddout3, ddin3, ddout4, ddin4:
    INT CA, PDO, PUO, RRO, RROWO:
    INT PDI, PUI, RRI, RROWI:
    SEQ
        CA :=3
        PDI :=4
        PDO :=4
        PUO :=4
        PUI :=4
        RRO :=4
        RRI :=4
        RROWO:=4
        RROWI:=4
        SEQ kk = 0 FOR 10000
        SEQ
            SEQ j = 0 FOR CA      -- calculation routine
            ddout1 := 2.0(REAL32)
            PAR
                SEQ j2 = 0 FOR PDO      -- down pipe
                t.p2 ! ddout1
                SEQ k2 = 0 FOR PDI
                f.p2 ? ddin1
                SEQ jj2 = 0 FOR RRO      -- round ring
                t.p1 ! ddout3
                SEQ kk2 = 0 FOR RRI
                f.p1 ? ddin3
                SEQ jj3 = 0 FOR RROWO    -- round ring other way
                t.p4 ! ddout4
                SEQ kk3 = 0 FOR RROWI
                f.p4 ? ddin4
:
!
sed "s/S84/S44/g" < S84.occ > S44.occ

occam -T8 -e M1
occam -T8 -e S84 ; occam      -e S44 ; occam      -e S43

ilink M1.t8h hostio.lib convert.lib snglmth.lib

ilink S84.t8h snglmth.lib
ilink S44.t4h snglmth.lib
ilink S43.t4h snglmth.lib

iconf net

```

DEF B014

SIZES

T2 1
C4 2
SLOT 8
EDGE 27

END

T2CHAIN

T2 0, LINK 0 C4 0
T2 0, LINK 3 C4 1

END

HARDWIRE

C4 1, LINK 1 TO SLOT 0, LINK 2
C4 0, LINK 1 TO SLOT 0, LINK 3
C4 0, LINK 2 TO SLOT 1, LINK 0
C4 1, LINK 2 TO SLOT 1, LINK 1
C4 1, LINK 3 TO SLOT 1, LINK 2
C4 0, LINK 3 TO SLOT 1, LINK 3
C4 0, LINK 4 TO SLOT 2, LINK 0
C4 1, LINK 4 TO SLOT 2, LINK 1
C4 1, LINK 5 TO SLOT 2, LINK 2
C4 0, LINK 5 TO SLOT 2, LINK 3
C4 0, LINK 6 TO SLOT 3, LINK 0
C4 1, LINK 6 TO SLOT 3, LINK 1
C4 1, LINK 7 TO SLOT 3, LINK 2
C4 0, LINK 7 TO SLOT 3, LINK 3
C4 0, LINK 8 TO SLOT 4, LINK 0
C4 1, LINK 8 TO SLOT 4, LINK 1
C4 1, LINK 9 TO SLOT 4, LINK 2
C4 0, LINK 9 TO SLOT 4, LINK 3
C4 0, LINK 10 TO SLOT 5, LINK 0
C4 1, LINK 10 TO SLOT 5, LINK 1
C4 1, LINK 11 TO SLOT 5, LINK 2
C4 0, LINK 11 TO SLOT 5, LINK 3
C4 0, LINK 12 TO SLOT 6, LINK 0
C4 1, LINK 12 TO SLOT 6, LINK 1
C4 1, LINK 13 TO SLOT 6, LINK 2
C4 0, LINK 13 TO SLOT 6, LINK 3
C4 0, LINK 14 TO SLOT 7, LINK 0
C4 1, LINK 14 TO SLOT 7, LINK 1
C4 1, LINK 15 TO SLOT 7, LINK 2
C4 0, LINK 15 TO SLOT 7, LINK 3

C4 0, LINK 16 TO EDGE 0
C4 0, LINK 17 TO EDGE 1
C4 0, LINK 18 TO EDGE 2
C4 0, LINK 19 TO EDGE 3
C4 0, LINK 20 TO EDGE 4
C4 0, LINK 21 TO EDGE 5
C4 0, LINK 22 TO EDGE 6
C4 0, LINK 23 TO EDGE 7
C4 1, LINK 16 TO EDGE 8
C4 1, LINK 17 TO EDGE 9
C4 1, LINK 18 TO EDGE 10
C4 1, LINK 19 TO EDGE 11
C4 1, LINK 20 TO EDGE 12
C4 1, LINK 21 TO EDGE 13
C4 1, LINK 22 TO EDGE 14

```

C4 1, LINK 23 TO EDGE 15
C4 1, LINK 24 TO EDGE 16
C4 1, LINK 25 TO EDGE 17
C4 1, LINK 26 TO EDGE 18
C4 1, LINK 27 TO EDGE 19
C4 1, LINK 28 TO EDGE 20
C4 1, LINK 29 TO EDGE 21
C4 1, LINK 30 TO EDGE 22
C4 1, LINK 31 TO EDGE 23
C4 0, LINK 0 TO EDGE 24
C4 0, LINK 31 TO EDGE 25
C4 1, LINK 0 TO EDGE 26
END

```

DEF B012a

```

SIZES
  T2  1
  C4  2
  SLOT 16
  EDGE 32
END

```

```

T2CHAIN
  T2 0, LINK 0 C4 0
  T2 0, LINK 3 C4 1
END

```

HARDWARE

```

SLOT 0, LINK 2 TO SLOT 1, LINK 1
SLOT 1, LINK 2 TO SLOT 2, LINK 1
SLOT 2, LINK 2 TO SLOT 3, LINK 1

```

```

C4 0, 5, I TO SLOT 1, LINK 0, O
C4 1, 5, O TO SLOT 1, LINK 0, I

```

```

C4 1, 2, I TO SLOT 1, LINK 3, O
C4 0, 2, O TO SLOT 1, LINK 3, I

```

```

C4 0, 4, I TO SLOT 2, LINK 0, O
C4 1, 4, O TO SLOT 2, LINK 0, I

```

```

C4 1, 0, I TO SLOT 2, LINK 3, O
C4 0, 0, O TO SLOT 2, LINK 3, I

```

```

C4 0, 19, I TO SLOT 3, LINK 0, O
C4 1, 19, O TO SLOT 3, LINK 0, I

```

```

C4 1, 17, I TO SLOT 3, LINK 3, O
C4 0, 17, O TO SLOT 3, LINK 3, I

```

```

C4 1, LINK 0, O TO EDGE 0, I
C4 0, LINK 0, I TO EDGE 0, O

```

```

C4 1, LINK 2, O TO EDGE 1, I
C4 0, LINK 2, I TO EDGE 1, O

```

```

C4 0, LINK 4, O TO EDGE 2, I
C4 1, LINK 4, I TO EDGE 2, O

```

```

C4 0, LINK 5, O TO EDGE 3, I

```

C4 1, LINK 5,I TO EDGE 3,O
C4 0, LINK 6,O TO EDGE 4,I
C4 1, LINK 6,I TO EDGE 4,O

C4 0, LINK 3,O TO EDGE 5,I
C4 1, LINK 3,I TO EDGE 5,O

C4 1, LINK 1,O TO EDGE 6,I
C4 0, LINK 1,I TO EDGE 6,O

C4 1, LINK 7,O TO EDGE 7,I
C4 0, LINK 7,I TO EDGE 7,O

C4 1, LINK 29,O TO EDGE 8,I
C4 0, LINK 29,I TO EDGE 8,O

C4 1, LINK 30,O TO EDGE 9,I
C4 0, LINK 30,I TO EDGE 9,O

C4 0, LINK 31,O TO EDGE 10,I
C4 1, LINK 31,I TO EDGE 10,O

C4 0, LINK 28,O TO EDGE 11,I
C4 1, LINK 28,I TO EDGE 11,O

C4 1, LINK 24,O TO EDGE 12,I
C4 0, LINK 24,I TO EDGE 12,O

C4 0, LINK 25,O TO EDGE 13,I
C4 1, LINK 25,I TO EDGE 13,O

C4 0, LINK 26,O TO EDGE 14,I
C4 1, LINK 26,I TO EDGE 14,O

C4 1, LINK 27,O TO EDGE 15,I
C4 0, LINK 27,I TO EDGE 15,O

C4 1, LINK 17,O TO EDGE 16,I
C4 0, LINK 17,I TO EDGE 16,O

C4 0, LINK 19,O TO EDGE 17,I
C4 1, LINK 19,I TO EDGE 17,O

C4 0, LINK 22,O TO EDGE 18,I
C4 1, LINK 22,I TO EDGE 18,O

C4 1, LINK 23,O TO EDGE 19,I
C4 0, LINK 23,I TO EDGE 19,O

C4 0, LINK 16,O TO EDGE 20,I
C4 1, LINK 16,I TO EDGE 20,O

C4 0, LINK 18,O TO EDGE 21,I
C4 1, LINK 18,I TO EDGE 21,O

C4 1, LINK 21,O TO EDGE 22,I
C4 0, LINK 21,I TO EDGE 22,O

C4 1, LINK 20,O TO EDGE 23,I
C4 0, LINK 20,I TO EDGE 23,O

C4 1, LINK 10,O TO EDGE 24,I
C4 0, LINK 10,I TO EDGE 24,O

C4 1, LINK 13,O TO EDGE 25,I
C4 0, LINK 13,I TO EDGE 25,O

C4 1, LINK 14,O TO EDGE 26,I
C4 0, LINK 14,I TO EDGE 26,O

C4 1, LINK 11,O TO EDGE 27,I
C4 0, LINK 11,I TO EDGE 27,O

C4 0, LINK 8,O TO EDGE 28,I
C4 1, LINK 8,I TO EDGE 28,O

C4 0, LINK 9,O TO EDGE 29,I
C4 1, LINK 9,I TO EDGE 29,O

C4 0, LINK 12,O TO EDGE 30,I
C4 1, LINK 12,I TO EDGE 30,O

C4 0, LINK 15,O TO EDGE 31,I
C4 1, LINK 15,I TO EDGE 31,O

END

DEF B012b

SIZES

T2 1
C4 2
SLOT 16
EDGE 32

END

T2CHAIN

T2 0, LINK 0 C4 0
T2 0, LINK 3 C4 1

END

HARDWIRE

SLOT 0, LINK 2 TO SLOT 1, LINK 1
SLOT 1, LINK 2 TO SLOT 2, LINK 1
SLOT 2, LINK 2 TO SLOT 3, LINK 1
SLOT 3, LINK 2 TO SLOT 4, LINK 1
SLOT 4, LINK 2 TO SLOT 5, LINK 1
SLOT 5, LINK 2 TO SLOT 6, LINK 1
SLOT 6, LINK 2 TO SLOT 7, LINK 1
SLOT 7, LINK 2 TO SLOT 8, LINK 1
SLOT 8, LINK 2 TO SLOT 9, LINK 1
SLOT 9, LINK 2 TO SLOT 10, LINK 1
SLOT 10, LINK 2 TO SLOT 11, LINK 1
SLOT 11, LINK 2 TO SLOT 12, LINK 1
SLOT 12, LINK 2 TO SLOT 13, LINK 1
SLOT 13, LINK 2 TO SLOT 14, LINK 1
SLOT 14, LINK 2 TO SLOT 15, LINK 1

C4 0, LINK 5,I TO SLOT 1, LINK 0,O
C4 1, LINK 5,O TO SLOT 1, LINK 0,I

C4 1, LINK 2,I TO SLOT 1, LINK 3,O

C4 0, LINK 2,O TO SLOT 1, LINK 3,I
 C4 0, LINK 4,I TO SLOT 2, LINK 0,O
 C4 1, LINK 4,O TO SLOT 2, LINK 0,I
 C4 1, LINK 0,I TO SLOT 2, LINK 3,O
 C4 0, LINK 0,O TO SLOT 2, LINK 3,I
 C4 0, LINK 19,I TO SLOT 3, LINK 0,O
 C4 1, LINK 19,O TO SLOT 3, LINK 0,I
 C4 1, LINK 17,I TO SLOT 3, LINK 3,O
 C4 0, LINK 17,O TO SLOT 3, LINK 3,I
 C4 0, LINK 18,I TO SLOT 4, LINK 0,O
 C4 1, LINK 18,O TO SLOT 4, LINK 0,I
 C4 1, LINK 21,I TO SLOT 4, LINK 3,O
 C4 0, LINK 21,O TO SLOT 4, LINK 3,I
 C4 0, LINK 3,I TO SLOT 5, LINK 0,O
 C4 1, LINK 3,O TO SLOT 5, LINK 0,I
 C4 1, LINK 1,I TO SLOT 5, LINK 3,O
 C4 0, LINK 1,O TO SLOT 5, LINK 3,I
 C4 0, LINK 6,I TO SLOT 6, LINK 0,O
 C4 1, LINK 6,O TO SLOT 6, LINK 0,I
 C4 1, LINK 7,I TO SLOT 6, LINK 3,O
 C4 0, LINK 7,O TO SLOT 6, LINK 3,I
 C4 0, LINK 16,I TO SLOT 7, LINK 0,O
 C4 1, LINK 16,O TO SLOT 7, LINK 0,I
 C4 1, LINK 20,I TO SLOT 7, LINK 3,O
 C4 0, LINK 20,O TO SLOT 7, LINK 3,I
 C4 0, LINK 9,I TO SLOT 8, LINK 0,O
 C4 1, LINK 9,O TO SLOT 8, LINK 0,I
 C4 1, LINK 14,I TO SLOT 8, LINK 3,O
 C4 0, LINK 14,O TO SLOT 8, LINK 3,I
 C4 0, LINK 28,I TO SLOT 9, LINK 0,O
 C4 1, LINK 28,O TO SLOT 9, LINK 0,I
 C4 1, LINK 29,I TO SLOT 9, LINK 3,O
 C4 0, LINK 29,O TO SLOT 9, LINK 3,I
 C4 0, LINK 31,I TO SLOT 10, LINK 0,O
 C4 1, LINK 31,O TO SLOT 10, LINK 0,I
 C4 1, LINK 30,I TO SLOT 10, LINK 3,O
 C4 0, LINK 30,O TO SLOT 10, LINK 3,I
 C4 0, LINK 15,I TO SLOT 11, LINK 0,O
 C4 1, LINK 15,O TO SLOT 11, LINK 0,I
 C4 1, LINK 11,I TO SLOT 11, LINK 3,O
 C4 0, LINK 11,O TO SLOT 11, LINK 3,I

C4 0, LINK 12,I TO SLOT 12, LINK 0,O
C4 1, LINK 12,O TO SLOT 12, LINK 0,I

C4 1, LINK 13,I TO SLOT 12, LINK 3,O
C4 0, LINK 13,O TO SLOT 12, LINK 3,I

C4 0, LINK 25,I TO SLOT 13, LINK 0,O
C4 1, LINK 25,O TO SLOT 13, LINK 0,I

C4 1, LINK 27,I TO SLOT 13, LINK 3,O
C4 0, LINK 27,O TO SLOT 13, LINK 3,I

C4 0, LINK 26,I TO SLOT 14, LINK 0,O
C4 1, LINK 26,O TO SLOT 14, LINK 0,I

C4 1, LINK 24,I TO SLOT 14, LINK 3,O
C4 0, LINK 24,O TO SLOT 14, LINK 3,I

C4 0, LINK 8,I TO SLOT 15, LINK 0,O
C4 1, LINK 8,O TO SLOT 15, LINK 0,I

C4 1, LINK 10,I TO SLOT 15, LINK 3,O
C4 0, LINK 10,O TO SLOT 15, LINK 3,I

C4 1, LINK 0,O TO EDGE 0,I
C4 0, LINK 0,I TO EDGE 0,O

C4 1, LINK 2,O TO EDGE 1,I
C4 0, LINK 2,I TO EDGE 1,O

C4 0, LINK 4,O TO EDGE 2,I
C4 1, LINK 4,I TO EDGE 2,O

C4 0, LINK 5,O TO EDGE 3,I
C4 1, LINK 5,I TO EDGE 3,O

C4 0, LINK 6,O TO EDGE 4,I
C4 1, LINK 6,I TO EDGE 4,O

C4 0, LINK 3,O TO EDGE 5,I
C4 1, LINK 3,I TO EDGE 5,O

C4 1, LINK 1,O TO EDGE 6,I
C4 0, LINK 1,I TO EDGE 6,O

C4 1, LINK 7,O TO EDGE 7,I
C4 0, LINK 7,I TO EDGE 7,O

C4 1, LINK 29,O TO EDGE 8,I
C4 0, LINK 29,I TO EDGE 8,O

C4 1, LINK 30,O TO EDGE 9,I
C4 0, LINK 30,I TO EDGE 9,O

C4 0, LINK 31,O TO EDGE 10,I
C4 1, LINK 31,I TO EDGE 10,O

C4 0, LINK 28,O TO EDGE 11,I
C4 1, LINK 28,I TO EDGE 11,O

C4 1, LINK 24,O TO EDGE 12,I

C4 0, LINK 24,I TO EDGE 12,O
 C4 0, LINK 25,O TO EDGE 13,I
 C4 1, LINK 25,I TO EDGE 13,O

 C4 0, LINK 26,O TO EDGE 14,I
 C4 1, LINK 26,I TO EDGE 14,O

 C4 1, LINK 27,O TO EDGE 15,I
 C4 0, LINK 27,I TO EDGE 15,O

 C4 1, LINK 17,O TO EDGE 16,I
 C4 0, LINK 17,I TO EDGE 16,O

 C4 0, LINK 19,O TO EDGE 17,I
 C4 1, LINK 19,I TO EDGE 17,O

 C4 0, LINK 22,O TO EDGE 18,I
 C4 1, LINK 22,I TO EDGE 18,O

 C4 1, LINK 23,O TO EDGE 19,I
 C4 0, LINK 23,I TO EDGE 19,O

 C4 0, LINK 16,O TO EDGE 20,I
 C4 1, LINK 16,I TO EDGE 20,O

 C4 0, LINK 18,O TO EDGE 21,I
 C4 1, LINK 18,I TO EDGE 21,O

 C4 1, LINK 21,O TO EDGE 22,I
 C4 0, LINK 21,I TO EDGE 22,O

 C4 1, LINK 20,O TO EDGE 23,I
 C4 0, LINK 20,I TO EDGE 23,O

 C4 1, LINK 10,O TO EDGE 24,I
 C4 0, LINK 10,I TO EDGE 24,O

 C4 1, LINK 13,O TO EDGE 25,I
 C4 0, LINK 13,I TO EDGE 25,O

 C4 1, LINK 14,O TO EDGE 26,I
 C4 0, LINK 14,I TO EDGE 26,O

 C4 1, LINK 11,O TO EDGE 27,I
 C4 0, LINK 11,I TO EDGE 27,O

 C4 0, LINK 8,O TO EDGE 28,I
 C4 1, LINK 8,I TO EDGE 28,O

 C4 0, LINK 9,O TO EDGE 29,I
 C4 1, LINK 9,I TO EDGE 29,O

 C4 0, LINK 12,O TO EDGE 30,I
 C4 1, LINK 12,I TO EDGE 30,O

 C4 0, LINK 15,O TO EDGE 31,I
 C4 1, LINK 15,I TO EDGE 31,O

END

PIPE B014, B012a, B012a, B012b END

```
#INCLUDE "hostio.inc"
#INCLUDE "linkaddr.inc"
PROTOCOL FPN IS INT :
```

```
#USE "S84.c8h"
#USE "S84X.c8h"
#USE "S82.c8h"
#USE "M1.c8h"
```

```
CHAN OF SP fs, ts:
[24]CHAN OF FPN PI,PO,LO,LI:
```

```
PLACED PAR
```

```
PROCESSOR 0 T800
```

```
PLACE ts AT link0.out:
PLACE fs AT link0.in:
PLACE PO[0] AT link2.out:
PLACE PI[0] AT link2.in:
M1(fs,ts,PO[0],PI[0],0)
```

```
PLACED PAR
```

```
PROCESSOR 1 T800
```

```
PLACE PO[0] AT link1.in:
PLACE PI[0] AT link1.out:
PLACE PI[1] AT link2.in:
PLACE PO[1] AT link2.out:
PLACE LO[9] AT link3.in:
PLACE LI[9] AT link3.out:
PLACE LI[5] AT link0.in:
PLACE LO[5] AT link0.out:
S84X(PI[0],PO[0],PO[1],PI[1],LI[9],LO[9],LO[5],LI[5],1)
```

```
PLACED PAR
```

```
PROCESSOR 2 T800
```

```
PLACE PO[1] AT link1.in:
PLACE PI[1] AT link1.out:
PLACE PI[2] AT link2.in:
PLACE PO[2] AT link2.out:
PLACE LO[3] AT link3.in:
PLACE LI[3] AT link3.out:
PLACE LI[4] AT link0.in:
PLACE LO[4] AT link0.out:
S84(PI[1],PO[1],PO[2],PI[2],LI[3],LO[3],LO[4],LI[4],2)
```

```
PLACED PAR
```

```
PROCESSOR 3 T800
```

```
PLACE PO[2] AT link1.in:
PLACE PI[2] AT link1.out:
PLACE PI[3] AT link2.in:
PLACE PO[3] AT link2.out:
PLACE LO[4] AT link3.in:
PLACE LI[4] AT link3.out:
PLACE LI[2] AT link0.in:
PLACE LO[2] AT link0.out:
S82(PI[2],PO[2],PO[3],PI[3],LI[4],LO[4],LO[2],LI[2],3)
```

```
occam 2 product compiler (19th September 1988)
PROCESSOR 0 0 T8 1
SC 3 1124 1124 0
CODE 28 0 204 528
PROCESSOR 1 1 T8 1
SC 1 48 48 0
CODE 36 28 68 0
PROCESSOR 2 2 T8 1
SC 0 144 144 0
CODE 36 64 112 0
PROCESSOR 3 3 T8 1
SC 2 128 128 0
CODE 36 100 112 0
LINK 0 2, 1 1
LINK 1 2, 2 1
LINK 2 0, 3 3
LINK 2 2, 3 1
```

```

cat > M1.occ << !
PROTOCOL FPN IS REAL32 :
#include "hostio.inc"
PROC M1 (CHAN OF SP fs, ts, CHAN OF FPN tPO, fPO, VAL INT MNUM)
  #USE "hostio.lib"
  #USE "snglmath.lib"
  INT t1, t2:
  TIMER clock:
  REAL32 id, od :

  SEQ
    od:=2.0(REAL32)
    clock ? t1
    tPO ! od
    fPO ? id
    clock ? t2
    t2 := t2 - t1
    so.write.int(fs, ts, t2, 0)
    so.write.nl(fs, ts)

    clock ? t1
    tPO ! od
    fPO ? id
    clock ? t2
    t2 := t2 *t1
    so.write.int(fs, ts, t2, 0)
    so.write.nl(fs, ts)
    so.exit(fs, ts, sps.success)
  :
  !

cat > S84X.occ << !
PROTOCOL FPN IS REAL32 :
#include "hostio.inc"
PROC S84X (CHAN OF FPN tPI, fPI, tPO, fPO, tRI, fRI, tRO, fRO, VAL INT
MNUM)
  #USE "hostio.lib"
  #USE "snglmath.lib"
  REAL32 id, od :

  SEQ
    od:=2.0(REAL32)
    fPI ? id
    tPO ! od
    fPO ? id
    tPI ! od

    fPI ? id
    tPO ! od
    fPO ? id
    tPI ! od
  :
  !

cat > S84.occ << !
PROTOCOL FPN IS REAL32 :
#include "hostio.inc"
PROC S84 (CHAN OF FPN tPI, fPI, tPO, fPO, tRI, fRI, tRO, fRO, VAL INT
MNUM)
  #USE "hostio.lib"
  #USE "snglmath.lib"
  REAL32 id, od :

```

```

SEQ
  od:=2.0(REAL32)
  fPI ? id
  SEQ k = 0 FOR 100000
    PAR
      SEQ j = 0 FOR 2
        tRO ! od
      SEQ j = 0 FOR 2
        fRO ? id
  tPI ! id

  fPI ? id
  SEQ k = 0 FOR 100000
    PAR
      SEQ j = 0 FOR 2
        tPO ! od
      SEQ j = 0 FOR 2
        fPO ? id
  tPI ! id

```

```

:
!

```

```

cat > S82.occ << !
PROTOCOL FPN IS REAL32 :
#include "hostio.inc"
PROC S82 (CHAN OF FPN tPI, fPI, tPO, fPO, tRI, fRI, tRO, fRO, VAL INT
MNUM)
  #USE "hostio.lib"
  #USE "snlmath.lib"
  REAL32 id, od :
  SEQ
    od:=2.0(REAL32)
    SEQ k = 0 FOR 100000
      PAR
        SEQ j = 0 FOR 2
          fRI ? id
        SEQ j = 0 FOR 2
          tRI ! od

      SEQ k = 0 FOR 100000
        PAR
          SEQ j = 0 FOR 2
            fPI ? id
          SEQ j = 0 FOR 2
            tPI ! od

```

```

:
!

```

```

occam -T8 -e M1 ; occam -T8 -e S84 ; occam -T8 -e S82 ; occam -T8 -e S84X

ilink M1.t8h hostio.lib convert.lib snlmath.lib

ilink S84.t8h snlmath.lib
ilink S82.t8h snlmath.lib
ilink S84X.t8h snlmath.lib

iconf   joe

```

occam 2 product compiler (19th September 1988)

```
PROCESSOR 0 0 T8 1
SC 3 1468 1468 0
CODE 32 0 208 528
PROCESSOR 1 1 T8 1
SC 0 1180 1180 0
CODE 40 32 428 0
PROCESSOR 2 2 T8 1
SC 0 1180 1180 0
CODE 40 72 428 0
PROCESSOR 3 3 T8 1
SC 0 1180 1180 0
CODE 40 112 428 0
PROCESSOR 4 4 T8 1
SC 0 1180 1180 0
CODE 40 152 428 0
PROCESSOR 5 5 T8 1
SC 0 1180 1180 0
CODE 40 192 428 0
PROCESSOR 6 6 T4 1
SC 1 916 916 0
CODE 40 232 428 0
PROCESSOR 7 7 T8 1
SC 0 1180 1180 0
CODE 40 272 428 0
PROCESSOR 8 8 T4 1
SC 1 916 916 0
CODE 40 312 428 0
PROCESSOR 9 9 T4 1
SC 1 916 916 0
CODE 40 352 428 0
PROCESSOR 10 10 T4 1
SC 1 916 916 0
CODE 40 392 428 0
PROCESSOR 11 11 T4 1
SC 1 916 916 0
CODE 40 432 428 0
PROCESSOR 12 12 T4 1
SC 1 916 916 0
CODE 40 472 428 0
PROCESSOR 13 13 T4 1
SC 1 916 916 0
CODE 40 512 428 0
PROCESSOR 14 14 T4 1
SC 1 916 916 0
CODE 40 552 428 0
PROCESSOR 15 15 T4 1
SC 1 916 916 0
CODE 40 592 428 0
PROCESSOR 16 16 T4 1
SC 1 916 916 0
CODE 40 632 428 0
PROCESSOR 17 17 T4 1
SC 1 916 916 0
CODE 40 672 428 0
PROCESSOR 18 18 T4 1
SC 1 916 916 0
CODE 40 712 428 0
PROCESSOR 19 19 T4 1
SC 1 916 916 0
CODE 40 752 428 0
```

PROCESSOR 20 20 T4 1
SC 1 916 916 0
CODE 40 792 428 0
PROCESSOR 21 21 T4 1
SC 1 916 916 0
CODE 40 832 428 0
PROCESSOR 22 22 T4 1
SC 2 176 176 0
CODE 32 872 308 0
LINK 0 2, 1 1
LINK 1 0, 5 3
LINK 1 2, 2 1
LINK 1 3, 9 0
LINK 2 0, 4 3
LINK 2 2, 3 1
LINK 2 3, 3 0
LINK 3 2, 4 1
LINK 3 3, 4 0
LINK 4 2, 5 1
LINK 5 0, 9 3
LINK 5 2, 6 1
LINK 6 0, 8 3
LINK 6 2, 7 1
LINK 6 3, 7 0
LINK 7 2, 8 1
LINK 7 3, 8 0
LINK 8 2, 9 1
LINK 9 2, 10 1
LINK 10 0, 11 3
LINK 10 2, 11 1
LINK 10 3, 22 0
LINK 11 0, 12 3
LINK 11 2, 12 1
LINK 12 0, 13 3
LINK 12 2, 13 1
LINK 13 0, 14 3
LINK 13 2, 14 1
LINK 14 0, 15 3
LINK 14 2, 15 1
LINK 15 0, 16 3
LINK 15 2, 16 1
LINK 16 0, 17 3
LINK 16 2, 17 1
LINK 17 0, 18 3
LINK 17 2, 18 1
LINK 18 0, 19 3
LINK 18 2, 19 1
LINK 19 0, 20 3
LINK 19 2, 20 1
LINK 20 0, 21 3
LINK 20 2, 21 1
LINK 21 0, 22 3
LINK 21 2, 22 1


```

#include "hostio.inc"
#include "linkaddr.inc"
PROTOCOL FPN IS REAL32 :
#USE "S84.c8h"
#USE "S44.c4h"
#USE "S43.c4h"
#USE "M1.c8h"
CHAN OF SP fs, ts:
CHAN OF FPN MO, MI:
CHAN OF FPN S1I, S10, L10, L1I:
CHAN OF FPN S2I, S20:
CHAN OF FPN S3I, S30:
CHAN OF FPN S4I, S40:
CHAN OF FPN S5I, S50, L50, L5I:
CHAN OF FPN S6I, S60:
CHAN OF FPN S7I, S70:
CHAN OF FPN S8I, S80:
CHAN OF FPN S9I, S90, L90, L9I:
CHAN OF FPN S10I, S100:
CHAN OF FPN S11I, S110:
CHAN OF FPN S12I, S120:
CHAN OF FPN S13I, S130:
CHAN OF FPN S14I, S140:
CHAN OF FPN S15I, S150:
CHAN OF FPN S16I, S160:
CHAN OF FPN S17I, S170:
CHAN OF FPN S18I, S180:
CHAN OF FPN S19I, S190:
CHAN OF FPN S20I, S200:
CHAN OF FPN S21I, S210:
CHAN OF FPN L2I, L20, L3I, L30, L4I, L40:
CHAN OF FPN L6I, L60, L7I, L70, L8I, L80:
CHAN OF FPN L10I, L100, L11I, L110, L12I, L120:
CHAN OF FPN L13I, L130, L14I, L140, L15I, L150:
CHAN OF FPN L16I, L160, L17I, L170, L18I, L180:
CHAN OF FPN L19I, L190, L20I, L200, L21I, L210:
CHAN OF FPN L22I, L220, L23I, L230:
PLACED PAR
  PROCESSOR 0 T800
    PLACE ts AT link0.out:
    PLACE fs AT link0.in:
    PLACE MO AT link2.out:
    PLACE MI AT link2.in:
    INT MNUM:
    SEQ
      MNUM := 0
      M1(fs, ts, MO, MI, MNUM)
  PLACED PAR
    PROCESSOR 1 T800
      PLACE MO AT link1.in:
      PLACE MI AT link1.out:
      PLACE S1I AT link2.in:
      PLACE S10 AT link2.out:
      PLACE L90 AT link0.in:
      PLACE L9I AT link0.out:
      PLACE L5I AT link3.in:
      PLACE L50 AT link3.out:
      INT MNUM:
      SEQ
        MNUM := 1
        S84(MI, MO, S10, S1I, L9I, L90, L50, L5I, MNUM)

```

```

PLACED PAR
PROCESSOR 2 T800
  PLACE S1O AT link1.in:
  PLACE S1I AT link1.out:
  PLACE S2I AT link2.in:
  PLACE S2O AT link2.out:
  PLACE L3O AT link0.in:
  PLACE L3I AT link0.out:
  PLACE L4I AT link3.in:
  PLACE L4O AT link3.out:
  INT MNUM:
  SEQ
    MNUM := 2
    S84(S1I,S1O,S2O,S2I,L3I,L3O,L4O,L4I,MNUM)
PLACED PAR
PROCESSOR 3 T800
  PLACE S2O AT link1.in:
  PLACE S2I AT link1.out:
  PLACE S3I AT link2.in:
  PLACE S3O AT link2.out:
  PLACE L4O AT link0.in:
  PLACE L4I AT link0.out:
  PLACE L2I AT link3.in:
  PLACE L2O AT link3.out:
  INT MNUM:
  SEQ
    MNUM := 3
    S84(S2I,S2O,S3O,S3I,L4I,L4O,L2O,L2I,MNUM)
PLACED PAR
PROCESSOR 4 T800
  PLACE S3O AT link1.in:
  PLACE S3I AT link1.out:
  PLACE S4I AT link2.in:
  PLACE S4O AT link2.out:
  PLACE L2O AT link0.in:
  PLACE L2I AT link0.out:
  PLACE L3I AT link3.in:
  PLACE L3O AT link3.out:
  INT MNUM:
  SEQ
    MNUM := 4
    S84(S3I,S3O,S4O,S4I,L2I,L2O,L3O,L3I,MNUM)
PLACED PAR
PROCESSOR 5 T800
  PLACE S4O AT link1.in:
  PLACE S4I AT link1.out:
  PLACE S5I AT link2.in:
  PLACE S5O AT link2.out:
  PLACE L1O AT link0.in:
  PLACE L1I AT link0.out:
  PLACE L9I AT link3.in:
  PLACE L9O AT link3.out:
  INT MNUM:
  SEQ
    MNUM := 5
    S84(S4I,S4O,S5O,S5I,L1I,L1O,L9O,L9I,MNUM)
PLACED PAR
PROCESSOR 6 T414
  PLACE S5O AT link1.in:
  PLACE S5I AT link1.out:
  PLACE S6I AT link2.in:

```

```

    PLACE S6O AT link2.out:
    PLACE L7O AT link0.in:
    PLACE L7I AT link0.out:
    PLACE L8I AT link3.in:
    PLACE L8O AT link3.out:
    INT MNUM:
    SEQ
    MNUM := 6
    S44(S5I,S5O,S6O,S6I,L7I,L7O,L8O,L8I,MNUM)
PLACED PAR
    PROCESSOR 7 T800
    PLACE S6O AT link1.in:
    PLACE S6I AT link1.out:
    PLACE S7I AT link2.in:
    PLACE S7O AT link2.out:
    PLACE L8O AT link0.in:
    PLACE L8I AT link0.out:
    PLACE L6I AT link3.in:
    PLACE L6O AT link3.out:
    INT MNUM:
    SEQ
    MNUM := 7
    S84(S6I,S6O,S7O,S7I,L8I,L8O,L6O,L6I,MNUM)
PLACED PAR
    PROCESSOR 8 T414
    PLACE S7O AT link1.in:
    PLACE S7I AT link1.out:
    PLACE S8I AT link2.in:
    PLACE S8O AT link2.out:
    PLACE L6O AT link0.in:
    PLACE L6I AT link0.out:
    PLACE L7I AT link3.in:
    PLACE L7O AT link3.out:
    INT MNUM:
    SEQ
    MNUM := 8
    S44(S7I,S7O,S8O,S8I,L6I,L6O,L7O,L7I,MNUM)
PLACED PAR
    PROCESSOR 9 T414
    PLACE S8O AT link1.in:
    PLACE S8I AT link1.out:
    PLACE S9I AT link2.in:
    PLACE S9O AT link2.out:
    PLACE L5O AT link0.in:
    PLACE L5I AT link0.out:
    PLACE L1I AT link3.in:
    PLACE L1O AT link3.out:
    INT MNUM:
    SEQ
    MNUM := 9
    S44(S8I,S8O,S9O,S9I,L5I,L5O,L1O,L1I,MNUM)
PLACED PAR
    PROCESSOR 10 T414
    PLACE S9O AT link1.in:
    PLACE S9I AT link1.out:
    PLACE S10I AT link2.in:
    PLACE S10O AT link2.out:
    PLACE L23O AT link3.in:
    PLACE L23I AT link3.out:
    PLACE L11I AT link0.in:
    PLACE L11O AT link0.out:

```

```

    INT MNUM:
    SEQ
      MNUM := 10
      S44(S9I,S9O,S10O,S10I,L23I,L23O,L11O,L11I,MNUM)
    PLACED PAR
      PROCESSOR 11 T414
        PLACE S10O AT link1.in:
        PLACE S10I AT link1.out:
        PLACE S11I AT link2.in:
        PLACE S11O AT link2.out:
        PLACE L11O AT link3.in:
        PLACE L11I AT link3.out:
        PLACE L12I AT link0.in:
        PLACE L12O AT link0.out:
      INT MNUM:
      SEQ
        MNUM := 11
        S44(S10I,S10O,S11O,S11I,L11I,L11O,L12O,L12I,MNUM)
    PLACED PAR
      PROCESSOR 12 T414
        PLACE S11O AT link1.in:
        PLACE S11I AT link1.out:
        PLACE S12I AT link2.in:
        PLACE S12O AT link2.out:
        PLACE L12O AT link3.in:
        PLACE L12I AT link3.out:
        PLACE L13I AT link0.in:
        PLACE L13O AT link0.out:
      INT MNUM:
      SEQ
        MNUM := 12
        S44(S11I,S11O,S12O,S12I,L12I,L12O,L13O,L13I,MNUM)
    PLACED PAR
      PROCESSOR 13 T414
        PLACE S12O AT link1.in:
        PLACE S12I AT link1.out:
        PLACE S13I AT link2.in:
        PLACE S13O AT link2.out:
        PLACE L13O AT link3.in:
        PLACE L13I AT link3.out:
        PLACE L14I AT link0.in:
        PLACE L14O AT link0.out:
      INT MNUM:
      SEQ
        MNUM := 13
        S44(S12I,S12O,S13O,S13I,L13I,L13O,L14O,L14I,MNUM)
    PLACED PAR
      PROCESSOR 14 T414
        PLACE S13O AT link1.in:
        PLACE S13I AT link1.out:
        PLACE S14I AT link2.in:
        PLACE S14O AT link2.out:
        PLACE L14O AT link3.in:
        PLACE L14I AT link3.out:
        PLACE L15I AT link0.in:
        PLACE L15O AT link0.out:
      INT MNUM:
      SEQ
        MNUM := 14
        S44(S13I,S13O,S14O,S14I,L14I,L14O,L15O,L15I,MNUM)
    PLACED PAR

```

```

PROCESSOR 15 T414
  PLACE S14O AT link1.in:
  PLACE S14I AT link1.out:
  PLACE S15I AT link2.in:
  PLACE S15O AT link2.out:
  PLACE L15O AT link3.in:
  PLACE L15I AT link3.out:
  PLACE L16I AT link0.in:
  PLACE L16O AT link0.out:
  INT MNUM:
  SEQ
    MNUM := 15
    S44(S14I,S14O,S15O,S15I,L15I,L15O,L16O,L16I,MNUM)
PLACED PAR
  PROCESSOR 16 T414
    PLACE S15O AT link1.in:
    PLACE S15I AT link1.out:
    PLACE S16I AT link2.in:
    PLACE S16O AT link2.out:
    PLACE L16O AT link3.in:
    PLACE L16I AT link3.out:
    PLACE L17I AT link0.in:
    PLACE L17O AT link0.out:
    INT MNUM:
    SEQ
      MNUM := 16
      S44(S15I,S15O,S16O,S16I,L16I,L16O,L17O,L17I,MNUM)
PLACED PAR
  PROCESSOR 17 T414
    PLACE S16O AT link1.in:
    PLACE S16I AT link1.out:
    PLACE S17I AT link2.in:
    PLACE S17O AT link2.out:
    PLACE L17O AT link3.in:
    PLACE L17I AT link3.out:
    PLACE L18I AT link0.in:
    PLACE L18O AT link0.out:
    INT MNUM:
    SEQ
      MNUM := 17
      S44(S16I,S16O,S17O,S17I,L17I,L17O,L18O,L18I,MNUM)
PLACED PAR
  PROCESSOR 18 T414
    PLACE S17O AT link1.in:
    PLACE S17I AT link1.out:
    PLACE S18I AT link2.in:
    PLACE S18O AT link2.out:
    PLACE L18O AT link3.in:
    PLACE L18I AT link3.out:
    PLACE L19I AT link0.in:
    PLACE L19O AT link0.out:
    INT MNUM:
    SEQ
      MNUM := 18
      S44(S17I,S17O,S18O,S18I,L18I,L18O,L19O,L19I,MNUM)
PLACED PAR
  PROCESSOR 19 T414
    PLACE S18O AT link1.in:
    PLACE S18I AT link1.out:
    PLACE S19I AT link2.in:
    PLACE S19O AT link2.out:

```

```

    PLACE L19O AT link3.in:
    PLACE L19I AT link3.out:
    PLACE L20I AT link0.in:
    PLACE L20O AT link0.out:
    INT MNUM:
    SEQ
      MNUM := 19
      S44(S18I,S18O,S19O,S19I,L19I,L19O,L20O,L20I,MNUM)
PLACED PAR
  PROCESSOR 20 T414
    PLACE S19O AT link1.in:
    PLACE S19I AT link1.out:
    PLACE S20I AT link2.in:
    PLACE S20O AT link2.out:
    PLACE L20O AT link3.in:
    PLACE L20I AT link3.out:
    PLACE L21I AT link0.in:
    PLACE L21O AT link0.out:
    INT MNUM:
    SEQ
      MNUM := 20
      S44(S19I,S19O,S20O,S20I,L20I,L20O,L21O,L21I,MNUM)
PLACED PAR
  PROCESSOR 21 T414
    PLACE S20O AT link1.in:
    PLACE S20I AT link1.out:
    PLACE S21I AT link2.in:
    PLACE S21O AT link2.out:
    PLACE L21O AT link3.in:
    PLACE L21I AT link3.out:
    PLACE L22I AT link0.in:
    PLACE L22O AT link0.out:
    INT MNUM:
    SEQ
      MNUM := 21
      S44(S20I,S20O,S21O,S21I,L21I,L21O,L22O,L22I,MNUM)
PLACED PAR
  PROCESSOR 22 T414
    PLACE S21O AT link1.in:
    PLACE S21I AT link1.out:
    PLACE L22O AT link3.in:
    PLACE L22I AT link3.out:
    PLACE L23I AT link0.in:
    PLACE L23O AT link0.out:
    INT MNUM:
    SEQ
      MNUM := 23
      S43(S21I,S21O,L22I,L22O,L23O,L23I,MNUM)

```

occam 2 product compiler (19th September 1988)

```
PROCESSOR 0 0 T8 1
SC 3 1808 1808 0
CODE 28 0 204 528
PROCESSOR 1 1 T8 1
SC 0 1320 1320 0
CODE 48 28 428 20
PROCESSOR 2 2 T8 1
SC 0 1320 1320 0
CODE 48 76 428 20
PROCESSOR 3 3 T8 1
SC 0 1320 1320 0
CODE 48 124 428 20
PROCESSOR 4 4 T8 1
SC 0 1320 1320 0
CODE 48 172 428 20
PROCESSOR 5 5 T8 1
SC 0 1320 1320 0
CODE 48 220 428 20
PROCESSOR 6 6 T4 1
SC 1 716 716 0
CODE 48 268 428 20
PROCESSOR 7 7 T8 1
SC 0 1320 1320 0
CODE 48 316 428 20
PROCESSOR 8 8 T4 1
SC 1 716 716 0
CODE 48 364 428 20
PROCESSOR 9 9 T4 1
SC 1 716 716 0
CODE 48 412 428 20
PROCESSOR 10 10 T4 1
SC 1 716 716 0
CODE 48 460 428 20
PROCESSOR 11 11 T4 1
SC 1 716 716 0
CODE 48 508 428 20
PROCESSOR 12 12 T4 1
SC 1 716 716 0
CODE 48 556 428 20
PROCESSOR 13 13 T4 1
SC 1 716 716 0
CODE 48 604 428 20
PROCESSOR 14 14 T4 1
SC 1 716 716 0
CODE 48 652 428 20
PROCESSOR 15 15 T4 1
SC 1 716 716 0
CODE 48 700 428 20
PROCESSOR 16 16 T4 1
SC 1 716 716 0
CODE 48 748 428 20
PROCESSOR 17 17 T4 1
SC 1 716 716 0
CODE 48 796 428 20
PROCESSOR 18 18 T4 1
SC 1 716 716 0
CODE 48 844 428 20
PROCESSOR 19 19 T4 1
SC 1 716 716 0
CODE 48 892 428 20
```

PROCESSOR 20 20 T4 1
SC 1 716 716 0
CODE 48 940 428 20
PROCESSOR 21 21 T4 1
SC 1 716 716 0
CODE 48 988 428 20
PROCESSOR 22 22 T4 1
SC 2 172 172 0
CODE 32 1036 304 0
LINK 0 2, 1 1
LINK 1 0, 5 3
LINK 1 2, 2 1
LINK 1 3, 9 0
LINK 2 0, 4 3
LINK 2 2, 3 1
LINK 2 3, 3 0
LINK 3 2, 4 1
LINK 3 3, 4 0
LINK 4 2, 5 1
LINK 5 0, 9 3
LINK 5 2, 6 1
LINK 6 0, 8 3
LINK 6 2, 7 1
LINK 6 3, 7 0
LINK 7 2, 8 1
LINK 7 3, 8 0
LINK 8 2, 9 1
LINK 9 2, 10 1
LINK 10 0, 11 3
LINK 10 2, 11 1
LINK 10 3, 22 0
LINK 11 0, 12 3
LINK 11 2, 12 1
LINK 12 0, 13 3
LINK 12 2, 13 1
LINK 13 0, 14 3
LINK 13 2, 14 1
LINK 14 0, 15 3
LINK 14 2, 15 1
LINK 15 0, 16 3
LINK 15 2, 16 1
LINK 16 0, 17 3
LINK 16 2, 17 1
LINK 17 0, 18 3
LINK 17 2, 18 1
LINK 18 0, 19 3
LINK 18 2, 19 1
LINK 19 0, 20 3
LINK 19 2, 20 1
LINK 20 0, 21 3
LINK 20 2, 21 1
LINK 21 0, 22 3
LINK 21 2, 22 1


```
#INCLUDE "hostio.inc"
#INCLUDE "linkaddr.inc"
PROTOCOL FPN IS INT :
```

```
#USE "S84.c8h"
#USE "S44.c4h"
#USE "S43.c4h"
#USE "M1.c8h"
```

```
CHAN OF SP fs, ts:
[24]CHAN OF FPN PI,PO,LO,LI:
```

```
PLACED PAR
```

```
PROCESSOR 0 T800
```

```
PLACE ts AT link0.out:
PLACE fs AT link0.in:
PLACE PO[0] AT link2.out:
PLACE PI[0] AT link2.in:
M1(fs,ts,PO[0],PI[0],0)
```

```
PLACED PAR
```

```
PROCESSOR 1 T800
```

```
PLACE PO[0] AT link1.in:
PLACE PI[0] AT link1.out:
PLACE PI[1] AT link2.in:
PLACE PO[1] AT link2.out:
PLACE LO[9] AT link0.in:
PLACE LI[9] AT link0.out:
PLACE LI[5] AT link3.in:
PLACE LO[5] AT link3.out:
S84(PI[0],PO[0],PO[1],PI[1],LI[9],LO[9],LO[5],LI[5],1)
```

```
PLACED PAR
```

```
PROCESSOR 2 T800
```

```
PLACE PO[1] AT link1.in:
PLACE PI[1] AT link1.out:
PLACE PI[2] AT link2.in:
PLACE PO[2] AT link2.out:
PLACE LO[3] AT link0.in:
PLACE LI[3] AT link0.out:
PLACE LI[4] AT link3.in:
PLACE LO[4] AT link3.out:
S84(PI[1],PO[1],PO[2],PI[2],LI[3],LO[3],LO[4],LI[4],2)
```

```
PLACED PAR
```

```
PROCESSOR 3 T800
```

```
PLACE PO[2] AT link1.in:
PLACE PI[2] AT link1.out:
PLACE PI[3] AT link2.in:
PLACE PO[3] AT link2.out:
PLACE LO[4] AT link0.in:
PLACE LI[4] AT link0.out:
PLACE LI[2] AT link3.in:
PLACE LO[2] AT link3.out:
S84(PI[2],PO[2],PO[3],PI[3],LI[4],LO[4],LO[2],LI[2],3)
```

```
PLACED PAR
```

```
PROCESSOR 4 T800
```

```
PLACE PO[3] AT link1.in:
PLACE PI[3] AT link1.out:
PLACE PI[4] AT link2.in:
```

```

PLACE PO[4] AT link2.out:
PLACE LO[2] AT link0.in:
PLACE LI[2] AT link0.out:
PLACE LI[3] AT link3.in:
PLACE LO[3] AT link3.out:
S84(PI[3],PO[3],PO[4],PI[4],LI[2],LO[2],LO[3],LI[3],4)

PLACED PAR
PROCESSOR 5 T800
PLACE PO[4] AT link1.in:
PLACE PI[4] AT link1.out:
PLACE PI[5] AT link2.in:
PLACE PO[5] AT link2.out:
PLACE LO[1] AT link0.in:
PLACE LI[1] AT link0.out:
PLACE LI[9] AT link3.in:
PLACE LO[9] AT link3.out:
S84(PI[4],PO[4],PO[5],PI[5],LI[1],LO[1],LO[9],LI[9],5)

PLACED PAR
PROCESSOR 6 T414
PLACE PO[5] AT link1.in:
PLACE PI[5] AT link1.out:
PLACE PI[6] AT link2.in:
PLACE PO[6] AT link2.out:
PLACE LO[7] AT link0.in:
PLACE LI[7] AT link0.out:
PLACE LI[8] AT link3.in:
PLACE LO[8] AT link3.out:
S44(PI[5],PO[5],PO[6],PI[6],LI[7],LO[7],LO[8],LI[8],6)

PLACED PAR
PROCESSOR 7 T800
PLACE PO[6] AT link1.in:
PLACE PI[6] AT link1.out:
PLACE PI[7] AT link2.in:
PLACE PO[7] AT link2.out:
PLACE LO[8] AT link0.in:
PLACE LI[8] AT link0.out:
PLACE LI[6] AT link3.in:
PLACE LO[6] AT link3.out:
S84(PI[6],PO[6],PO[7],PI[7],LI[8],LO[8],LO[6],LI[6],7)

PLACED PAR
PROCESSOR 8 T414
PLACE PO[7] AT link1.in:
PLACE PI[7] AT link1.out:
PLACE PI[8] AT link2.in:
PLACE PO[8] AT link2.out:
PLACE LO[6] AT link0.in:
PLACE LI[6] AT link0.out:
PLACE LI[7] AT link3.in:
PLACE LO[7] AT link3.out:
S44(PI[7],PO[7],PO[8],PI[8],LI[6],LO[6],LO[7],LI[7],8)

PLACED PAR
PROCESSOR 9 T414
PLACE PO[8] AT link1.in:
PLACE PI[8] AT link1.out:
PLACE PI[9] AT link2.in:
PLACE PO[9] AT link2.out:

```

```

PLACE LO[5] AT link0.in:
PLACE LI[5] AT link0.out:
PLACE LI[1] AT link3.in:
PLACE LO[1] AT link3.out:
S44(PI[8],PO[8],PO[9],PI[9],LI[5],LO[5],LO[1],LI[1],9)

PLACED PAR
PROCESSOR 10 T414
PLACE PO[9] AT link1.in:
PLACE PI[9] AT link1.out:
PLACE PI[10] AT link2.in:
PLACE PO[10] AT link2.out:
PLACE LO[23] AT link3.in:
PLACE LI[23] AT link3.out:
PLACE LI[11] AT link0.in:
PLACE LO[11] AT link0.out:
S44(PI[9],PO[9],PO[10],PI[10],LI[23],LO[23],LO[11],LI[11],10)

PLACED PAR
PROCESSOR 11 T414
PLACE PO[10] AT link1.in:
PLACE PI[10] AT link1.out:
PLACE PI[11] AT link2.in:
PLACE PO[11] AT link2.out:
PLACE LO[11] AT link3.in:
PLACE LI[11] AT link3.out:
PLACE LI[12] AT link0.in:
PLACE LO[12] AT link0.out:
S44(PI[10],PO[10],PO[11],PI[11],LI[11],LO[11],LO[12],LI[12],11)

PLACED PAR
PROCESSOR 12 T414
PLACE PO[11] AT link1.in:
PLACE PI[11] AT link1.out:
PLACE PI[12] AT link2.in:
PLACE PO[12] AT link2.out:
PLACE LO[12] AT link3.in:
PLACE LI[12] AT link3.out:
PLACE LI[13] AT link0.in:
PLACE LO[13] AT link0.out:
S44(PI[11],PO[11],PO[12],PI[12],LI[12],LO[12],LO[13],LI[13],12)

PLACED PAR
PROCESSOR 13 T414
PLACE PO[12] AT link1.in:
PLACE PI[12] AT link1.out:
PLACE PI[13] AT link2.in:
PLACE PO[13] AT link2.out:
PLACE LO[13] AT link3.in:
PLACE LI[13] AT link3.out:
PLACE LI[14] AT link0.in:
PLACE LO[14] AT link0.out:
S44(PI[12],PO[12],PO[13],PI[13],LI[13],LO[13],LO[14],LI[14],13)

PLACED PAR
PROCESSOR 14 T414
PLACE PO[13] AT link1.in:
PLACE PI[13] AT link1.out:
PLACE PI[14] AT link2.in:
PLACE PO[14] AT link2.out:
PLACE LO[14] AT link3.in:

```

```

PLACE LI[14] AT link3.out:
PLACE LI[15] AT link0.in:
PLACE LO[15] AT link0.out:
S44(PI[13],PO[13],PO[14],PI[14],LI[14],LO[14],LO[15],LI[15],14)

```

PLACED PAR

PROCESSOR 15 T414

```

PLACE PO[14] AT link1.in:
PLACE PI[14] AT link1.out:
PLACE PI[15] AT link2.in:
PLACE PO[15] AT link2.out:
PLACE LO[15] AT link3.in:
PLACE LI[15] AT link3.out:
PLACE LI[16] AT link0.in:
PLACE LO[16] AT link0.out:
S44(PI[14],PO[14],PO[15],PI[15],LI[15],LO[15],LO[16],LI[16],15)

```

PLACED PAR

PROCESSOR 16 T414

```

PLACE PO[15] AT link1.in:
PLACE PI[15] AT link1.out:
PLACE PI[16] AT link2.in:
PLACE PO[16] AT link2.out:
PLACE LO[16] AT link3.in:
PLACE LI[16] AT link3.out:
PLACE LI[17] AT link0.in:
PLACE LO[17] AT link0.out:
S44(PI[15],PO[15],PO[16],PI[16],LI[16],LO[16],LO[17],LI[17],16)

```

PLACED PAR

PROCESSOR 17 T414

```

PLACE PO[16] AT link1.in:
PLACE PI[16] AT link1.out:
PLACE PI[17] AT link2.in:
PLACE PO[17] AT link2.out:
PLACE LO[17] AT link3.in:
PLACE LI[17] AT link3.out:
PLACE LI[18] AT link0.in:
PLACE LO[18] AT link0.out:
S44(PI[16],PO[16],PO[17],PI[17],LI[17],LO[17],LO[18],LI[18],17)

```

PLACED PAR

PROCESSOR 18 T414

```

PLACE PO[17] AT link1.in:
PLACE PI[17] AT link1.out:
PLACE PI[18] AT link2.in:
PLACE PO[18] AT link2.out:
PLACE LO[18] AT link3.in:
PLACE LI[18] AT link3.out:
PLACE LI[19] AT link0.in:
PLACE LO[19] AT link0.out:
S44(PI[17],PO[17],PO[18],PI[18],LI[18],LO[18],LO[19],LI[19],18)

```

PLACED PAR

PROCESSOR 19 T414

```

PLACE PO[18] AT link1.in:
PLACE PI[18] AT link1.out:
PLACE PI[19] AT link2.in:
PLACE PO[19] AT link2.out:
PLACE LO[19] AT link3.in:
PLACE LI[19] AT link3.out:

```

```

    PLACE LI[20] AT link0.in:
    PLACE LO[20] AT link0.out:
    S44(PI[18],PO[18],PO[19],PI[19],LI[19],LO[19],LO[20],LI[20],19)

PLACED PAR
  PROCESSOR 20 T414
    PLACE PO[19] AT link1.in:
    PLACE PI[19] AT link1.out:
    PLACE PI[20] AT link2.in:
    PLACE PO[20] AT link2.out:
    PLACE LO[20] AT link3.in:
    PLACE LI[20] AT link3.out:
    PLACE LI[21] AT link0.in:
    PLACE LO[21] AT link0.out:
    S44(PI[19],PO[19],PO[20],PI[20],LI[20],LO[20],LO[21],LI[21],20)

PLACED PAR
  PROCESSOR 21 T414
    PLACE PO[20] AT link1.in:
    PLACE PI[20] AT link1.out:
    PLACE PI[21] AT link2.in:
    PLACE PO[21] AT link2.out:
    PLACE LO[21] AT link3.in:
    PLACE LI[21] AT link3.out:
    PLACE LI[22] AT link0.in:
    PLACE LO[22] AT link0.out:
    S44(PI[20],PO[20],PO[21],PI[21],LI[21],LO[21],LO[22],LI[22],21)

PLACED PAR
  PROCESSOR 22 T414
    PLACE PO[21] AT link1.in:
    PLACE PI[21] AT link1.out:
    PLACE LO[22] AT link3.in:
    PLACE LI[22] AT link3.out:
    PLACE LI[23] AT link0.in:
    PLACE LO[23] AT link0.out:
    S43(PI[21],PO[21],LI[22],LO[22],LO[23],LI[23],23)

```

D OUTPUTS

This section includes the results of the programs written to test the different systems.

Load Flow Solution

THIRTY BUS IEEE TEST SYSTEM

From Bus	Volt Mag	Volt Angle	Mw Load	Mvar Load	Mw Gen	Mvar Gen	to Bus	Mw Flow	Mvar Flow	Mva Flow
1	1.05	0.00	0.00	0.00	139.71	-5.24				
+							2	91.35	-1.64	91.37
+							3	48.36	-3.60	48.50
2	1.03	-2.76	21.70	12.70	57.56	-6.20				
+							1	-89.90	0.26	89.90
+							4	29.17	-9.03	30.53
+							5	58.04	1.67	58.07
+							6	38.55	-11.81	40.32
3	1.04	-4.76	2.40	1.20						
+							1	-47.40	3.09	47.50
							4	45.00	-4.29	45.21
4	1.03	-5.70	7.60	1.60						
+							2	-28.69	6.57	29.43
+							3	-44.75	4.12	44.94
+							6	42.09	-13.13	44.09
+							12	23.75	-31.66	39.58
5	1.01	-9.01	19.20	19.02	4.56	17.12				
+							2	-56.55	0.26	56.55
+							7	-13.09	-2.15	13.27
6	1.03	-6.72	0.00	0.00						
+							2	-37.69	10.43	39.10
+							4	-41.87	12.93	43.82
+							7	36.33	10.51	37.82
+							8	-1.46	20.39	20.44
+							9	19.0	-44.68	48.56
+							10	14.4	-25.34	29.15
+							8	11.27	-2.30	11.50
7	1.01	-8.19	22.80	10.90						
+							5	13.17	0.26	13.17
+							6	-35.97	-11.17	37.66
8	1.02	-6.55	30.03	10.89	35.00	1.75				
+							6	1.51	-21.17	21.22
+							28	3.0	-7.09	7.90
9	1.12	-8.64	0.00	0.0						
+							6	-19.01	49.19	52.74
+							11	-17.93	10.69	20.88
+							10	36.9	-46.32	59.25
10	1.17	-10.42	5.80	2.00						
+							6	-14.41	29.65	32.96
+							9	-36.94	49.40	61.68
+							20	10.83	13.16	17.04

+							17	7.14	21.58	22.73
+							21	18.30	13.52	22.75
+							22	9.28	6.88	11.55
11	1.10	-6.91	0.00	0.00	17.93	-9.97				
+							9	17.93	-9.97	20.51
12	1.11	-8.55	11.20	7.50						
+							4	-23.75	35.17	42.44
+							13	-16.91	13.80	21.83
+							1	6.90	-1.17	7.0
+							15	16.77	-7.50	18.37
+							16	5.79	-12.90	14.21
13	1.09	-7.42	0.00	0.00	16.91	-13.26				
+							12	16.91	-13.26	21.49
14	1.10	-9.45	6.20	1.60						
+							12	-6.85	1.27	6.97
+							15	0.65	-2.87	2.94
15	1.10	-9.81	8.20	2.50						
+							12	-16.59	7.86	18.36
+							14	-0.64	2.88	2.95
+							18	4.43	-7.39	8.62
+							23	4.59	-5.85	7.44
16	1.12	-9.65	3.50	1.80						
+							12	-5.63	13.31	14.45
+							17	2.13	-15.11	15.26
17	1.15	-10.38	9.00	5.80						
+							16	-1.98	15.46	15.59
+							10	-7.02	-21.26	22.39
18	1.12	-10.63	3.20	0.90						
+							15	-4.37	7.52	8.70
+							19	1.17	-8.42	8.50
19	1.12	-10.94	9.50	3.40						
+							18	-1.13	8.50	8.57
+							20	-8.37	-11.90	14.55
20	1.13	-10.87	2.20	0.70						
+							19	8.43	12.01	14.67
+							10	-10.63	-12.71	16.57
21	1.15	-10.81	17.50	11.20						
+							10	-18.17	-13.24	22.48
+							22	0.67	2.04	2.14
22	1.15	-10.80	0.00	0.00						
+							10	-9.21	-6.73	11.41
+							21	-0.67	-2.04	2.14
+							24	9.88	8.77	13.21
23	1.11	-10.52	3.20	1.60						
+							15	-4.55	5.94	7.49
+							24	1.35	-7.54	7.66
24	1.13	-11.14	8.70	6.70						
+							22	-9.73	-8.53	12.94
+							23	-1.29	7.67	7.78
+							25	2.31	10.57	10.82
25	1.09	-10.57	0.00	0.00						

+				
+				
+				
26	1.08	-10.93	3.50	2.30
+				
27	1.08	-10.01	0.00	0.00
+				
+				
+				
+				
28	1.03	-7.10	0.00	0.00
+				
+				
+				
29	1.06	-11.11	2.40	0.90
+				
+				
30	1.05	-11.90	10.60	1.90
+				
+				

24	-2.14	-10.27	10.49
26	3.54	2.36	4.25
27	-1.40	7.91	8.04
25	-3.50	-2.30	4.19
25	1.46	-7.80	7.94
28	-14.71	14.26	20.49
29	6.18	1.64	6.39
30	7.08	1.63	7.26
27	14.71	-12.88	19.55
8	-3.46	2.73	4.41
6	11.25	0.99	11.29
27	-6.10	-1.50	6.28
30	3.70	0.60	3.75
27	-6.93	-1.36	7.06
29	-3.67	-0.54	3.71

Load Flow Solution
FIFTY SEVEN BUS IEEE TEST SYSTEM

From Bus	Volt Mag	Volt Angle	Mw Load	Mvar Load	Mw Gen	Mvar Gen	to Bus	Mw Flow	Mva Flow	Mva Flow
1	1.04	0.00	55.0	17.00	126.67	160.50				
+							2	1.85	26.96	27.02
+							15	0.00	-5.34	5.34
+							16	0.00	-2.95	2.95
+							17	0.00	-1.55	1.55
2	1.01	0.24	3.00	88.00	0.00	-15.16				
+							1	-1.16	-110.27	111.30
+							3	0.00	- .17	4.17
3	1.00	-0.15	41.00	21.00						
+							2	-27.14	-31.18	41.34
+							4	0.00	-1.89	1.89
+							15	0.00	-2.70	2.70
4	0.99	-0.25	0.00	0.00						
+							3	-1.97	-4.91	5.30
+							5	0.00	-1.27	1.27
+							6	0.00	-1.71	1.71
+							18	0.00	0.00	0.00
5	0.98	-0.31	13.00	4.00						
+							4	0.00	-1.25	1.25
+							6	0.00	-0.60	0.60
6	0.99	-1.33	75.00	2.00						
+							4	-23.16	10.67	25.50
+							5	0.00	-0.61	0.61
+							7	0.00	-1.36	1.36
+							9	0.00	-2.31	2.31
7	1.01	-0.11	0.00	0.00						
+							6	0.00	-1.41	1.41
+							8	0.00	-0.99	0.99
+							29	0.00	0.00	0.00
8	1.00	5.08	150.00	22.00	450.00	29.56				
+							7	0.00	-0.98	0.98
+							9	0.00	-2.77	2.77
9	1.00	-1.20	121.00	26.00						
+							6	3.16	3.23	4.51
+							8	0.00	-2.75	2.75
+							10	0.00	-2.21	2.21
+							11	0.00	-1.10	1.10
+							12	0.00	-3.88	3.88

+						13	0.00	-2.04	2.04
+						55	0.00	0.00	0.00
10	1.04	-0.33	5.00	2.00					
+						9	0.00	-2.37	2.37
+						12	0.00	-1.77	1.77
+						51	0.00	0.00	0.00
11	1.00	-0.18	0.00	0.00					
+						9	0.00	-1.10	1.10
+						13	0.00	-0.95	0.95
+						41	0.00	0.00	0.00
+						43	0.00	0.00	0.00
12	1.01	-1.11	377.00	24.00	310.00	106.94			
+						9	0.00	-3.98	3.98
+						10	0.00	-1.69	1.69
+						13	0.00	-3.11	3.11
+						16	0.00	-1.11	1.11
+						17	0.00	-2.45	2.45
13	1.01	-0.27	18.00	2.30					
+						9	0.00	-2.07	2.07
+						11	0.00	-0.96	0.96
+						12	0.00	-3.08	3.08
+						14	0.00	-0.56	0.56
+						15	0.00	-1.17	1.17
+						49	0.00	0.00	0.00
14	1.03	-0.45	10.50	5.30					
+						13	0.00	-0.58	0.58
+						15	0.00	-0.78	0.78
+						46	0.00	0.00	0.00
15	1.01	-0.3	22.00	5.00					
+						1	-16.20	-36.08	39.55
+						3	1.58	19.51	19.57
+						13	0.00	-1.17	1.17
+						14	0.00	-0.75	0.75
+						45	0.00	0.0	0.00
16	1.02	-1.39	43.00	3.00					
+						1	-14.24	-10.96	17.96
+						12	0.00	-1.12	1.12
17	1.02	-1.51	42.00	8.00					
+						1	-28.30	-12.45	30.91
+						12	0.00	-2.48	2.48
18	0.92	-4.90	27.20	9.80					
+						4	0.00	0.00	0.00

+					19	0.00	0.00	0.00
19	0.99	-0.45	3.30	0.60				
+					18	0.00	0.00	0.00
+					20	0.00	0.00	0.00
20	1.01	-0.67	2.30	1.00				
+					19	0.00	0.00	0.00
+					21	2.45	-6.05	6.53
21	0.99	0.17	0.00	0.00				
+					20	0.00	0.00	0.00
+					22	0.00	0.00	0.00
22	1.00	0.00	0.00	0.00				
+					21	-5.56	-57.42	57.69
+					23	0.00	0.00	0.00
+					38	0.00	0.00	0.00
23	1.00	-0.04	6.30	2.10				
+					22	0.00	0.00	0.00
+					24	0.00	-0.42	0.42
24	0.93	0.28	0.00	0.00				
+					23	0.00	-0.37	0.37
+					25	0.00	0.00	0.00
+					26	0.00	0.00	0.00
25	0.86	3.34	6.30	3.20				
+					24	0.00	0.00	0.00
+					30	0.00	0.00	0.00
26	1.04	-0.17	0.00	0.00				
+					24	0.00	0.00	0.00
+					27	0.00	0.00	0.00
27	1.00	-0.36	9.30	0.50				
+					26	0.00	0.00	0.00
+					28	0.00	0.00	0.00
28	1.00	-0.06	4.60	2.30				
+					27	0.00	0.00	0.00
+					29	0.00	0.00	0.00
29	0.98	0.04	17.00	2.60				
+					7	0.00	0.00	0.00
+					28	0.00	0.00	0.00
+					52	0.00	0.00	0.00
30	0.99	-0.20	3.60	1.80				
+					25	0.00	0.00	0.00

+					31	0.00	0.00	0.00
31	0.98	-0.68	5.80	2.90				
+					30	0.00	0.00	0.00
+					32	0.00	0.00	0.00
32	1.00	0.04	1.60	0.80				
+					31	0.00	0.00	0.00
+					33	0.00	0.00	0.00
+					34	0.00	0.00	0.00
33	1.00	-0.04	3.80	1.90				
+					32	0.00	0.00	0.00
34	1.00	-0.07	0.00	0.00				
+					32	0.00	0.00	0.00
+					35	0.00	-0.16	0.16
35	1.00	-0.07	6.00	3.00				
+					34	0.00	-0.16	0.16
+					36	0.00	-0.08	0.08
36	1.00	0.00	0.00	0.00				
+					35	0.00	-0.08	0.08
+					37	0.00	0.00	0.00
+					40	0.00	0.00	0.00
37	1.00	0.00	0.00	0.00				
+					36	0.00	0.00	0.00
+					38	0.00	-0.10	0.10
+					39	0.00	0.00	0.00
38	1.00	-0.08	14.00	7.00				
+					22	0.00	0.00	0.00
+					37	0.00	-0.10	0.10
+					44	0.00	-0.10	0.10
+					48	0.00	0.00	0.00
+					49	0.00	-0.30	0.30
39	1.00	-0.02	0.00	0.00				
+					37	0.00	0.00	0.00
+					57	0.00	0.00	0.00
40	1.00	-0.06	0.00	0.00				
+					36	0.00	0.00	0.00
+					56	0.00	-0.20	0.20
41	0.98	-0.26	6.30	3.00				
+					11	0.00	0.00	0.00
+					42	0.00	0.00	0.00
+					43	0.00	0.00	0.00

+						56	0.00	0.00	0.00
42	0.98	-0.46	7.10	4.40		41	0.00	0.00	0.00
+						56	0.00	0.00	0.00
+									
43	0.97	-0.13	2.00	1.00		11	0.0	0.00	0.00
+						41	0.00	0.00	0.00
+									
44	1.00	-0.26	12.00	1.80		38	0.00	-0.10	0.10
+						45	0.00	-0.20	0.20
+									
45	0.97	0.30	0.00	0.00		15	0.00	0.00	0.00
+						44	0.00	-0.19	0.19
+									
46	0.95	0.49	0.00	0.00		14	0.00	0.00	0.00
+						47	0.00	-0.14	0.14
+									
47	0.99	-0.23	29.70	11.60		46	0.00	-0.16	0.16
+						48	0.00	0.00	0.00
+									
48	1.00	0.00	0.00	0.00		38	0.00	0.00	0.00
+						47	0.00	0.00	0.00
+						49	0.00	-0.24	0.24
+									
49	0.97	0.36	18.00	8.50		13	0.00	0.00	0.00
+						38	0.00	-0.28	0.28
+						48	0.00	-0.22	0.22
+						50	0.00	0.00	0.00
+									
50	0.98	-0.68	21.00	10.50		49	0.00	0.00	0.00
+						51	0.00	0.00	0.00
+									
51	0.94	-0.20	18.00	5.30		10	0.00	0.00	0.00
+						50	0.00	0.00	0.00
+									
52	1.00	-0.12	4.90	2.20		29	0.00	0.00	0.00
+						53	0.00	0.00	0.00
+									
53	0.98	-0.49	20.00	10.00		52	0.00	0.00	0.00
+									

+						54	0.00	0.00	0.00
	54	0.99	-0.20	4.10	1.40				
+						53	0.00	0.00	0.00
+						55	0.00	0.00	0.00
	55	0.94	0.31	6.80	3.40				
+						9	0.00	0.00	0.00
+						54	0.00	0.00	0.00
	56	0.99	-0.26	7.60	2.20				
+						40	0.00	-0.20	0.20
+						41	0.00	0.00	0.00
+						42	0.00	0.00	0.00
+						57	0.00	0.00	0.00
	57	0.98	-0.66	6.70	2.00				
+						39	0.00	0.00	0.00
+						56	0.00	0.00	0.00

Load Flow Solution
118 BUS IEEE TEST SYSTEM

From Bus	Volt Mag	Volt Angle	Mw Load	Mvar Load	Mw Gen	Mvar Gen	to Bus	Mw Flow	Mvar Flow	Mva Flow
1	0.95	0.00	51.00	27.00	-12.54	3.64				
+							2	-17.78	-11.21	21.03
+							3	-45.76	-12.11	47.34
2	0.97	0.91	20.00	9.00						
+							1	17.91	9.35	20.21
+							12	-37.91	-18.35	42.12
3	0.97	1.11	39.00	10.00						
+							1	46.08	12.15	47.65
+							5	-71.69	-10.21	72.41
+							12	-13.39	-11.94	17.94
4	1.00	5.09	30.00	12.00	-9.00	44.90				
+							11	63.00	1.67	63.02
+							5	-102.00	31.23	106.68
5	1.00	5.59	0.00	0.00						
+							3	73.03	13.50	74.27
+							4	102.21	-30.52	106.67
+							11	75.09	-1.69	75.11
+							6	86.25	8.37	86.66
+							8	-336.58	-91.48	348.79
6	0.98	2.93	52.00	22.00						
+							5	-85.35	-5.68	85.54
+							7	33.35	-16.32	37.13
7	0.99	2.48	19.00	2.00						
+							6	-33.29	16.10	36.97
+							12	14.29	-18.10	23.06
8	1.03	10.56	28.00	-158.20						
+							30	76.20	49.66	90.96
+							9	-440.78	-75.98	447.28
+							5	336.58	123.67	358.58
9	1.05	17.72	0.00	0.00						
+							8	445.22	7.49	445.29
+							10	-445.22	-7.49	445.29
10	1.05	25.29	0.00	0.00	450.00	-68.76				
+							9	450.00	-68.76	455.22
11	0.98	2.59	70.00	23.00						

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31	0.97	2.50	43.00	27.00	7.00	31.54			
+							17	-14.44	-11.26 18.31
+							29	8.54	7.89 11.63
+							32	-30.10	7.90 31.12
32	0.97	4.49	59.00	23.00					
+							23	-90.05	-8.16 90.42
+							27	-12.12	2.35 12.34
+							31	30.41	-9.20 31.78
+							113	3.39	-12.82 13.26
+							114	9.37	4.83 10.54
33	0.96	0.29	23.00	9.00					
+							15	-9.12	-0.24 9.12
+							37	-13.88	-8.76 16.42
34	0.98	0.77	59.00	26.00					
+							19	1.97	4.55 4.96
+							36	30.58	16.55 34.78
+							37	-92.54	15.64 93.86
+							43	0.99	-9.35 9.40
35	0.97	0.37	33.00	9.00					
+							36	0.53	0.02 0.53
+							37	-33.53	-9.02 34.72
36	0.97	0.36	31.00	17.00					
+							34	-30.47	-16.74 34.77
+							35	-0.53	-0.26 0.59
37	0.98	1.32	0.00	0.00					
+							33	13.99	5.70 15.11
+							34	92.78	-15.70 94.10
+							35	33.67	8.40 34.70
+							38	-239.47	68.22 249.00
+							39	55.08	-4.80 55.29
+							40	43.95	-11.27 45.37
38	0.96	6.49	0.00	0.00					
+							30	-66.94	-62.72 91.73
+							37	239.47	-45.39 243.73
+							65	-172.53	-63.88 183.98
39	0.96	-2.30	27.00	11.00					
+							37	-54.06	5.63 54.35
+							40	27.06	-16.63 31.76
40	0.97	-3.48	20.00	23.00	-46.00	44.43			
+							37	-42.69	10.83 44.05
+							39	-26.87	15.83 31.18

+						41	15.42	1.20	15.47
+						42	-11.86	-6.44	13.50
	41	0.97	-3.92	37.00	10.00				
+						40	-15.38	-2.22	15.54
+						42	-21.62	-7.78	22.97
	42	0.99	-2.32	37.00	23.00	-59.00	41.05		
+						40	11.96	2.29	12.17
+						41	21.84	5.23	22.46
+						49	-129.79	10.53	130.22
	43	0.99	0.49	18.00	7.00				
+						34	-0.96	5.37	5.46
+						44	-17.04	-12.37	21.06
	44	1.02	2.54	16.00	8.00				
+						43	17.27	7.19	18.71
+						45	-33.27	5.74	33.76
	45	1.02	4.26	53.00	22.00				
+						44	33.52	-7.10	34.26
+						46	-37.50	-1.81	37.54
+						49	-49.02	18.41	52.36
	46	1.04	6.9	9.00	8.30				
+						45	38.04	0.08	38.04
+						47	-32.23	18.25	37.03
+						48	-14.81	5.86	15.93
	47	1.03	9.59	34.00	0.00				
+						46	32.73	-19.95	38.33
+						49	-9.64	8.95	13.15
+						69	-57.08	10.99	58.12
	48	1.03	8.75	20.00	11.00				
+						46	14.97	-10.43	18.25
+						49	-34.97	31.54	47.09
	49	1.02	10.02	87.00	30.00	204.00	37.56		
+						42	136.14	0.64	136.14
+						45	50.86	-18.06	53.97
+						47	9.67	-10.53	14.30
+						48	35.35	-31.80	47.55
+						50	54.51	13.01	56.04
+						51	62.02	17.39	64.41
+						66	-261.81	7.78	261.92
+						69	-46.96	6.02	47.34
+						54	77.24	23.11	80.62
	50	1.00	7.94	17.00	4.00				

+						49	-53.71	-12.65	55.18
+						57	36.71	8.65	37.71
	51	0.97	5.67	17.00	8.00				
+						49	-60.07	-15.31	61.99
+						52	31.02	7.01	31.81
+						58	12.04	0.30	12.04
	52	0.96	4.64	18.00	5.00				
+						51	-30.81	-7.68	31.75
+						53	12.81	2.68	13.08
	53	0.95	3.45	23.00	11.00				
+						52	-12.72	-6.05	14.09
+						54	-10.28	-4.95	11.41
	54	0.96	4.18	65.00	20.00				
+						49	-74.62	-27.99	79.69
+						53	10.31	2.30	10.56
+						55	7.39	2.90	7.94
+						56	22.43	9.70	24.44
+						59	-30.52	-6.91	31.29
	55	0.95	3.89	63.00	22.00				
+						54	-7.38	-4.68	8.74
+						56	-20.91	-9.21	22.84
+						59	-34.71	-8.11	35.65
	56	0.95	4.06	84.00	18.00				
+						54	-22.41	-10.30	24.66
+						55	20.93	8.95	22.77
+						57	-23.79	-8.52	25.27
+						58	0.00	-1.10	1.10
+						59	-58.73	-7.03	59.15
	57	0.97	5.32	12.00	3.00				
+						50	-36.02	-9.93	37.37
+						56	24.02	6.93	25.00
	58	0.97	5.16	12.00	3.00				
+						51	-12.00	-1.87	12.15
+						56	0.00	-1.13	1.13
	59	0.99	8.31	277.00	113.00	155.00	61.03		
+						54	31.04	3.66	31.25
+						55	35.36	5.75	35.82
+						56	60.28	1.19	60.29
+						60	-44.25	-0.66	44.25
+						61	-52.65	0.43	52.65
+						63	-151.76	42.40	157.57

60	1.00	12.07	78.00	3.00					59	44.89	-0.11	44.89
+									61	-112.76	2.56	112.79
+									62	-10.11	-5.45	11.48
61	1.00	12.94	0.00	0.00	160.00	-9.78			59	53.59	0.03	53.59
+									60	113.09	-2.30	113.12
+									62	25.37	-9.35	27.04
+									64	-32.08	58.93	67.09
62	1.00	12.36	77.00	14.00					60	10.12	4.06	10.91
+									61	-25.31	8.64	26.74
+									66	-37.35	-14.77	40.17
+									67	-24.45	-11.92	27.20
63	0.97	11.68	0.00	0.00					59	151.76	-32.92	155.29
+									64	-151.75	-73.04	168.41
64	0.99	13.43	0.00	0.00					61	32.08	-57.74	66.06
+									63	152.24	58.07	162.94
+									65	-184.32	-56.50	192.79
65	1.00	16.59	0.00	0.00	391.00	132.12			38	175.48	-4.47	175.54
+									64	185.30	29.80	187.68
+									68	24.18	34.55	42.17
+									66	6.05	-130.72	130.86
66	1.05	16.48	39.00	18.00	392.00	-7.11			49	267.69	16.86	268.22
+									62	38.09	12.00	39.93
+									65	-6.05	136.59	136.72
+									67	53.28	16.60	55.80
67	1.02	13.81	28.00	7.00					62	24.63	9.56	26.42
+									66	-52.63	-16.56	55.18
68	0.99	16.42	0.00	0.00					65	-24.11	-97.49	100.43
+									116	184.12	77.33	199.70
+									81	-40.19	-21.74	45.70
+									69	-119.73	-156.65	197.16
69	1.05	18.70	0.00	0.00	514.30	-9.22			47	59.85	-9.54	60.60
+									49	49.13	-7.79	49.74

+					68	119.73	170.26	208.14
+					75	111.08	17.98	112.52
+					77	66.33	11.35	67.29
+					70	107.99	15.43	109.09
	70	1.00	11.55	66.00	20.00			
+					24	4.79	-7.47	8.88
+					69	-104.68	-14.22	105.64
+					71	16.04	-13.78	21.14
+					74	16.98	7.24	18.46
+					75	0.90	8.23	8.28
	71	1.00	11.16	0.00	0.00			
+					70	-16.00	13.07	20.66
+					72	9.99	-1.35	10.08
+					73	6.01	-11.72	13.17
	72	1.00	10.15	12.00	8.70			
+					24	-2.05	-5.80	6.15
+					71	-9.94	-2.90	10.36
	73	1.01	10.95	6.00	-10.60			
+					71	-6.00	10.60	12.18
	74	0.98	10.45	68.00	27.00			
+					70	-16.84	-10.05	19.61
+					75	-51.14	6.15	51.51
	75	0.98	11.73	47.00	11.00			
+					69	-106.31	-16.47	107.58
+					70	-0.86	-11.63	11.66
+					74	51.48	-6.01	51.83
+					118	41.74	29.44	51.08
+					77	-33.03	-6.34	33.63
	76	0.95	10.65	68.00	36.00			
+					118	-8.30	-15.34	17.44
+					77	-59.69	-20.66	63.16
	77	1.02	15.38	61.00	28.00			
+					69	-65.01	-18.11	67.49
+					75	33.71	3.64	33.91
+					76	61.60	23.46	65.92
+					78	45.56	1.03	45.57
+					80	-137.88	-32.31	141.61
+					82	1.05	-5.72	5.81
	78	1.01	15.07	71.00	26.00			
+					77	-45.49	-2.08	45.53
+					79	-25.51	-23.92	34.97

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+						88	99.65	2.39	99.68
+						90	168.33	0.50	168.33
+						92	266.75	-11.18	266.99
	90	0.99	21.06	78.00	42.00	-85.00	44.14		
+						89	-163.94	1.84	163.95
+						91	0.96	0.31	1.01
	91	0.98	21.03	10.00	12.00				
+						90	-0.96	-2.38	2.56
+						92	-9.04	-9.62	13.20
	92	1.00	21.52	85.00	10.00				
+						89	-261.25	27.94	262.74
+						91	9.10	6.62	11.25
+						93	52.54	-10.86	53.65
+						94	47.07	-14.39	49.22
+						100	27.20	-15.09	31.10
+						102	40.37	-4.21	40.59
	93	0.99	18.80	12.00	7.00				
+						92	-51.79	11.14	52.98
+						94	39.80	-18.14	43.73
	94	1.00	16.90	30.00	16.00				
+						92	-45.93	14.11	48.04
+						93	-39.37	17.67	43.15
+						95	38.48	3.82	38.67
+						96	17.16	-15.61	23.20
+						100	-0.34	-35.98	35.98
	95	0.99	15.96	42.00	31.00				
+						94	-38.29	-4.25	38.52
+						96	-3.71	-26.75	27.01
	96	1.01	15.82	38.00	15.00				
+						80	-21.51	-16.83	27.31
+						82	10.59	-25.22	27.35
+						94	-17.02	13.75	21.88
+						95	3.83	25.66	25.94
+						97	-13.88	-12.36	18.59
	97	1.02	16.40	15.00	9.00				
+						80	-28.94	-19.18	34.72
+						96	13.94	10.18	17.26
	98	1.02	16.06	34.00	8.00				
+						80	-29.84	-10.17	31.52
+						100	-4.16	2.17	4.69
	99	1.01	15.62	42.00	15.60				

+						80	-20.44	-11.86	23.64
+						100	-21.56	-3.74	21.88
100	1.02	16.57	27.00	18.00	252.00	7.61			
+						92	-26.63	9.82	28.39
+						94	0.54	30.48	30.49
+						98	4.18	-7.06	8.20
+						99	21.64	1.89	21.72
+						101	-12.68	20.71	24.29
+						103	119.18	-42.44	126.51
+						104	57.79	-10.70	58.77
+						106	60.99	-13.11	62.38
101	0.99	17.84	22.00	18.00					
+						100	12.86	-23.22	26.54
+						102	-34.86	5.22	35.25
102	0.99	20.20	5.00	3.00					
+						92	-40.17	3.69	40.34
+						101	35.17	-6.69	35.80
103	1.02	12.77	-17.00	-24.00					
+						100	-116.74	44.88	125.07
+						110	58.71	2.30	58.75
+						104	32.43	-6.48	33.07
+						105	42.61	-16.70	45.76
104	1.01	9.81	38.00	25.00					
+						100	-56.30	11.84	57.53
+						103	-31.95	3.97	32.19
+						105	50.25	-40.74	64.69
105	1.02	8.55	31.00	26.00					
+						103	-41.57	15.59	44.39
+						104	-49.86	41.24	64.70
+						106	8.20	18.59	20.32
+						107	26.80	-5.78	27.42
+						108	25.42	9.34	27.08
106	1.01	8.45	43.00	16.00					
+						100	-58.76	15.17	60.69
+						105	-8.15	-19.85	21.46
+						107	23.90	-11.32	26.45
107	1.02	5.75	50.00	2.70					
+						105	-26.43	2.12	26.52
+						106	-23.57	7.61	24.77
108	1.01	7.71	2.00	1.00					
+						105	-25.23	-10.74	27.42
+						109	23.23	9.74	25.19

109	1.01	7.39	8.00	3.00				
+								
+								
110	1.00	6.86	39.00	30.00				
+								
+								
+								
+								
111	1.00	8.43	-36.00	1.40				
+								
112	0.98	4.34	25.00	13.00	-43.00	6.63		
+								
113	0.99	3.69	0.00	0.00				
+								
+								
114	0.96	4.18	8.00	3.00				
+								
+								
115	0.96	4.18	22.00	7.00				
+								
+								
116	0.99	16.01	184.00	91.80				
+								
117	0.97	0.56	20.00	8.00				
+								
118	0.96	10.78	33.00	15.00				
+								
+								
108	-23.16	-10.33	25.36					
110	15.16	7.33	16.84					
103	-57.41	-0.94	57.41					
109	-15.08	-9.13	17.63					
111	-35.72	0.38	35.72					
112	69.20	3.48	69.29					
110	36.00	-1.40	36.03					
110	-68.00	-6.37	68.30					
17	3.31	-8.13	8.78					
32	-3.31	8.13	8.78					
32	-9.35	-6.26	11.25					
115	1.35	3.26	3.53					
27	-20.65	-3.48	20.94					
114	-1.35	-3.52	3.77					
68	-183.99	-91.80	205.62					
12	-20.00	-8.00	21.54					
75	-41.35	-29.25	50.65					
76	8.36	14.25	16.52					

Load Flow Solution

FPL data

Buses=1883 generators=222

From Bus	V Mag	V Angle	Mw Load	Mvar Load	Mw Gen	Mvar Gen	to Bus	Mw Flow	Mvar Flow	Mva Flow
1	1.03	0.00	0.00	0.00	-97.02	1098.72				
						119	-93.57	1218.97	1222.55	
2	1.03	13.58	0.00	0.00	367.00	1125.54				
						119	380.32	1247.48	1304.17	
3	1.01	12.27	0.00	0.00	666.00	1955.11				
						119	700.98	2353.19	2455.38	
4	0.98	12.63	0.00	0.00	666.00	1745.15				
						119	699.04	2121.77	2233.96	
5	0.59	0.13	0.00	0.00						
						40	255.75	190.37	318.82	
						119	-243.59	-228.10	333.71	
6	0.19	-60.76	33.04	9.64						
						12	6.51	-4.31	7.80	
						20	30.80	18.81	36.09	
						22	-79.04	-42.92	89.94	
8	1.00	-12.73	0.00	0.00	60.00	363.12				
						35	62.80	404.32	409.17	
9	0.18	-66.79	34.24	9.99						
						12	-43.34	-18.89	47.27	
10	0.45	-22.42	53.93	15.70						
						40	-56.89	-23.10	61.40	
						3303	57.52	10.37	58.45	
11	1.00	-4.93	0.00	0.00	150.00	493.22				
						35	153.58	547.92	569.04	
12	0.19	-62.15	0.00	0.00						
						6	-6.49	4.27	7.76	
						9	44.57	23.75	50.50	
						57	-32.45	-17.65	36.94	
14	0.19	-47.81	8.99	2.62						
						61	46.68	20.57	51.01	
						73	-9.90	-39.51	40.73	
15	0.52	-8.06	38.09	11.11						
						110	-122.01	-117.89	169.66	
						118	100.89	97.00	139.95	
16	0.17	-65.97	37.58	10.96						
						17	-19.86	-5.76	20.68	
						21	-4.14	-10.28	11.09	
						72	-17.61	-2.29	17.76	
17	0.18	-59.72	0.00	0.00						
						16	20.10	7.78	21.55	
						73	-19.84	-4.34	20.31	
18	0.17	-54.66	46.31	13.51						
						33	106.63	35.69	112.44	

19	0.73	-18.76	25.51	7.44	73	-135.38	-62.91	149.28
20	0.18	-63.21	9.07	2.65	76	-25.39	-3.50	25.63
21	0.17	-65.75	21.23	6.19	6	-30.24	-16.85	34.61
22	0.27	-37.23	0.00	0.00	21	24.76	7.77	25.95
23	0.18	-51.08	42.37	12.36	16	4.21	10.51	11.33
24	0.14	-52.86	35.10	10.24	20	-24.45	-6.61	25.33
25	0.73	-16.86	37.49	10.94	6	80.87	103.63	131.45
26	0.18	-54.64	30.82	8.99	65	-83.84	-113.69	141.26
27	0.39	-27.63	37.15	10.84	26	57.27	37.03	68.20
28	0.73	-16.88	17.55	5.12	41	-91.63	-54.56	106.64
29	0.44	-24.51	10.10	2.95	54	-103.65	-112.21	152.76
30	0.27	-39.70	22.94	6.69	611	62.76	90.54	110.16
31	0.40	-30.35	32.01	9.34	28	12.02	-13.29	17.92
32	0.54	-20.22	39.98	11.66	51	-95.41	-35.62	101.84
33	0.15	-61.00	42.12	12.28	76	-14.35	-21.90	26.19
34	0.47	-18.16	29.53	8.61	96	49.57	23.67	54.93
					23	-56.47	-31.74	64.78
					85	26.79	22.85	35.21
					29	-178.53	-283.58	335.09
					71	147.75	250.07	290.46
					25	-11.38	11.00	15.83
					27	183.65	330.31	377.93
					32	-195.39	-329.74	383.28
					65	-96.26	-114.29	149.43
					68	77.79	94.95	122.75
					50	124.70	167.95	209.18
					142	-159.56	-185.94	245.02
					29	208.93	421.18	470.15
					167	-250.72	-427.96	495.99
					18	-100.71	-22.42	103.18
					39	58.78	24.57	63.71
					97	-1.08	-11.11	11.17
					35	-3.96	-107.13	107.21

35	0.51	-18.83	29.53	8.61	38	-19.76	90.70	92.83
					8	-53.74	-201.53	208.58
					11	-143.12	-252.30	290.07
					34	5.72	116.21	116.35
					38	-5.00	117.19	117.30
					75	5.23	115.11	115.23
					90	83.22	28.41	87.94
					93	82.95	27.77	87.47
36	0.30	-34.68	32.87	9.59	54	152.58	296.87	333.79
					55	43.06	4.46	43.29
					58	16.28	1.22	16.32
					84	51.98	-43.56	67.82
					88	57.33	2.01	57.37
					100	40.12	63.67	75.26
					104	-397.81	-287.59	490.88
37	0.49	-21.96	24.83	7.24	90	-60.21	-33.35	68.82
					91	37.18	2.54	37.27
38	0.45	-17.03	34.75	10.14	34	20.50	-86.13	88.54
					35	7.58	-102.78	103.06
					52	-52.66	-42.36	67.59
					67	154.54	200.15	252.87
					75	15.69	-101.41	102.62
					79	66.67	18.65	69.23
					102	-2.11	-11.55	11.74
					105	-234.82	144.22	275.58
39	0.15	-65.35	39.38	11.48	33	-57.74	-19.13	60.82
					49	15.88	8.54	18.03
40	0.53	-8.79	19.09	5.57	5	-252.88	-132.96	285.70
					10	58.79	40.28	71.27
					56	80.72	44.56	92.21
					66	111.03	65.43	128.88
41	0.25	-35.68	53.42	15.58	23	99.54	103.61	143.68
					70	13.54	-38.90	41.19
					83	95.81	128.47	160.26
					95	-24.09	-68.12	72.26
					106	-231.70	-146.86	274.32
42	0.11	-58.64	25.68	7.49	611	-101.59	-234.65	255.70
43	0.73	-17.32	30.82	8.99	96	-9.62	-18.57	20.91
					101	-23.03	6.02	23.80
44	0.44	-28.93	27.39	7.99				

45	0.49	-22.27	34.67	10.11	46	-113.41	-163.59	199.05
					78	84.68	139.51	163.20
					60	-37.53	-15.94	40.78
					91	2.63	-1.68	3.12
46	0.49	-26.99	28.93	8.44	44	118.48	183.76	218.64
					89	-147.34	-192.76	242.63
47	0.30	-37.27	31.16	9.09	55	-7.32	-4.47	8.58
					65	-25.66	-14.67	29.56
48	0.43	-20.83	24.14	7.04	79	-20.14	-11.57	23.22
49	0.14	-67.93	42.37	12.36	39	-15.72	-7.57	17.45
					94	-28.34	-5.12	28.80
50	0.32	-37.80	49.82	14.53	31	-116.80	-120.83	168.05
					82	67.99	38.33	78.05
					84	-10.73	44.68	45.95
51	0.74	-15.67	24.83	7.24	25	95.82	37.69	102.97
					92	87.11	20.06	89.39
					107	-338.20	-148.13	369.22
					149	29.22	28.29	40.67
					480	98.62	29.19	102.85
52	0.48	-13.90	14.38	4.19	38	53.72	48.00	72.04
					66	-67.28	-52.13	85.11
53	0.73	-16.72	17.46	5.09	76	36.64	-4.31	36.89
					92	-59.65	-16.49	61.89
54	0.22	-40.85	11.47	3.35	24	125.30	210.86	245.28
					36	-135.60	-205.82	246.48
55	0.30	-36.65	35.53	10.36	36	-42.81	-2.99	42.91
					47	7.36	4.53	8.64
56	0.48	-13.62	29.79	8.69	40	-76.68	-34.45	84.06
					80	48.20	26.78	55.14
57	0.28	-38.93	17.89	5.22	12	33.63	42.69	54.34
					64	-53.11	-64.61	83.64
58	0.30	-36.30	20.97	6.12	36	-16.24	-0.89	16.26
					65	-5.72	-4.78	7.45
59	0.73	-16.06	32.70	9.54	149	-8.20	-28.57	29.73

60	0.50	-21.53	23.11	6.74	159	-25.15	3.65	25.41
					45	37.65	16.49	41.10
61	0.18	-51.73	22.85	6.67	93	-57.99	-27.62	64.23
					14	-45.14	-17.49	48.41
62	0.18	-50.47	38.01	11.09	99	25.73	3.28	25.94
					73	-64.40	-56.92	85.95
63	0.12	-59.97	26.54	7.74	83	33.24	41.13	52.88
					83	-24.39	-46.17	52.22
64	0.29	-37.37	17.38	5.07	611	-3.15	30.48	30.64
					57	50.73	61.95	80.07
65	0.30	-35.79	28.93	8.44	65	-69.19	-75.96	102.74
					22	89.94	125.44	154.35
					30	100.65	137.50	170.40
					47	25.84	15.64	30.21
					58	5.70	4.75	7.42
					64	69.79	80.99	106.91
					71	-268.27	-263.73	376.19
					78	-52.95	-91.06	105.34
66	0.52	-9.70	29.77	8.68	40	-110.54	-62.83	127.15
					52	69.27	61.99	92.96
67	0.37	-24.29	33.38	9.74	38	-146.19	-146.71	207.11
					98	112.94	136.37	177.06
68	0.23	-44.89	31.84	9.29	30	-74.19	-75.47	105.84
					74	45.59	68.11	81.96
69	0.30	-40.96	20.12	5.87	82	-23.98	-35.10	42.51
					87	-3.44	7.71	8.44
70	0.26	-37.41	29.96	8.74	41	-13.12	41.57	43.59
					100	-20.25	-58.69	62.08
71	0.35	-30.26	29.10	8.49	27	-141.70	-216.62	258.85
					65	277.46	331.08	431.97
					114	-167.53	-104.22	197.31
72	0.18	-53.91	0.00	0.00	16	17.76	6.28	18.83
					99	-11.04	-11.11	15.66
73	0.19	-47.81	86.12	25.12	14	9.87	39.51	40.73
					17	19.96	8.99	21.90

					18	147.72	90.50	173.24
					62	65.13	62.36	90.17
					81	54.63	-35.37	65.08
					112	-216.30	-98.73	237.77
					113	-184.17	-83.67	202.28
74	0.21	-48.00	18.32	5.34				
					68	-44.09	-58.73	73.44
					81	31.78	49.89	59.15
75	0.48	-18.21	14.98	4.37				
					35	-3.74	-108.64	108.71
					38	-14.65	109.12	110.10
76	0.73	-16.81	0.00	0.00				
					19	25.42	4.40	25.80
					25	16.56	11.82	20.34
					53	-35.20	-0.50	35.21
77	0.74	-16.09	41.43	12.08				
					147	44.54	29.91	53.65
					480	-89.05	-56.55	105.48
78	0.41	-30.43	22.26	6.49				
					44	-81.69	-127.05	151.05
					65	59.34	128.15	141.22
79	0.44	-20.36	42.12	12.28				
					38	-65.99	-14.57	67.58
					48	20.25	11.79	23.44
80	0.47	-14.75	17.38	5.07				
					56	-47.52	-25.29	53.83
					86	30.33	20.76	36.75
81	0.20	-49.12	68.14	19.87				
					73	-54.53	36.30	65.51
					74	-31.54	-47.59	57.10
82	0.31	-39.81	49.65	14.48				
					50	-67.47	-35.02	76.02
					69	24.30	37.08	44.33
83	0.15	-56.74	35.95	10.49				
					41	-83.85	-52.89	99.14
					62	-31.65	-31.45	44.62
					63	26.84	58.56	64.41
					94	50.48	18.30	53.69
84	0.31	-36.94	43.74	12.76				
					36	-51.55	46.72	69.57
					50	10.99	-43.08	44.46
85	0.16	-58.74	0.00	0.00				
					26	-26.26	-19.35	32.61
					97	30.52	17.40	35.13
86	0.46	-16.22	3.94	1.15				
					80	-30.05	-19.69	35.92
					102	29.39	15.73	33.34
87	0.30	-40.71	34.24	9.99				
					69	3.43	-7.72	8.44

88	0.30	-37.84	21.83	6.37	88	-37.35	0.07	37.35
					36	-56.93	1.07	56.94
89	0.52	-24.85	27.91	8.14	87	37.61	1.70	37.65
					46	150.58	212.86	260.74
90	0.50	-21.28	20.54	5.99	160	-178.69	-223.04	285.79
					35	-82.61	-25.54	86.47
91	0.49	-22.38	40.23	11.73	37	60.41	33.67	69.16
					37	-37.13	-2.32	37.20
92	0.74	-16.11	29.28	8.54	45	-2.61	1.46	2.99
					51	-86.91	-19.41	89.05
93	0.50	-20.91	22.68	6.62	53	59.87	17.14	62.28
					35	-82.37	-24.44	85.92
94	0.15	-61.60	20.89	6.09	60	58.13	28.42	64.71
					49	28.93	8.58	30.18
95	0.26	-35.16	41.94	12.23	83	-49.52	-13.34	51.28
					41	24.76	72.03	76.17
96	0.73	-17.26	39.89	11.64	98	-70.03	-78.85	105.46
					25	-49.47	-23.35	54.71
97	0.16	-61.11	23.54	6.87	43	9.66	18.46	20.83
					33	1.13	11.47	11.52
98	0.33	-28.41	33.38	9.74	85	-30.24	-15.63	34.04
					67	-109.41	-114.36	158.26
99	0.18	-53.45	6.08	1.77	95	74.87	107.39	130.92
					61	-26.61	-4.37	26.97
100	0.27	-37.04	18.66	5.44	72	10.12	9.62	13.96
					36	-38.73	-56.23	68.28
101	0.73	-17.22	27.99	8.16	70	20.59	60.79	64.18
					43	23.03	-6.14	23.83
102	0.45	-17.02	24.05	7.02	136	-49.60	0.77	49.60
					38	2688.08	*****	2998.49
103	0.78	-9.98	6.51	1.90	86	-29.29	-15.29	33.04
					107	346.07	123.56	367.46
					182	-338.05	-143.70	367.32

104 0.47 -12.51 0.00 0.00

36 405.30 649.41 765.50
109 -289.01 -217.61 361.77
111 -63.92 -340.22 346.17
114 177.16 196.61 264.65
121 -71.10 -85.33 111.07
496 -132.77 -314.64 341.50

105 0.41 -7.21 0.00 0.00

38 235.94 -94.07 254.00
109 -67.25 -282.75 290.64
119 -237.16 -338.95 413.68
119 -239.35 -341.46 416.99
119 -237.15 -338.99 413.71
119 -239.35 -341.50 417.03

106 0.36 -14.70 0.00 0.00

41 236.49 317.78 396.12
112 245.80 348.25 426.26
115 -173.16 -319.04 363.01
117 -125.22 -179.65 218.98
119 -202.55 -197.49 282.90
501 -132.71 -303.55 331.29
610 207.70 311.95 374.77

107 0.78 -10.36 0.00 0.00

51 339.69 188.01 388.25
103 -347.36 -148.98 377.96

108 0.43 -8.79 28.25 8.24

116 217.90 253.02 333.92
119 -225.08 -261.82 345.27

109 0.54 -5.45 0.00 0.00

104 296.73 285.44 411.74
105 76.86 369.61 377.52
115 252.47 535.50 592.03
119 -139.59 -107.36 176.10
120 -478.38 ***** 1270.67

110 0.54 -6.34 88.17 25.72

15 123.06 125.67 175.89
119 -215.13 -147.07 260.60

111 0.53 -11.92 42.54 12.41

104 68.26 384.16 390.18
185 -115.43 -390.93 407.61

112 0.31 -18.11 0.00 0.00

73 220.72 306.44 377.66
106 -231.29 -317.97 393.19

113 0.29 -21.05 0.00 0.00

73 187.37 232.94 298.95
610 -178.16 -246.51 304.15

114 0.42 -17.42 0.00 0.00

71 169.77 168.12 238.93
104 -173.09 -162.69 237.55

115	0.41	-11.94	46.22	13.48					
					106	178.22	369.49	410.23	
					109	-235.40	-381.80	448.54	
116	0.39	-11.68	34.67	10.11					
					108	-213.61	-224.73	310.05	
					117	190.08	215.20	287.13	
117	0.38	-13.39	32.87	9.59					
					106	126.99	191.09	229.43	
					116	-188.03	-200.76	275.06	
118	0.49	-10.78	19.77	5.77					
					15	-99.84	-88.48	133.40	
					121	87.67	73.84	114.62	
119	0.64	3.72	0.00	0.00					
					1	107.02	-750.73	758.32	
					2	-365.00	-722.09	809.10	
					5	249.23	262.52	361.98	
					105	263.83	584.28	641.08	
					106	232.64	441.74	499.25	
					108	246.48	453.68	516.32	
					109	145.50	146.27	206.31	
					110	223.49	214.45	309.74	
120	0.71	-0.11	0.00	0.00					
					109	484.09	1605.03	1676.44	
					189	-481.24	-1607.89	1535.54	
121	0.48	-11.85	0.00	0.00					
					104	71.11	87.01	112.37	
					118	-87.71	-71.75	113.32	
122	1.10	15.45	0.00	0.00					
					123	-131.81	39.10	137.49	
					441	17.09	54.93	57.53	
					449	114.72	-66.22	132.46	
123	1.09	16.72	0.00	0.00					
					122	131.92	-35.97	136.74	
					266	-133.35	214.46	252.54	
					464	7.64	-213.97	214.10	
124	1.04	-15.35	0.00	0.00	0.00	171.58			
					152	-0.27	158.15	158.15	
125	0.99	-8.97	0.00	0.00	0.00	166.58			
					181	0.91	188.04	188.04	
126	0.99	-8.52	0.00	0.00	0.00	155.81			
					185	1.08	179.10	179.11	
127	0.94	-4.76	0.00	0.00	137.00	150.90			
					133	141.13	232.34	271.84	
128	0.94	-5.43	0.00	0.00	137.00	148.77			
					134	140.97	230.25	269.98	
129	1.02	-3.59	0.00	0.00	204.00	335.29			
					165	206.11	388.68	439.94	
130	1.02	-3.58	0.00	0.00	204.00	334.53			
					165	206.10	387.79	439.16	

131	0.97	0.63	0.00	0.00	367.00	326.95		
						185	373.93	502.25 626.16
132	0.97	0.70	0.00	0.00	367.00	324.71		
						185	373.83	498.56 623.14
133	0.80	-10.14	0.00	0.00				
						127	-139.21	-187.04 233.17
						152	138.47	169.24 218.67
134	0.80	-10.81	27.71	8.08				
						128	-139.15	-185.59 231.97
						152	110.32	156.76 191.69
135	1.48	23.37	13.41	3.91				
						472	160.55	-228.65 279.39
						3014	-175.96	173.04 246.79
136	0.73	-16.65	58.53	17.07				
						101	49.59	-0.96 49.60
						152	-108.13	-10.26 108.62
137	1.00	-11.42	0.00	0.00				
						138	63.57	16.35 65.63
						143	114.21	241.74 267.36
						145	52.18	16.21 54.64
						154	234.41	354.46 424.96
						163	119.76	354.84 374.51
						176	-579.16	615.08 844.83
						497	175.33	332.22 375.65
						498	-122.19	50.33 132.15
						533	-64.02	-26.66 69.35
138	1.00	-11.44	25.55	7.45				
						137	-63.56	-16.34 65.63
						141	45.28	30.41 54.54
139	0.93	-12.03	45.83	13.37				
						157	47.38	307.00 310.64
						163	-93.26	-326.70 339.75
140	0.83	-10.42	23.10	6.74				
						150	169.07	166.16 237.06
						165	-190.63	-179.94 262.14
141	0.99	-11.83	49.25	14.36				
						138	-45.21	-30.93 54.78
						170	14.64	-31.57 34.80
						230	-20.30	55.20 58.81
142	0.57	-20.49	44.49	12.98				
						31	179.01	300.07 349.41
						152	-222.03	-312.49 383.34
143	0.95	-12.21	35.58	10.38				
						137	-112.19	-230.31 256.18
						153	76.89	223.83 236.67
144	0.79	-14.65	31.20	9.10				
						168	-78.15	-241.90 254.21
						169	47.66	230.51 235.38
145	0.99	-11.82	4.75	1.39				

				137	-52.06	-16.88	54.73
				170	45.64	11.31	47.02
146	0.84	-11.10	53.41	157	48.72	-254.30	258.93
				161	230.91	329.48	402.34
				173	67.63	-218.84	229.06
				179	-211.20	201.43	291.86
				482	-182.16	-118.64	217.39
147	0.73	-16.51	61.35	77	-44.42	-29.65	53.40
				156	-16.52	8.01	18.36
148	0.87	-14.54	44.79	154	-187.09	-305.33	358.09
				155	141.15	354.90	381.94
149	0.73	-16.04	21.24	51	-29.16	-28.46	40.75
				59	8.23	28.51	29.67
150	0.80	-12.04	36.40	140	-167.07	-155.64	228.34
				171	131.05	141.69	193.00
151	0.90	-12.43	50.29	153	-19.87	-213.20	214.12
				157	-30.65	189.77	192.23
152	0.73	-14.56	0.00	124	1.72	-111.64	111.65
				133	-137.61	-143.97	199.16
				134	-109.76	-136.12	174.86
				136	108.64	13.06	109.43
				142	241.75	427.10	490.77
				159	49.94	-2.83	50.02
				160	224.27	349.03	414.87
				161	-176.35	-278.40	329.55
				162	-29.64	-290.35	291.86
				166	53.47	-1.94	53.51
				167	306.96	605.78	679.12
				169	-16.46	-218.47	219.08
				171	-87.45	-128.47	155.41
				181	-424.82	-185.21	463.44
153	0.92	-12.51	55.26	143	-75.70	-217.34	230.14
				151	20.67	217.76	218.73
154	0.92	-13.62	36.32	137	-228.03	-318.64	391.83
				148	191.97	324.15	376.74
155	0.81	-15.05	54.97	148	-134.85	-331.11	357.51
				162	79.80	318.16	328.02
156	0.73	-16.36	20.87	147	16.52	-8.22	18.46

157	0.88	-12.05	69.90	20.39	166	-37.35	2.87	37.46
					139	-45.23	-293.32	296.79
					146	-46.96	268.44	272.52
					151	31.30	-186.26	188.87
					173	-8.38	230.70	230.86
158	0.90	-13.33	34.17	9.97	168	111.18	275.50	297.09
					497	-145.96	-292.52	326.91
159	0.73	-15.88	24.74	7.21	59	25.17	-3.73	25.44
					152	-49.80	2.93	49.89
160	0.56	-22.50	24.07	7.02	89	182.87	248.32	308.39
					152	-207.96	-242.94	319.79
161	0.80	-12.52	46.05	13.43	146	-228.60	-310.12	385.27
					152	181.97	309.83	359.31
162	0.79	-15.03	42.78	12.48	152	34.35	310.82	312.72
					155	-77.08	-308.01	317.50
163	0.96	-11.80	22.80	6.65	137	-117.66	-341.76	361.44
					139	95.25	338.37	351.52
164	0.86	-8.93	30.53	8.90	165	-226.58	-181.89	290.55
					482	210.66	126.84	245.90
165	0.87	-8.77	0.00	0.00	129	-203.92	-312.61	373.24
					130	-203.92	-311.81	372.58
					140	193.08	192.53	272.67
					164	226.70	182.98	291.33
					185	-19.99	197.24	198.26
166	0.73	-15.50	16.04	4.68	152	-53.34	2.10	53.38
					156	37.42	-3.18	37.56
167	0.66	-16.49	21.24	6.20	32	271.59	540.88	605.24
					152	-295.81	-538.46	614.36
168	0.87	-13.79	27.19	7.93	144	82.23	267.02	279.39
					158	-109.43	-265.42	287.09
169	0.77	-14.74	27.78	8.10	144	-46.61	-223.94	228.73
					152	17.88	227.61	228.31
170	0.99	-11.92	62.25	18.16	141	-14.64	31.22	34.48
					145	-45.63	-11.41	47.04
171	0.78	-13.03	40.33	11.76				

					150 -130.00 -136.16 188.25
					152 89.26 137.89 164.26
172	0.75	-6.86	17.38	5.07	
					175 -133.29 23.05 135.27
					495 122.43 -38.11 128.23
173	0.86	-11.69	56.45	16.47	
					146 -66.97 224.33 234.12
					157 9.53 -224.13 224.33
174	0.99	-8.77	36.25	10.57	
					216 -173.23 31.43 176.06
					498 136.30 -43.24 142.99
175	0.75	-5.47	0.00	0.00	
					172 133.85 -23.41 135.88
					180 11.58 -297.66 297.88
					181 128.61 -98.34 161.90
					187 158.08 -94.47 184.16
					189 -923.57 -293.71 969.15
					206 139.39 -100.65 171.93
					500 12.82 -294.60 294.88
					501 175.59 654.45 677.60
					502 191.44 526.34 560.07
176	0.92	-6.21	0.00	0.00	
					137 581.90 -515.13 777.15
					183 84.66 379.26 388.60
					264 56.93 -46.09 73.25
					268 -413.83 -95.10 424.62
					269 -335.07 -27.71 336.21
					483 27.02 356.33 357.35
177	0.76	-8.81	34.09	9.94	
					181 -52.58 -160.81 169.19
					271 30.47 122.52 126.25
178	0.86	-6.56	23.32	6.80	
					183 -5.74 -350.15 350.20
					500 -4.88 326.13 326.16
179	0.81	-8.68	0.00	0.00	
					146 211.57 -185.33 281.26
					185 -200.39 196.14 280.41
180	0.78	-5.87	27.71	8.08	
					175 -9.85 309.83 309.99
					483 -19.22 -317.24 317.82
181	0.77	-8.68	0.00	0.00	
					125 0.04 -146.86 146.86
					152 426.02 240.37 489.15
					175 -127.46 102.52 163.58
					177 52.79 161.32 169.74
					182 49.05 -186.87 193.21
					185 -68.86 -211.44 222.37
					187 -104.43 108.46 150.56
					188 -109.24 -202.80 230.35

						206	-107.47	106.50	151.30	
182	0.79	-9.12	0.00	0.00		103	337.94	72.09	345.54	
						181	-48.66	189.12	195.28	
						185	-287.52	-255.84	384.87	
183	0.87	-6.60	68.71	20.04		176	26.88	-386.13	387.07	
						178	6.08	353.23	353.28	
184	0.76	-8.84	68.56	20.00		186	-54.90	78.80	96.04	
						271	1.32	-142.43	142.44	
185	0.80	-8.22	0.00	0.00		111	135.89	592.84	608.21	
						126	-0.13	-144.70	144.70	
						131	-369.64	-363.04	518.11	
						132	-369.58	-359.53	515.61	
						165	20.31	-182.87	184.00	
						179	200.54	-264.43	331.87	
						181	69.68	217.07	227.98	
						182	288.46	263.88	390.95	
186	0.75	-8.60	63.21	18.44		184	54.96	-79.42	96.58	
						495	-93.12	-13.13	94.04	
187	0.76	-7.29	48.43	14.12		175	-157.56	97.98	185.54	
						181	104.60	-107.39	149.91	
188	0.81	-7.72	35.73	10.42		181	110.19	209.64	236.83	
						258	-147.63	-219.20	264.28	
189	0.78	1.30	0.00	0.00		120	483.65	1571.12	1643.88	
						175	925.26	420.04	1016.14	
						275	-1256.98	-876.09	-670.98	
						354	-146.32	-992.70	1003.43	
190	0.93	-6.44	66.21	19.31		273	-66.31	-89.97	111.76	
						531	1.56	56.83	56.86	
191	1.01	2.46	0.00	0.00	0.00	12.91				
						212	-0.37	1.69	1.73	
192	1.01	2.43	0.00	0.00	0.00	23.46				
						212	-1.04	3.10	3.27	
193	1.00	10.79	0.00	0.00	272.00	-69.17				
						250	274.66	21.68	275.51	
194	1.00	10.83	0.00	0.00	272.00	-68.06				
						250	274.61	22.01	275.49	
195	1.01	20.55	0.00	0.00						
						275	594.21	-313.91	672.03	
196	1.03	21.73	0.00	0.00						
						275	786.54	-118.56	795.42	

199	1.02	37.83	0.00	0.00	
					272 886.55 245.01 919.78
200	1.02	37.83	0.00	0.00	880.00 -71.92
					272 886.55 245.01 919.78
201	1.06	1.56	19.57	5.71	
					211 -32.35 3.90 32.58
					214 12.20 3.25 12.63
202	1.08	10.92	2.23	0.65	
					208 -2.17 -0.58 2.24
203	0.99	0.78	36.82	10.74	
					204 25.26 7.55 26.36
					215 -27.93 -12.18 30.47
					253 -36.52 -32.11 48.62
204	0.99	0.58	25.59	7.47	
					203 -25.21 -7.49 26.30
205	1.09	10.70	0.00	0.00	
					209 35.40 -3.27 35.55
					265 -34.46 33.63 48.15
206	0.77	-8.01	26.15	7.63	
					175 -139.07 103.97 173.64
					181 107.41 -106.26 151.09
207	1.00	1.43	33.02	9.63	
					212 -90.03 -30.36 95.01
					215 55.49 20.67 59.22
208	1.09	11.22	23.12	6.74	
					202 2.37 -0.24 2.38
					213 -25.45 0.06 25.45
209	1.08	9.16	9.91	2.89	
					205 -35.26 3.79 35.46
					277 25.25 -6.54 26.08
210	1.07	5.25	10.81	3.16	
					211 33.39 -2.82 33.51
					277 -44.62 7.09 45.18
211	1.06	2.27	0.99	0.29	
					201 32.39 -3.70 32.61
					210 -33.08 3.82 33.30
212	1.01	2.51	23.20	6.77	
					191 0.37 -1.68 1.72
					192 1.04 -3.08 3.26
					207 90.49 32.28 96.08
					250 -111.48 50.37 122.33
213	1.09	11.97	0.00	0.00	
					208 25.59 0.04 25.59
					270 -24.66 19.75 31.59
214	1.06	0.87	11.89	3.47	
					201 -12.24 -3.56 12.74
					251 0.09 -3.81 3.81
215	0.99	1.13	28.24	8.23	
					203 27.99 12.22 30.54

216	1.01	1.70	70.92	20.68					207	-55.35	-20.43	59.00
									174	181.51	-7.45	181.67
217	0.98	-10.20	32.44	9.46					249	-265.94	-42.68	269.34
									220	97.93	-46.59	108.45
218	0.99	4.96	25.43	7.42					233	-131.87	45.65	139.55
									242	11.01	-18.00	21.10
219	1.01	1.89	31.62	9.22					250	-37.63	10.31	39.02
									231	63.87	-14.51	65.50
220	0.98	-11.31	45.90	13.39					253	-100.36	2.61	100.40
									217	-97.70	47.58	108.67
221	0.97	-8.32	38.97	11.36					230	50.98	-62.67	80.79
									225	-8.22	26.10	27.36
222	0.97	-5.37	47.31	13.80					257	-35.93	-37.36	51.84
									223	37.29	10.05	38.62
223	0.97	-5.63	0.00	0.00					237	-85.86	-19.28	88.00
									222	-37.26	-10.62	38.75
									226	126.57	-1.52	126.58
									258	-175.77	179.90	251.51
224	0.99	-2.01	40.78	11.90	3.00				560	88.18	20.46	90.52
									227	-897.89	496.21	2303.62
225	0.97	-8.24	46.98	13.70					249	-196.66	-12.60	197.06
									221	8.08	-26.68	27.88
226	0.97	-7.02	31.37	9.15					238	-55.78	11.52	56.95
									223	-126.05	3.40	126.10
227	0.98	-3.73	0.00	0.00					238	94.46	-13.42	95.41
									224	-157.36	-31.13	160.41
228	0.96	-6.70	28.98	8.45					596	156.65	30.28	159.55
									248	46.91	5.52	47.23
229	1.08	15.45	43.30	12.63					560	-78.23	-19.08	80.52
									240	-77.59	26.30	81.93
230	0.99	-11.62	31.78	9.27					441	32.17	-48.82	58.46
									141	20.17	-55.54	59.09
231	1.01	1.73	24.02	7.01					220	-51.07	62.70	80.87

					219	-63.83	14.40	65.43
					241	25.37	3.77	25.65
					243	12.73	-4.48	13.50
232	1.02	7.42	0.00	0.00				
					244	129.34	39.88	135.35
					247	45.89	11.64	47.34
					261	-183.02	-65.35	194.34
233	0.97	-9.05	33.77	9.85				
					217	132.27	-43.74	139.32
					257	-166.83	31.47	169.77
234	1.05	16.14	56.14	16.37				
					504	-8.54	-32.77	33.86
					530	-87.25	-59.36	105.53
235	0.99	4.85	51.43	15.00				
					239	-41.53	15.43	44.30
					539	-11.77	-17.12	20.78
236	1.00	5.24	48.21	14.06				
					244	-101.10	-35.52	107.16
					245	50.50	31.64	59.60
237	0.98	-4.74	39.88	11.63				
					222	85.99	19.48	88.17
					596	-131.39	-23.03	133.40
238	0.97	-7.94	39.46	11.51				
					225	55.64	-11.78	56.87
					226	-94.29	13.95	95.31
239	0.99	5.09	36.33	10.60				
					235	41.58	-15.84	44.49
					250	-78.13	5.29	78.31
240	1.07	16.56	0.00	0.00				
					229	78.35	-26.40	82.68
					246	29.98	34.28	45.54
					266	-106.13	67.97	126.03
					556	-1.43	-31.77	31.80
241	1.01	1.65	34.01	9.92				
					231	-25.43	-4.91	25.90
					249	-7.76	2.43	8.13
242	0.99	4.83	36.33	10.60				
					218	-11.00	17.31	20.51
					245	-25.64	-13.99	29.20
243	1.01	1.68	13.70	4.00				
					231	-12.77	3.97	13.37
244	1.02	7.31	32.36	9.44				
					232	-129.27	-39.70	135.23
					236	101.91	37.66	108.65
245	1.00	5.06	0.00	0.00				
					236	-50.49	-31.86	59.70
					242	25.62	13.02	28.74
					539	25.06	18.95	31.42
246	1.06	16.18	21.47	6.26				

247	1.01	6.70	45.98	13.41	240	-29.54	-35.68	46.32
					504	7.28	27.43	28.38
248	0.96	-6.90	47.64	13.89	232	-45.62	-13.06	47.45
249	1.01	1.77	0.00	0.00	228	-47.03	-5.80	47.39
					216	266.01	43.01	269.47
					224	198.73	23.93	200.17
					241	7.71	-4.05	8.71
					250	-114.94	53.53	126.80
					251	4.17	-43.06	43.26
250	0.99	5.57	0.00	0.00	268	-344.84	118.01	364.47
					193	-273.84	3.35	273.86
					194	-273.79	3.24	273.81
					212	111.76	-43.47	119.92
					218	37.93	-11.27	39.57
					239	78.29	-5.32	78.47
					249	115.91	-48.10	125.50
					580	205.84	-95.11	226.75
					600	-10.11	-40.86	42.09
251	1.06	0.86	0.00	0.00	214	-0.09	3.82	3.82
					249	-4.60	37.84	38.12
					479	3.46	-38.00	38.15
252	1.05	15.68	47.88	13.97	530	-48.88	-9.42	49.78
253	1.01	2.20	0.00	0.00	203	36.59	33.82	49.82
					219	100.51	-2.43	100.54
					254	-135.89	125.56	185.02
254	1.00	2.95	55.40	16.16	253	136.43	-123.38	183.95
					538	-192.89	107.00	220.58
255	1.11	13.78	39.58	11.54	449	-85.20	71.25	111.07
					457	43.37	-88.01	98.12
256	1.07	15.01	29.72	8.67	441	-30.35	-10.90	32.25
257	0.97	-8.28	0.00	0.00	221	35.92	37.29	51.78
					233	167.10	-29.68	169.72
					273	-192.02	275.78	336.04
258	0.94	-3.36	0.00	0.00	188	152.28	250.35	293.02
					223	176.23	-166.65	242.55
					262	292.18	17.74	292.72
					268	-622.16	-161.83	642.87

259 1.04 17.30 0.00 0.00

260 1.05 12.24 0.08 0.02

261 1.03 9.38 0.00 0.00

262 0.93 -4.65 24.52 7.15

263 1.05 11.55 0.00 0.00

264 0.92 -6.31 27.78 8.10

265 1.05 12.63 0.00 0.00

266 1.05 18.59 0.00 0.00

267 1.04 9.53 29.23 8.52

268 1.00 4.66 0.00 0.00

269 0.93 -3.86 48.21 14.06

270 1.05 14.87 13.21 3.85

530 107.86 -57.41 122.19

532 -112.58 -29.15 116.29

263 114.13 -23.68 116.56

265 -112.80 16.03 113.93

232 183.28 72.61 197.13

263 -183.23 -73.45 197.40

258 -292.10 -14.48 292.46

273 265.99 6.42 266.07

260 -113.16 20.55 115.01

261 183.93 71.36 197.29

266 -495.04 87.80 502.77

267 425.67 165.47 456.70

176 -57.01 45.24 72.78

537 29.35 -56.01 63.24

205 34.52 -31.49 46.73

260 113.64 -17.59 114.99

270 -147.13 22.40 148.82

123 137.63 -211.14 252.04

240 106.25 -62.83 123.44

263 502.08 -47.58 504.33

268 435.40 77.35 442.22

270 190.44 -31.39 193.01

272 234.85 756.99 1881.71

276 167.82 -723.62 742.83

532 134.47 21.48 136.18

542 49.77 -223.29 228.77

263 -423.00 -154.05 450.17

268 396.99 150.34 424.51

176 418.85 168.62 451.51

249 345.59 -99.13 359.52

258 630.49 254.65 679.98

266 -432.29 -11.69 432.45

267 -394.99 -125.23 414.36

535 -280.00 85.14 292.65

599 -315.15 82.64 325.81

176 336.65 37.66 338.75

534 -384.97 -50.81 388.30

					213	24.74	-17.84	30.50
					265	150.04	-29.19	152.85
					266	-188.16	25.82	189.93
271	0.76	-8.87	22.95	6.69				
					177	-30.70	-122.87	126.64
					184	-1.45	142.42	142.43
272	0.99	31.65	8.67	2.53				
					199	-884.98	-144.39	896.68
					200	-884.98	-144.39	896.68
					266	1749.97	-338.38	1782.38
273	0.93	-6.29	0.00	0.00				
					190	66.05	88.88	110.74
					257	192.71	-257.23	321.41
					262	-266.64	-3.63	266.67
274	1.05	12.11	0.00	0.00				
					275	-1276.87	37.17	1099.75
					535	1109.63	-41.59	1110.41
275	1.05	16.36	0.00	0.00				
					189	1366.02	1445.87	1989.11
					195	-592.90	371.00	699.41
					196	-784.79	194.87	808.62
					274	1124.20	-92.86	1128.02
					276	-569.78	-1320.53	1160.64
					476	-455.31	-276.98	1440.85
276	1.10	17.92	0.00	0.00				
					266	-167.31	762.11	780.26
					275	593.82	963.32	1131.64
					476	-379.02	-1675.87	1366.87
277	1.07	6.21	0.00	0.00				
					209	-24.65	6.86	25.59
					210	44.79	-6.55	45.26
278	1.00	5.31	0.00	0.00				
					344	20.92	-74.82	77.69
279	1.15	6.43	0.00	0.00				
					309	138.89	32.61	142.66
280	1.02	7.43	0.00	0.00				
					309	359.57	-463.17	586.36
281	1.38	20.39	0.00	0.00				
					349	522.87	651.52	835.39
282	1.38	21.36	0.00	0.00				
					349	802.65	651.44	1033.74
283	1.79	5.82	17.94	5.23				
					286	-16.02	16.52	23.01
284	1.74	7.99	0.00	0.00				
					286	23.74	-37.14	44.08
					295	-20.40	73.21	76.00
285	1.35	10.44	2.36	0.69				
					583	-7.02	0.13	7.03
					3231	5.54	-0.08	5.54

286	1.78	6.15	5.31	1.55
287	1.36	10.81	0.00	0.00
288	1.08	-2.61	0.00	0.00
289	0.99	-5.92	44.13	12.87
290	1.12	1.99	5.98	1.74
291	1.83	10.41	20.97	6.12
292	1.05	-5.30	23.33	6.80
293	1.82	10.63	47.67	13.90
294	0.79	-20.60	14.32	4.18
295	1.68	8.62	0.00	0.00
296	1.55	8.15	38.07	11.10
297	1.68	8.61	6.99	2.04
298	1.60	8.20	14.65	4.28
299	1.00	-5.58	0.00	0.00
300	1.13	-0.97	45.31	13.22

283	16.04	-17.06	23.41
284	-22.89	37.10	43.59
353	-4.63	40.30	40.56
583	9.26	1.24	9.34
299	65.15	78.85	102.28
305	146.62	63.19	159.66
314	-41.30	-98.12	106.46
340	-175.71	-50.22	182.74
299	-49.27	-12.27	50.77
309	-42.23	-18.20	45.99
316	36.19	16.68	39.84
313	2.35	28.95	29.05
305	-94.00	-46.63	104.92
324	66.16	43.18	79.00
307	5.37	9.83	11.20
594	170.62	420.48	453.77
543	6.96	-12.89	14.65
551	-327.55	-157.14	363.29
284	20.51	-70.60	73.52
297	108.13	114.91	157.78
329	114.33	161.73	198.06
342	83.95	880.10	884.09
485	6.38	49.75	50.16
592	44.97	87.65	98.51
295	-108.12	-114.91	157.78
330	-87.53	-125.61	153.10
318	-15.41	-184.60	185.24
319	10.02	193.25	193.51
288	-64.74	-76.93	100.55
289	49.02	11.48	50.35
320	37.56	-110.23	116.45
343	-202.97	-30.20	205.21
551	359.52	295.21	465.19
559	-184.28	-32.54	187.13

301	1.78	10.67	59.13	17.25	303	116.01	-35.50	121.32
					309	-163.74	27.14	165.97
					315	-38.04	625.23	626.39
					321	28.95	-202.15	204.21
					325	-11.75	-265.97	266.23
303	1.13	-1.84	46.66	13.61	300	-115.91	35.79	121.32
					314	68.37	88.46	111.80
304	1.55	8.35	37.90	11.06	319	-39.29	14.69	41.95
					331	23.70	19.11	30.44
305	1.07	-3.88	54.16	15.80	288	-146.15	-60.60	158.21
					292	93.87	46.87	104.93
306	1.13	2.17	33.44	9.75	322	-34.88	4.18	35.13
307	1.82	10.63	25.27	7.37	293	-5.35	-10.91	12.15
					330	-2.16	-5.00	5.45
308	1.83	10.46	32.17	9.38	330	-53.78	82.68	98.64
					554	53.01	-23.97	58.18
309	1.13	2.78	0.00	0.00	279	-138.60	-23.33	140.56
					280	-356.93	546.12	652.42
					290	42.47	15.82	45.32
					300	165.49	-20.80	166.79
					335	55.31	-16.14	57.62
					344	-58.91	143.41	155.04
					595	195.17	69.63	207.22
					3238	62.89	-1.45	62.91
311	1.65	8.16	28.05	8.18	318	61.59	174.87	185.40
					329	-67.12	-153.54	167.57
312	1.21	11.81	34.74	10.13	443	33.22	-5.09	33.61
					446	-74.59	-18.57	76.87
313	1.83	10.42	42.79	12.48	291	-2.29	-30.64	30.73
					336	-29.47	114.63	118.36
314	1.11	-2.48	27.96	8.16	288	42.31	98.54	107.24
					303	-68.27	-88.30	111.62
315	1.67	11.51	0.00	0.00	301	44.67	-591.19	592.88
					346	-49.14	504.27	506.65
316	1.11	1.41	14.07	4.10	290	-35.73	-18.37	40.17

317	1.53	8.59	0.00	0.00	479	21.70	21.74	30.72
					334	36.46	-53.55	64.79
					337	51.09	-58.11	77.38
					348	-73.82	132.64	151.80
318	1.63	8.08	34.87	10.17	298	16.82	185.17	185.93
					311	-61.12	-175.00	185.37
319	1.55	8.43	0.00	0.00	298	-8.71	-193.24	193.43
					304	39.32	-15.68	42.33
					339	13.84	3.01	14.17
					350	-52.65	88.16	102.68
320	1.01	-6.04	43.71	12.75	299	-37.68	110.65	116.89
					333	-9.49	-126.56	126.92
321	1.79	10.54	41.27	12.04	301	-28.56	201.64	203.65
					338	-12.35	-144.13	144.66
322	1.13	2.38	23.67	6.90	306	34.72	-5.47	35.15
					335	-58.79	-2.37	58.84
323	1.55	8.23	12.21	3.56	334	-15.40	63.22	65.07
					485	22.14	-27.62	35.40
324	1.03	-6.07	24.76	7.22	292	-34.77	-34.52	43.08
					333	34.89	29.80	45.88
325	1.80	10.58	45.48	13.27	301	12.46	266.84	267.13
					594	-52.92	-229.45	235.47
326	1.83	10.41	47.50	13.85	332	22.45	117.56	119.68
327	1.83	10.24	42.96	12.53	593	-17.14	51.98	54.73
329	1.66	8.28	35.04	10.22	295	-113.77	-161.74	197.75
					311	67.32	152.53	166.73
330	1.82	10.65	0.00	0.00	297	90.60	111.19	143.43
					307	2.42	-7.09	7.49
					308	54.16	-84.71	100.54
					332	66.12	-126.21	142.48
					336	76.42	-72.92	105.62
					352	-268.26	3742.94	3752.54
					597	51.43	107.62	119.28
331	1.54	8.19	35.97	10.49	304	-23.61	-24.22	33.82
					337	-6.69	38.08	38.66

332 1.83 10.41 38.66 11.28

333 1.03 -6.20 32.93 9.60

334 1.54 8.36 13.31 3.88

335 1.13 2.76 17.35 5.06

336 1.83 10.48 20.80 6.07

337 1.54 8.25 36.22 10.56

338 1.80 10.50 38.91 11.35

339 1.55 8.35 10.78 3.14

340 1.11 -0.08 16.84 4.91

341 1.53 12.45 31.84 9.29

342 1.29 7.34 0.00 0.00

343 1.01 -1.78 0.00 0.00

344 1.09 3.91 0.00 0.00

345 1.38 15.14 12.21 3.56

326 -22.37 -117.86 119.96

330 -65.83 124.23 140.59

320 9.74 127.33 127.70

324 -34.96 -30.28 46.25

317 -36.49 51.27 62.93

323 15.29 -66.10 67.85

309 -55.31 16.09 57.61

322 58.70 1.11 58.71

313 29.66 -115.51 119.25

330 -76.17 71.61 104.54

317 -50.91 56.03 75.70

331 6.72 -40.41 40.97

592 2.63 -31.81 31.92

321 12.45 141.94 142.49

597 -49.18 -109.89 120.39

319 -14.06 -7.28 15.83

288 176.70 56.88 185.63

595 -195.99 -64.45 206.31

346 211.81 -852.18 878.11

555 -200.33 907.42 929.27

295 -79.21 -671.88 676.54

344 352.55 725.71 806.81

348 -205.49 -582.09 617.30

352 -300.79 -513.17 594.83

499 -269.44 -20.63 270.23

3239 492.85 949.62 1069.90

299 203.43 44.25 208.19

351 -206.70 -87.78 224.57

278 -20.73 81.81 84.39

309 59.09 -136.13 148.40

342 -336.41 -610.60 697.14

351 523.89 1115.37 1232.28

3239 -195.13 -586.61 618.22

555 249.12 -820.90 857.86

1556 -255.13 826.14 864.63

346 1.55 12.13 0.00 0.00

347 1.33 16.02 12.63 3.68

348 1.50 9.37 0.00 0.00

349 1.33 18.65 0.00 0.00

350 1.53 8.97 0.00 0.00

351 1.06 3.34 0.00 0.00

352 1.56 11.63 0.00 0.00

353 1.31 11.10 0.00 0.00

354 1.02 2.72 0.00 0.00

356 1.47 28.35 0.00 0.00

357 1.60 23.90 0.00 0.00

315 50.55 -466.94 469.66
341 -209.02 857.64 882.74
553 171.88 -304.13 349.34

349 -287.79 7.43 287.88
353 281.89 -0.20 281.89

317 73.91 -128.66 148.38
342 205.57 648.14 679.96
352 -337.75 -289.36 444.76
552 71.58 -186.32 199.60

281 -521.47 -610.79 803.11
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347 289.74 -13.58 290.05
352 831.17 157.03 1393.89
1555 95.26 563.71 571.70
1725 58.56 519.82 523.11

319 52.69 -86.37 101.17
552 -48.93 197.57 203.54

343 199.21 73.55 212.36
344 -521.92 -675.80 1203.95
354 160.32 530.10 553.81
535 -64.64 19.93 67.64
541 198.98 74.58 212.50

330 284.70-1674.87 3217.14
342 308.60 591.44 667.11
348 332.94 286.78 439.42
349 -818.55 1374.78 1600.02
553 -129.66 341.85 365.61

287 4.67 -38.94 39.22
347 -279.35 -12.68 279.63
499 277.03 11.92 277.28

189 52.15 768.86 770.63
351 -160.04 -509.06 533.63

463 490.72 -443.73 661.59
476 786.93 -178.20 806.86
477 224.47 93.77 243.27
2498 -436.82 199.04 480.03
2499 -799.24 141.29 811.63

468 101.61 101.11 143.35

358	1.58	23.96	0.00	0.00
359	1.61	22.52	0.00	0.00
360	1.58	22.57	0.00	0.00
361	1.56	19.32	0.00	0.00
362	1.43	22.36	0.00	0.00
363	1.43	19.46	0.00	0.00
364	1.60	20.01	0.00	0.00
365	1.61	19.98	0.00	0.00
367	1.60	18.60	0.00	0.00
368	1.33	8.03	15.73	4.59
370	1.46	18.38	9.34	2.72
371	1.20	14.31	14.72	4.29
372	1.15	9.30	6.48	1.89
373	1.25	7.11	0.00	0.00
374	1.36	13.75	3.11	0.91
375	1.46	23.78	0.00	0.00
376	1.35	20.06	0.00	0.00
377	1.57	18.05	12.62	3.68

468	101.57	62.85	119.44
468	82.75	199.79	216.25
468	82.66	114.31	141.07
422	141.45	145.28	202.76
461	366.68	216.13	425.63
461	75.11	238.69	250.23
469	311.97	577.71	656.56
469	320.65	613.60	692.33
378	47.54	146.29	153.82
468	-271.41	293.69	399.90
474	223.40	-353.56	418.23
373	54.50	121.99	133.61
1069	-61.02	-91.38	109.88
419	-340.62	-523.40	624.48
427	-113.23	-122.20	166.59
3301	-133.48	-180.36	224.38
409	-111.43	-115.50	160.49
3004	-136.15	-159.74	209.89
368	-53.82	-118.27	129.93
384	-214.64	-122.29	247.03
3148	-391.58	-353.61	527.61
379	-30.67	-10.88	32.55
413	21.33	-0.91	21.35
380	-155.01	-119.81	195.92
406	215.14	37.82	218.44
458	-214.16	18.98	215.00
3007	147.29	66.50	161.61
459	-245.37	-247.11	348.24
574	23.07	-505.84	506.36
3002	132.87	-44.78	140.21
391	-15.25	-8.16	17.30

378 1.57 18.29 0.00 0.00

379 1.36 14.06 16.40 4.78

380 1.49 24.65 0.00 0.00

381 1.50 23.80 24.40 7.11

382 1.38 15.50 0.00 0.00

383 1.48 16.33 12.03 3.51

384 1.32 10.65 43.32 12.64

385 1.36 14.05 24.14 7.04

386 1.43 17.53 4.88 1.42

387 1.62 14.32 35.92 10.48

388 1.48 16.52 1.51 0.44

389 1.62 12.00 27.51 8.02

390 1.62 14.28 30.62 8.93

391 1.57 18.23 10.01 2.92

392 1.38 15.51 14.22 4.15

367 -47.38 -143.17 150.81

391 11.65 -26.79 29.21

419 32.82 89.78 95.58

426 -26.21 -66.57 71.55

374 30.87 7.57 31.79

416 -48.22 -14.80 50.44

375 157.59 123.56 200.26

381 24.60 -15.15 28.89

1900 -183.13 -115.22 216.36

380 -23.56 9.09 25.25

392 -67.03 -137.24 152.73

395 64.14 15.28 65.94

461 -252.92 20.40 253.75

572 23.18 -101.94 104.54

589 89.14 6.63 89.39

394 -47.81 -52.60 71.08

558 30.89 32.16 44.59

373 217.86 139.71 258.81

405 -116.36 5.99 116.52

570 -151.36 -12.34 151.87

423 62.26 22.80 66.31

589 -92.72 -14.27 93.81

587 -15.43 -10.04 18.41

3003 -2.42 -5.26 5.78

393 -44.40 8.87 45.28

407 -62.50 1.72 62.53

420 45.39 -11.59 46.84

422 -41.24 -32.11 52.26

1359 36.98 22.20 43.13

613 -31.41 42.84 53.12

397 -39.75 -10.32 41.06

415 -22.04 -39.41 45.15

377 15.44 4.91 16.20

378 -11.62 26.40 28.84

393	1.62	14.66	26.84	7.83	382	67.05	137.28	152.78
					387	44.36	-10.95	45.69
394	1.49	16.50	28.94	8.44	430	-88.22	-38.64	96.31
					383	47.92	51.77	70.54
395	1.37	14.85	2.61	0.76	401	-79.17	-42.82	90.01
					382	-63.97	-15.96	65.93
396	1.51	18.97	5.97	1.74	416	57.86	8.87	58.54
					419	83.64	79.10	115.12
397	1.62	14.35	35.50	10.35	425	-95.21	-87.63	129.40
					390	39.77	9.69	40.93
398	1.52	22.03	10.10	2.94	430	-71.82	-10.17	72.53
					468	139.03	-236.39	274.24
399	1.40	14.87	26.08	7.61	3206	-161.71	157.42	225.67
					428	-21.76	-101.62	103.93
400	1.22	11.62	3.37	0.98	572	-22.01	89.33	92.00
					409	210.47	172.80	272.31
401	1.49	16.73	6.73	1.96	3006	-224.37	-187.00	292.08
					394	79.24	42.46	89.90
402	1.38	20.73	2.86	0.83	421	-93.70	-61.87	112.29
					411	133.10	67.68	149.32
403	1.59	19.90	21.87	6.38	3007	-141.27	-65.69	155.80
					484	-29.57	-35.37	46.11
404	1.43	15.19	8.16	2.38	410	-14.97	-19.71	24.75
					384	118.60	-2.91	118.64
405	1.34	15.71	6.22	1.82	427	-124.94	7.95	125.19
					375	-210.76	-29.10	212.76
406	1.42	21.09	19.52	5.69	3011	190.88	47.36	196.67
					387	62.54	-2.33	62.58
407	1.62	14.45	29.86	8.71	430	-90.46	-3.20	90.52
					426	44.31	58.20	73.15
408	1.62	19.04	17.67	5.15	579	-69.53	67.57	96.95
					372	112.49	117.70	162.81
409	1.17	9.71	6.90	2.01				

					400 -206.80 -159.88 261.39
					3001 -133.65 -95.89 164.49
410	1.43	15.23	23.13	6.75	
					404 14.98 19.04 24.23
					414 -95.34 -62.36 113.93
					428 52.10 64.52 82.93
411	1.35	19.62	0.00	0.00	
					402 -131.34 -65.52 146.78
					427 82.64 44.17 93.71
					3009 41.64 7.53 42.31
412	1.61	12.33	34.58	10.08	
					584 -44.26 -8.79 45.12
					613 -228.15 -133.21 264.19
413	1.35	13.57	10.52	3.07	
					374 -21.28 -0.11 21.28
					423 10.00 -4.24 10.86
414	1.44	15.51	0.00	0.00	
					410 95.46 62.25 113.97
					465 -64.75 -34.09 73.18
					558 -28.83 -43.42 52.12
415	1.62	14.30	50.30	14.67	
					390 22.03 38.87 44.68
					430 -65.86 -5.32 66.08
416	1.37	14.54	14.05	4.10	
					379 48.30 13.57 50.17
					395 -57.82 -9.37 58.58
417	1.61	12.80	58.46	17.05	
					478 -122.82 -20.45 124.51
					584 38.64 -17.63 42.47
418	1.39	16.63	26.67	7.78	
					419 -280.39 -251.88 376.92
					3000 242.33 222.66 329.09
419	1.46	18.40	0.00	0.00	
					370 340.99 524.28 625.41
					378 -30.24 -91.30 96.17
					396 -81.92 -78.48 113.45
					418 285.44 271.13 393.68
					468 -360.69 -312.15 477.01
					3012 46.55 20.82 50.99
420	1.62	14.07	48.54	14.16	
					387 -45.37 9.68 46.39
421	1.50	16.87	16.49	4.81	
					401 93.79 61.26 112.02
					422 -106.12 -47.22 116.15
422	1.50	17.40	0.00	0.00	
					361 -141.10 -135.51 195.63
					388 41.50 27.22 49.63
					421 106.40 47.16 116.38
					469 -46.13 4.97 46.40

423	1.35	13.46	7.57	2.21	1365	38.87	49.52	62.95
					385	-62.07	-23.38	66.32
					413	-9.97	2.93	10.39
					454	66.82	77.95	102.67
424	1.60	19.82	39.12	11.41	425	-46.55	45.24	64.91
425	1.60	20.06	0.00	0.00	396	99.47	89.95	134.11
					424	46.75	-46.10	65.66
					470	-244.83	153.89	289.18
					484	21.44	4.42	21.89
					579	79.58	-84.27	115.90
426	1.59	18.39	20.52	5.99	378	26.41	65.50	70.62
					408	-43.71	-61.06	75.09
427	1.34	19.24	0.00	0.00	371	113.98	146.44	185.56
					405	125.49	-5.25	125.60
					411	-82.23	-44.21	93.36
					429	4.50	-4.92	6.66
					3002	-172.39	-113.42	206.35
					3008	5.41	-4.05	6.75
428	1.42	14.88	34.15	9.96	399	22.01	101.61	103.96
					410	-51.85	-65.54	83.57
429	1.34	19.20	7.15	2.09	427	-4.36	3.77	5.77
430	1.63	14.78	0.00	0.00	393	88.25	38.37	96.23
					397	71.97	8.91	72.52
					407	90.60	2.66	90.64
					415	65.89	3.80	66.00
					474	-605.83	-351.16	700.25
					478	134.21	8.42	134.47
					613	116.89	5.55	117.02
431	1.38	18.14	5.38	1.57	570	177.13	30.26	179.69
					3011	-191.87	-55.14	199.63
432	1.24	11.54	35.92	10.48	440	-28.85	-140.94	143.87
					442	-20.79	117.37	119.20
433	1.29	11.55	8.33	2.43	451	42.01	83.98	93.90
					453	-62.32	-83.28	104.02
434	1.31	13.88	0.00	0.00	438	111.61	44.04	119.98
					439	152.85	-9.36	153.13
					460	-275.47	-24.57	276.57

435 1.31 13.27 17.83 5.20
 436 1.31 13.16 14.72 4.29
 437 1.31 12.00 18.17 5.30
 438 1.30 13.18 24.56 7.16
 439 1.31 13.34 0.00 0.00
 440 1.26 11.55 19.85 5.79
 441 1.08 15.33 19.98 5.83
 442 1.23 11.71 55.01 16.05
 443 1.21 11.62 13.96 4.07
 444 1.27 11.45 24.31 7.09
 445 1.21 11.51 19.85 5.79
 446 1.22 12.43 0.00 0.00
 447 1.24 11.66 37.69 10.99
 448 1.16 12.35 11.19 3.26
 449 1.10 14.80 30.30 8.84

439 -27.99 -13.51 31.08
 439 -147.23 -20.10 148.59
 492 101.80 -44.41 111.06
 453 70.62 54.40 89.14
 455 -55.11 37.41 66.61
 456 -55.17 -66.05 86.06
 434 -111.12 -44.19 119.58
 452 83.18 50.09 97.10
 434 -152.50 9.96 152.82
 435 28.00 12.77 30.77
 436 147.30 20.20 148.68
 432 29.12 141.30 144.27
 444 11.09 -134.80 135.26
 447 -0.16 77.73 77.73
 536 -68.84 -68.89 97.39
 122 -16.20 -56.59 58.87
 229 -32.03 48.51 58.13
 256 30.50 9.22 31.86
 432 20.96 -117.48 119.33
 446 -75.03 102.66 127.16
 312 -33.16 3.81 33.38
 445 17.16 -10.76 20.26
 440 -10.96 134.90 135.34
 451 -13.62 -123.16 123.91
 443 -17.17 9.24 19.50
 312 74.84 16.74 76.69
 442 75.42 -102.68 127.40
 450 58.06 79.15 98.16
 464 -247.09 64.97 255.49
 488 36.36 -90.52 97.55
 440 0.27 -79.16 79.16
 488 -40.55 81.44 90.97
 481 -21.12 73.36 76.34
 573 5.94 -83.76 83.97

					122 -114.34 66.85 132.45
					255 85.42 -71.02 111.09
450	1.20	11.97	45.26	13.20	
					446 -57.88 -79.77 98.56
					573 9.95 80.50 81.11
451	1.28	11.44	34.32	10.01	
					433 -42.65 -95.22 104.34
					444 13.67 122.78 123.54
452	1.29	12.86	17.67	5.15	
					438 -83.28 -50.80 97.55
					536 66.07 60.17 89.37
453	1.31	11.78	16.32	4.76	
					433 62.37 82.72 103.59
					437 -70.64 -55.11 89.60
454	1.33	12.47	0.00	0.00	
					423 -66.81 -75.27 100.64
					456 62.08 44.54 76.41
455	1.31	12.42	37.85	11.04	
					437 55.21 -38.54 67.33
					557 -100.10 36.23 106.46
456	1.32	12.18	14.39	4.20	
					437 55.08 65.11 85.28
					454 -62.29 -45.94 77.40
457	1.13	13.01	12.11	3.53	
					255 -43.26 87.61 97.71
					481 29.65 -77.06 82.57
458	1.46	26.21	0.00	0.00	
					375 214.66 -9.88 214.89
					471 -277.79 -574.87 638.47
459	1.44	23.06	0.00	0.00	
					376 246.68 275.91 370.11
					463 -310.50 -57.96 315.86
					468 65.23 -257.96 266.08
460	1.33	18.09	0.00	0.00	
					434 276.35 45.29 280.04
					461 -230.45 -489.11 540.68
					464 222.51 369.35 431.20
					467 -275.55 14.61 275.94
461	1.37	18.79	0.00	0.00	
					362 -365.82 -186.01 410.39
					363 -74.81 -228.45 240.38
					382 253.26 -5.84 253.33
					460 231.35 498.94 549.97
					465 75.06 -484.70 490.48
					2023 -142.17 -127.57 191.01
462	1.44	29.20	0.00	0.00	
					477 651.48 -317.11 724.55
					3205 -642.48 272.36 697.83
463	1.46	26.41	0.00	0.00	

					356 -472.58 457.31 657.62
					459 315.46 42.65 318.33
					471 297.07 353.48 461.74
					475 64.34 -216.84 226.18
					521 1.13 27.88 27.90
					1965 -519.53 -772.91 931.30
464	1.20	15.79	0.00	0.00	3014 321.43 -8.52 321.55
					123 0.93 200.13 200.14
					446 247.53 -49.79 252.49
					460 -216.87 -355.33 416.28
					493 -33.64 211.61 214.26
465	1.47	17.65	0.00	0.00	
					414 89.76 345.88 509.45
					461 -73.44 495.99 501.40
					474 3.93 -512.97 512.99
466	1.58	25.23	7.57	2.21	
					473 586.15 75.29 590.96
					588 -601.98 -168.41 625.09
467	1.33	19.59	0.00	0.00	
					460 275.07 -20.64 275.85
					476 -532.22 209.83 572.09
					520 -27.93 18.74 33.63
					576 20.02 -369.72 370.27
					1233 259.08 150.90 299.82
468	1.54	21.50	0.00	0.00	
					357 7047.76 2980.98 174.00
					358 -101.45 -56.90 116.32
					359 -82.53 -189.61 206.79
					360 -82.56 -109.82 137.39
					367 278.03 -305.38 412.99
					398 -137.18 226.26 264.60
					419 361.38 348.74 502.21
					459 -56.05 218.72 225.79
					473 -329.84 -116.59 349.84
					474 260.09 -333.58 423.00
469	1.50	18.10	0.00	0.00	
					364 -310.86 -532.30 616.43
					365 -318.73 -563.98 647.81
					422 46.15 -4.41 46.36
					474 66.36 -530.64 534.78
					576 -8.58 349.62 349.72
					591 62.24 -519.88 523.59
					1378 424.38 541.72 688.16
470	1.56	22.66	0.00	0.00	
					425 4654.87 4540.88 4773.90
					473 -252.79 -14.41 253.20
471	1.46	26.23	0.00	0.00	
					458 278.06 575.33 639.00

					463 -296.41 -352.82 460.81
					598 38.68 -228.01 231.27
472	1.49	23.02	3.45	1.01	
					135 -157.93 227.78 277.17
					3206 157.99 -218.36 269.52
473	1.56	23.57	0.00	0.00	
					466 1265.67 345.45 265.89
					468 337.14 111.50 355.10
					470 258.17 11.38 258.42
474	1.67	16.60	0.00	0.00	
					367 -221.24 340.96 406.44
					430 610.50 380.25 719.24
					465 -0.17 522.22 522.22
					468 -250.53 308.58 397.48
					469 -55.05 549.45 552.20
					591 -33.84 549.59 550.63
475	1.52	25.39	19.09	5.57	
					463 -52.49 164.24 172.42
					2500 44.89 -177.12 182.72
476	1.32	20.91	0.00	0.00	
					275 567.40 1126.86 1261.65
					276 471.32 1081.92 1180.12
					356 -585.19 -967.80 1130.96
					467 533.33 -196.24 568.29
					477 -774.85 -900.10 1187.67
					520 28.42 1.48 28.46
477	1.45	27.84	0.00	0.00	
					356 -126.47 -510.03 525.47
					462 -651.22 336.21 732.89
					476 1030.74 67.33 1032.93
478	1.62	13.18	18.34	5.35	
					417 122.91 20.37 124.59
					430 -133.54 -7.86 133.77
479	1.08	0.47	3.80	1.11	
					251 -4.27 34.90 35.16
					316 -22.62 -28.72 36.56
					3192 12.89 2.02 13.05
					3302 13.24 2.65 13.51
480	0.74	-15.87	11.73	3.42	
					51 -99.04 -38.17 106.14
					77 89.14 57.00 105.81
481	1.15	12.62	10.90	3.18	
					448 21.16 -73.98 76.94
					457 -29.41 76.62 82.07
482	0.85	-10.55	24.51	7.15	
					146 182.51 121.16 219.06
					164 -209.65 -118.86 241.00
483	0.85	-6.06	0.00	0.00	
					176 -23.84 -336.16 337.00

484	1.60	19.97	0.00	0.00	180	22.32	337.88	338.61
					403	29.72	34.56	45.58
485	1.55	8.16	13.22	3.86	425	-21.27	-5.49	21.97
					296	-6.15	-50.69	51.06
488	1.23	11.95	0.00	0.00	323	-22.07	26.31	34.34
					446	-36.16	90.10	97.08
489	1.82	10.62	0.00	0.00	447	40.63	-81.93	91.45
492	1.31	12.90	0.00	0.00	597	-432.56	897.09	129.78
					436	-354.55	453.98	342.12
493	1.19	16.00	3.79	1.10	557	88.82	-63.40	109.12
					464	7775.79	432.45	298.07
495	0.75	-8.53	12.63	3.68	542	-32.35	222.39	224.73
					172	-121.78	36.47	127.12
496	0.61	-8.57	36.32	10.59	186	93.14	12.97	94.03
					104	-786.08	567.87	167.98
497	0.95	-12.43	24.07	7.02	502	-169.05	-434.13	465.88
					137	-172.36	-313.64	357.88
498	0.99	-9.82	13.74	4.01	158	148.61	309.47	343.30
					137	122.46	-47.93	131.51
499	1.30	10.46	0.00	0.00	174	-136.21	45.08	143.47
					342	3564.36	-768.32	127.43
500	0.80	-6.03	0.00	0.00	353	-273.81	-13.36	274.14
					175	15.65	843.98	187.23
501	0.61	-7.38	0.00	0.00	178	6.83	-308.39	308.46
					106	497.37	452.88	672.66
502	0.64	-7.84	0.00	0.00	175	-162.68	-536.82	560.93
					175	1237.60	874.09	398.02
504	1.06	16.16	0.00	0.00	496	171.15	456.30	487.34
					234	8.95	32.21	33.43
520	1.32	20.26	0.00	0.00	246	-6.94	-28.10	28.95
					467	-987.56	-78.98	54.17
521	1.46	26.40	0.00	0.00	476	-28.42	-1.16	28.44

					463 -894.56 1876.98 7236.14
522	0.98	7.74	0.00	0.00	
					535 -312.48 2498.78 2518.24
530	1.05	16.16	0.00	0.00	
					234 87.27 59.38 105.56
					252 49.10 7.98 49.74
					259 -107.72 60.12 123.36
531	0.92	-6.42	31.04	9.05	
					190 -2.35 -59.89 59.93
					537 -25.23 37.24 44.98
532	1.04	17.60	21.47	6.26	
					259 113.29 26.65 116.38
					266 -132.79 -26.74 135.46
533	1.00	-11.30	0.00	0.00	65.00 26.61
					137 64.05 26.61 69.35
534	0.96	4.02	0.00	0.00	
					269 389.66 87.29 399.32
					535 -391.59 -97.77 403.61
535	0.99	7.73	0.00	0.00	
					268 278.75 -77.72 289.39
					274 -954.87 119.31 1048.96
					351 38.60 -91.46 99.28
					522 -0.22 9.09 9.09
					534 392.09 114.28 408.41
					599 316.60 -77.34 325.91
536	1.28	12.21	0.00	0.00	
					440 69.28 67.77 96.91
					452 -66.25 -61.99 90.72
537	0.92	-6.38	0.00	0.00	
					264 -29.58 54.96 62.41
					531 24.91 -38.39 45.77
538	1.00	3.66	12.05	3.52	
					254 193.44 -104.51 219.87
					580 -206.67 100.99 230.03
539	0.99	4.95	14.45	4.21	
					235 11.85 16.54 20.35
					245 -25.00 -19.18 31.51
541	1.05	2.28	11.03	3.22	
					351 -200.91 -76.86 215.11
					559 182.72 72.75 196.68
542	1.11	17.33	9.08	2.65	
					266 -47.83 223.24 228.30
					493 37.36 -224.48 227.56
543	0.79	-20.61	0.00	0.00	
					294 -6.98 12.86 14.63
					3237 -177.57 -97.84 202.74
551	0.92	-9.64	14.65	4.28	
					294 341.10 250.86 423.41
					299 -352.99 -251.36 433.34

552	1.50	9.27	7.58	2.21				
					348	-72.64	183.44	197.30
					350	44.62	-211.28	215.94
553	1.55	11.92	10.02	2.92				
					346	-172.07	301.59	347.23
					352	128.46	-346.49	369.54
554	1.83	10.36	16.68	4.86				
					308	-53.10	22.70	57.74
					593	44.43	-12.01	46.02
555	1.48	13.35	22.83	6.66				
					341	206.43	-882.62	906.44
					345	-239.17	865.87	898.30
556	1.09	16.56	0.00	0.00				
					240	1.45	32.37	32.41
557	1.31	12.74	6.56	1.91				
					455	100.18	-36.43	106.60
					492	-88.77	63.42	109.09
558	1.47	16.02	3.28	0.96				
					383	-30.77	-34.68	46.37
					414	28.73	39.16	48.57
559	1.01	-1.45	0.00	0.00				
					299	184.59	46.53	190.37
					541	-187.64	-77.51	203.02
560	0.97	-6.38	10.73	3.13				
					223	-88.18	-19.96	90.41
					228	78.15	19.09	80.44
570	1.32	11.64	0.00	0.00				
					384	151.95	14.06	152.60
					431	-172.37	-13.82	172.92
					3013	20.34	1.66	20.41
571	1.56	17.43	14.64	4.27				
					591	-32.01	-75.33	81.85
572	1.40	15.01	10.60	3.09				
					382	-22.72	101.52	104.03
					399	22.16	-89.76	92.45
573	1.19	11.98	19.09	5.57				
					448	-6.36	81.68	81.93
					450	-9.98	-81.15	81.76
574	1.39	19.96	0.00	0.00				
					376	-22.66	518.11	518.61
					2354	43.97	46.13	63.73
576	1.48	18.24	9.42	2.75				
					467	-17.54	371.48	371.89
					469	10.04	-349.95	350.09
579	1.61	19.35	15.14	4.42				
					408	69.65	-67.81	97.21
					425	-79.19	84.40	115.74
580	1.00	4.26	0.00	0.00				
					250	-205.13	99.52	227.99

583	1.36	10.76	0.00	0.00		538	207.01	-98.83	229.39
						285	7.08	-0.69	7.12
						287	-9.26	-1.35	9.36
584	1.61	12.70	6.06	1.77					
						412	44.06	6.62	44.55
						417	-38.70	17.05	42.29
587	1.43	17.62	4.21	1.23					
						386	15.41	8.74	17.72
						3010	-44.90	-38.77	59.32
588	1.59	26.17	78.47	22.89					
						466	603.94	174.49	628.64
						1960	-681.69	-208.45	712.85
589	1.37	14.79	0.00	0.00					
						382	-88.91	-6.64	89.16
						385	92.95	14.53	94.08
591	1.57	17.44	0.00	0.00					
						469	-57.15	530.87	533.94
						474	38.31	-539.26	540.62
						571	31.97	73.16	79.84
592	1.55	8.14	0.00	0.00					
						296	-44.95	-87.80	98.64
						337	-2.99	26.24	26.41
593	1.83	10.28	0.00	0.00					
						327	17.09	-53.23	55.91
						554	-44.77	10.79	46.05
594	1.82	10.61	0.00	0.00					
						293	-170.50	-419.92	453.22
						325	53.27	229.47	235.57
595	1.11	0.72	0.00	0.00					
						309	-194.39	-63.85	204.61
						340	196.24	66.92	207.34
596	0.98	-4.63	29.01	8.46					
						227	-156.43	-28.28	158.97
						237	131.40	23.22	133.44
597	1.82	10.60	0.00	0.00					
						330	-51.41	-108.66	120.21
						338	49.01	107.83	118.45
						489	-40.13	-61.37	73.32
598	1.46	26.22	51.73	15.09					
						471	-38.57	227.71	230.95
599	0.99	5.99	0.00	0.00					
						268	314.77	-78.05	324.30
						535	-317.11	82.45	327.65
600	1.00	5.62	0.00	0.0	10.00				
						39.74			
						250	10.00	39.72	40.96
610	0.32	-18.25	0.00	0.00					
						106	-202.55	-266.91	335.06
						113	169.26	256.25	307.10

611 0.11 -58.17 0.00 0.00

24 -57.14 -68.01 88.82
42 101.59 240.04 260.65
63 3.66 -27.30 27.54

613 1.61 12.36 0.00 0.00

389 31.27 -44.77 54.61
412 228.41 133.48 264.55
430 -116.33 -5.86 116.48

701 1.16 22.53 0.00 0.00

801 1.37 25.10 25.14

702 1.16 22.53 0.00 0.00

801 1.37 25.10 25.14

703 1.19 26.07 0.00 0.00

758 93.37 89.38 129.25

704 1.08 26.93 0.00 0.00

758 93.03 9.68 93.54

705 1.24 23.74 0.00 0.00

754 42.26 137.50 143.85

706 1.14 24.41 0.00 0.00

754 43.70 50.52 66.80

707 1.24 22.14 0.00 0.00

768 29.19 140.59 143.59

708 1.12 21.30 0.00 0.00

754 1.28 34.67 34.69

709 1.11 20.62 0.00 0.00

768 1.27 34.50 34.53

710 1.14 27.58 0.00 0.00

798 40.30 7.62 41.01

712 1.22 23.50 0.00 0.00

755 113.17 219.86 247.27

713 1.13 24.84 0.00 0.00

756 124.06 118.75 171.74

716 1.11 31.95 0.00 0.00

800 511.34 82.56 517.96

717 1.08 32.11 0.00 0.00

800 510.30 -3.19 510.31

718 1.18 25.47 0.00 0.00

801 215.99 170.10 274.92

727 1.01 17.07 41.00 11.96

728 -7.29 -2.00 7.56
736 -33.34 -11.96 35.43

728 1.01 17.23 61.36 17.90

727 7.28 1.85 7.52
733 -68.66 -19.68 71.43

729 1.01 17.33 46.97 13.70

731 -44.49 -17.53 47.82
734 -1.89 0.94 2.11

730 1.05 14.78 14.85 4.33

908 4.90 -10.80 11.86

					1457	8.25	-9.76	12.78
					3044	-28.51	14.67	32.06
731	1.02	18.38	0.00	0.00				
					729	44.68	18.40	48.32
					742	11.56	8.89	14.58
					764	-57.10	-51.03	76.58
732	1.03	18.99	36.70	10.70				
					735	-2.92	-0.30	2.93
					739	-33.38	-11.95	35.45
733	1.03	19.90	53.04	15.47				
					728	69.41	23.15	73.17
					735	41.66	10.75	43.02
					765	-58.56	-49.62	76.75
					803	-111.63	-154.73	190.80
734	1.01	17.35	7.94	2.32				
					729	1.88	-1.02	2.14
					736	-9.95	-0.76	9.98
735	1.03	19.05	38.29	11.17				
					732	2.93	0.15	2.93
					733	-41.50	-10.24	42.75
736	1.01	17.61	39.32	11.47				
					727	33.41	12.21	35.57
					734	9.95	0.62	9.97
					744	43.89	14.40	46.20
					746	40.50	13.19	42.59
					805	-174.02	-179.98	250.36
737	1.00	17.09	44.83	13.07				
					741	-69.91	-18.87	72.41
					745	25.47	3.71	25.74
738	1.04	16.83	0.00	0.00				
					740	-31.45	13.24	34.12
					3044	31.39	-13.81	34.30
739	1.04	19.97	15.50	4.52				
					732	33.51	12.44	35.74
					743	-0.81	3.03	3.14
					810	-51.22	-81.54	96.29
740	1.04	18.54	1.96	0.57				
					738	31.62	-12.50	34.01
					743	-33.50	11.72	35.49
741	1.02	18.43	45.48	13.27				
					737	70.26	20.59	73.22
					742	13.15	-2.71	13.43
					808	-140.32	-252.89	289.21
742	1.02	18.06	24.47	7.14				
					731	-11.54	-8.95	14.60
					741	-13.15	2.62	13.41
743	1.03	20.05	0.00	0.00				
					739	0.84	-3.58	3.68
					740	33.69	-11.20	35.51

744	1.00	16.85	34.74	10.13	783	-35.71	-18.19	40.08
					736	-43.76	-13.87	45.91
745	1.00	16.64	47.53	13.86	745	9.01	3.60	9.70
					737	-25.45	-3.64	25.71
					744	-9.03	-3.76	9.78
746	1.01	16.93	26.99	7.87	746	-13.17	-6.17	14.55
					736	-40.40	-12.78	42.37
754	1.06	21.29	0.00	0.00	745	13.17	6.03	14.49
					705	-41.25	-116.27	123.37
					706	-43.45	-45.02	62.57
					708	-1.22	-33.01	33.04
					765	46.61	36.41	59.14
755	1.09	20.49	0.00	0.00	774	33.53	20.17	39.13
					712	-111.63	-191.44	221.61
756	1.06	20.95	0.00	0.00	788	103.30	67.25	123.27
					713	-123.20	-102.86	160.50
757	1.07	19.89	28.20	8.23	792	117.50	-18.52	118.95
					758	-182.42	-43.88	187.62
					761	68.16	-0.90	68.17
758	1.07	20.05	0.00	0.00	785	58.32	-8.95	59.00
					786	31.90	4.87	32.27
					703	-92.44	-71.51	116.87
759	1.05	20.47	53.33	15.55	704	-92.53	1.53	92.54
					757	182.72	44.43	188.04
760	1.06	19.05	25.59	7.46	765	-55.90	9.90	56.77
761	1.07	19.69	30.72	8.96	779	3.73	-33.28	33.49
					771	-24.91	-9.77	26.76
762	1.06	19.57	37.64	10.98	757	-68.91	-18.15	71.26
					771	53.27	23.41	58.18
763	1.04	20.61	27.36	7.98	788	-12.82	-25.92	28.91
					769	-4.60	11.51	12.39
764	1.05	20.04	50.15	14.63	775	-29.43	-51.36	59.20
					770	4.23	10.51	11.33
					774	-30.86	-21.67	37.71
					731	57.27	54.24	78.88

765	1.05	20.79	0.00	0.00	769	45.53	-23.73	51.34
					787	-32.86	-8.07	33.84
					792	-116.29	-27.83	119.58
					733	58.67	51.28	77.92
					754	-46.32	-36.26	58.82
					759	55.94	-10.62	56.94
					778	16.04	-38.16	41.40
					803	-92.27	-146.31	172.97
766	1.00	21.55	35.11	10.24	780	-35.00	-12.16	37.06
767	1.00	21.19	32.59	9.51	772	41.18	29.12	50.44
					780	-72.16	-42.00	83.49
768	1.06	20.61	0.00	0.00	707	-28.07	-119.11	122.37
					709	-1.21	-32.86	32.88
					778	22.86	46.24	51.58
					783	2.94	19.98	20.20
769	1.06	19.58	39.41	11.49	762	3.61	-26.18	26.43
					764	-45.51	23.58	51.26
770	1.04	20.58	28.11	8.20	763	-4.12	-11.11	11.85
					783	-23.53	1.99	23.62
771	1.06	19.26	45.01	13.13	760	25.23	9.01	26.79
					761	-52.93	-23.64	57.97
					789	-16.80	2.01	16.92
772	0.99	20.66	22.79	6.65	767	-40.88	-29.42	50.37
					777	-2.99	-16.42	16.69
					3058	1.40	11.79	11.87
					3059	26.91	-16.88	31.77
773	1.07	19.97	47.35	13.81	776	20.90	-3.85	21.26
					788	11.29	-4.74	12.24
					806	-81.32	-88.91	120.49
774	1.05	20.86	2.15	0.63	754	-33.10	-20.72	39.05
					763	31.14	21.38	37.77
775	1.06	19.59	41.00	11.96	762	30.71	35.16	46.68
					788	-17.04	-56.92	59.42
					789	8.18	-44.49	45.23
					807	-68.49	-191.23	203.12
776	1.07	19.72	50.71	14.79	773	-20.62	2.98	20.84
					785	-26.15	-27.37	37.86

777 0.99 20.66 43.52 12.69

778 1.05 20.56 38.20 11.14

779 1.05 20.40 14.19 4.14

780 1.01 21.81 0.00 0.00

781 1.04 22.63 0.00 0.00

782 1.04 20.82 0.47 0.14

783 1.04 20.82 42.58 12.42

784 1.06 20.39 54.26 15.83

785 1.07 19.80 28.02 8.17

786 1.07 19.70 32.87 9.59

787 1.05 20.14 0.00 0.00

788 1.07 19.70 34.93 10.19

789 1.06 19.49 36.61 10.68

772 3.21 15.84 16.16
3062 -46.95 -28.28 54.81

765 -15.97 37.97 41.19
768 -22.74 -46.28 51.56

759 -3.64 32.29 32.50
784 -10.47 -36.82 38.28

766 35.30 11.92 37.26
767 72.55 42.49 84.08
809 -163.91 -252.35 300.91
3062 54.49 24.65 59.81

783 99.87 -26.01 103.20
809 -103.88 -147.89 180.73

783 -0.47 -1.32 1.40

743 35.74 18.82 40.39
768 -2.40 -22.01 22.14
770 23.76 -2.51 23.90
781 -98.71 27.95 102.59
782 0.71 0.50 0.87

779 10.65 36.56 38.08
787 34.18 0.87 34.19
811 -105.26 -184.28 212.22

757 -56.80 -1.19 56.81
776 32.37 0.97 32.39

757 -31.80 -5.21 32.22
788 -0.76 -4.70 4.76

764 33.00 7.53 33.85
784 -33.40 -2.39 33.49

755 -93.48 -108.93 143.55
761 18.41 1.28 18.45
773 -10.49 2.85 10.87
775 17.38 56.54 59.15
786 1.07 3.97 4.11
789 47.43 46.75 66.60
790 4.38 -20.36 20.82

771 17.45 -3.24 17.75
775 -7.96 44.06 44.77

790	1.07	19.69	0.00	0.00	788	-47.17	-46.78	66.43
792	1.06	20.45	0.00	0.00	788	4.16	1.60	4.45
798	1.13	22.44	0.00	0.00	756	-113.15	1.88	113.17
799	1.09	25.42	0.00	0.00	764	121.80	0.46	121.80
800	1.09	25.40	31.28	9.12	710	-40.24	-3.92	40.43
					806	43.63	-21.53	48.65
					800	40.18	-79.91	89.44
					716	-509.14	-23.32	509.67
					717	-508.08	62.96	511.97
					799	-40.18	79.94	89.47
					803	304.93	-92.30	318.59
					805	245.51	-80.90	258.50
801	1.13	22.52	0.00	0.00	809	467.67	83.35	475.04
					701	-1.34	-24.51	24.55
					702	-1.34	-24.51	24.55
					718	-214.92	-151.99	263.24
					806	238.76	48.03	243.55
803	1.10	22.29	0.00	0.00	733	111.97	169.70	203.31
					765	92.77	156.05	181.55
					800	-295.81	97.34	311.42
					804	63.83	72.41	96.53
					811	52.06	-157.81	166.17
804	1.09	21.98	0.00	0.00	803	-59.84	-78.42	98.64
					809	-261.09	103.30	280.79
					810	51.39	-45.11	68.38
					811	-2.58	-121.00	121.03
					818	-407.02	45.59	409.57
					963	-86.20	129.44	155.52
					1425	790.73	-8.26	790.77
805	1.10	21.65	0.00	0.00	736	175.76	209.47	273.43
					800	-232.61	77.29	245.11
					808	191.86	-23.16	193.25
					810	3.49	45.75	45.88
					811	-114.75	-181.17	214.45
806	1.13	22.37	0.00	0.00	773	81.69	97.18	126.95
					798	-42.98	19.80	47.32
					801	-186.82	-145.67	236.90
					811	177.07	120.37	214.11
807	1.11	20.42	0.00	0.00				

						775	68.83	201.32	212.76
						808	-57.64	45.99	73.74
808	1.11	20.66	0.00	0.00					
						741	141.83	280.81	314.59
						805	-188.42	18.58	189.33
						807	59.66	-51.86	79.05
809	1.08	24.08	0.00	0.00					
						780	164.76	277.09	322.37
						781	104.17	156.60	188.08
						800	-462.25	-78.73	468.91
						804	266.51	-102.20	285.44
						965	-55.12	109.82	122.88
810	1.10	21.70	0.00	0.00					
						739	51.55	87.84	101.85
						804	-47.90	38.88	61.70
						805	2.77	-58.51	58.57
811	1.12	21.94	0.00	0.00					
						784	106.04	197.88	224.50
						803	-48.38	153.77	161.20
						804	10.01	109.90	110.36
						805	117.09	179.62	214.41
						806	-174.97	-121.82	213.20
817	1.09	25.45	0.00	0.00					
						818	401.08	-4.10	401.10
						987	-372.71	-43.56	375.24
818	1.09	25.35	0.00	0.00					
						804	408.44	-21.53	409.00
						817	-399.61	4.77	399.63
830	1.05	34.24	0.00	0.00	370.00		157.52		
						971	375.27	244.26	447.76
831	1.03	30.86	0.00	0.00					
						971	252.67	302.09	393.83
832	1.19	35.06	0.00	0.00					
						983	852.71	516.23	996.80
833	1.03	34.26	0.00	0.00					
						962	726.12	306.91	788.32
834	1.20	35.82	0.00	0.00					
						986	656.36	383.21	760.04
836	1.05	20.55	0.00	0.00					
						837	2.20	-1.94	2.94
						906	-18.23	12.10	21.88
						907	27.89	-20.72	34.74
837	1.05	20.48	0.00	0.00					
						836	-2.14	1.64	2.69
838	0.44	87.16	0.00	0.00					
						839	12.46	8.42	15.04
						840	9.29	8.10	12.32
839	0.43	86.28	3.74	1.09					
						838	-12.33	-8.12	14.76

840	0.42	86.02	0.00	0.00				
					838	-9.02	-7.67	11.84
					841	379.89	-115.52	397.06
					866	48.50	9.43	49.41
841	0.42	85.03	1.31	0.38				
					840	-371.12	119.91	390.01
					3083	123.11	-45.28	131.17
842	1.31	14.29	0.00	0.00				
					875	0.51	-16.63	16.64
					1396	-36.95	18.66	41.40
					3026	36.52	20.03	41.65
843	1.31	16.55	3.64	1.06				
					844	20.05	10.73	22.74
					914	16.01	-25.40	30.03
					967	-41.03	-71.99	82.86
844	1.30	16.36	0.00	0.00				
					843	-19.94	-10.84	22.70
					3027	3.30	-5.99	6.85
					3028	17.09	5.29	17.88
845	1.15	14.26	0.00	0.00				
					846	9.33	3.25	9.88
					890	-38.13	41.02	56.00
					1306	30.11	-54.68	62.42
846	1.15	14.07	0.00	0.00				
					845	-9.32	-3.21	9.86
					3328	15.50	60.39	62.35
847	1.18	14.78	0.00	0.00				
					899	-14.08	-38.84	41.31
					909	12.68	36.21	38.37
					3119	2.63	0.01	2.63
848	1.23	19.76	0.00	0.00				
					897	-7.09	-111.31	111.53
					918	10.45	100.24	100.79
					3071	4.84	0.10	4.85
849	1.04	15.66	0.00	0.00				
					854	25.85	-10.21	27.80
					932	-70.17	43.04	82.32
					3041	4.68	32.89	33.22
					3043	0.99	-15.51	15.54
					3047	40.53	8.27	41.36
850	1.02	11.98	0.00	0.00				
					851	2.71	-1.55	3.12
					854	-17.72	12.36	21.61
					878	14.61	-17.76	23.00
851	1.02	11.96	2.80	0.82				
					850	-2.71	1.53	3.11
852	1.08	14.46	0.00	0.00				
					853	-2.90	21.66	21.85
					856	3.97	-1.36	4.20

853	1.08	14.62	0.00	0.00	1395	24.89	6.12	25.63
					3086	-24.17	4.57	24.60
					852	2.94	-21.72	21.92
					3043	0.54	14.38	14.39
854	1.03	13.57	7.00	2.04	3072	-3.24	5.72	6.57
					849	-25.20	10.54	27.31
855	1.08	14.40	0.93	0.27	850	18.26	-12.30	22.01
856	1.08	14.41	0.00	0.00	856	-0.98	-0.86	1.30
					852	-3.98	1.27	4.17
					855	0.98	0.41	1.06
857	1.11	17.85	0.00	0.00	3089	2.72	-0.01	2.72
					860	34.83	-33.31	48.19
					889	50.16	-23.24	55.28
					891	46.47	-16.39	49.28
					924	-4.97	53.06	53.30
858	1.31	16.25	0.00	0.00	969	-132.63	-139.20	192.27
					901	-6.60	36.94	37.52
					914	4.41	-22.13	22.57
859	0.92	15.84	0.00	0.00	3025	3.78	25.15	25.44
					874	-26.29	-67.82	72.74
					917	27.51	60.15	66.14
860	1.11	17.82	0.00	0.00	3120	9.23	-4.52	10.28
					857	-34.81	33.33	48.19
					861	36.52	5.79	36.98
861	1.10	16.50	9.81	2.86	3091	3.20	-1.00	3.35
					860	-36.04	-5.34	36.44
862	1.06	15.57	5.32	1.55	865	26.60	1.80	26.66
					863	-3.39	-10.17	10.72
863	1.06	15.51	2.71	0.79	905	5.84	-4.77	7.54
					862	3.46	10.03	10.61
864	1.08	18.55	0.00	0.00	900	-6.61	-10.56	12.45
					887	-6.34	-12.78	14.27
					3073	18.96	-4.58	19.50
865	1.09	15.79	0.00	0.00	3090	-3.28	9.20	9.77
					861	-26.39	-1.74	26.45
					3074	0.78	-4.78	4.85

866	0.37	60.89	9.53	2.78	3086	27.42	-10.14	29.24
					840	-41.39	10.33	42.66
					3042	31.55	-8.88	32.78
					3084	4.59	0.87	4.67
867	1.02	11.72	3.45	1.01	878	-3.48	-1.45	3.77
868	0.96	18.86	2.71	0.79	869	9.38	-30.03	31.46
					3080	-11.10	25.65	27.95
869	0.96	18.60	0.00	0.00	868	-9.28	30.15	31.55
					2996	6.54	-30.00	30.71
					3075	2.66	-0.40	2.69
870	1.33	11.92	2.24	0.65	871	-11.35	41.77	43.29
					939	-57.40	-45.70	73.37
					1031	13.25	0.03	13.25
					3138	53.22	11.01	54.35
871	1.30	12.50	0.00	0.00	870	11.61	-41.38	42.97
					879	-14.34	40.23	42.71
					3031	2.61	-0.21	2.61
872	1.30	15.85	0.00	0.00	873	13.36	-15.43	20.41
					881	-34.93	4.20	35.18
					912	20.00	4.19	20.44
873	1.30	15.10	0.00	0.00	872	-13.16	15.28	20.17
					875	8.78	-16.50	18.69
					3032	4.16	0.71	4.22
874	0.99	15.53	3.45	1.01	859	28.58	72.13	77.59
					909	-32.39	-58.96	67.27
875	1.32	14.04	8.97	2.62	842	-0.36	16.40	16.40
					873	-8.47	16.11	18.20
876	0.93	21.60	0.00	0.00	880	-22.44	-4.64	22.92
					884	17.34	0.47	17.35
					3076	6.79	1.44	6.94
877	1.02	11.57	11.02	3.21	878	-11.22	15.93	19.49
878	1.02	11.78	0.00	0.00	850	-14.55	17.79	22.98
					867	3.51	1.29	3.73
					877	11.28	-15.93	19.52
879	1.27	13.38	6.07	1.77	871	14.68	-39.76	42.38

					899	10.99	56.95	58.00
					3026	-31.45	-19.73	37.13
880	0.94	22.86	3.08	0.90				
					876	22.68	4.74	23.17
					964	-85.91	-133.67	158.89
					3045	61.79	126.38	140.68
881	1.30	16.08	0.00	0.00				
					872	35.07	-4.40	35.34
					903	-2.00	-15.94	16.06
					955	-38.38	-17.39	42.14
					3034	4.22	0.29	4.23
882	0.43	30.47	0.19	0.05				
					883	-18.41	27.60	33.17
					888	-0.46	-28.70	28.70
					942	48.69	54.86	73.35
					3045	-16.51	-60.36	62.58
883	0.42	31.14	0.00	0.00				
					882	18.60	-27.18	32.94
					3042	-18.93	25.01	31.36
					3122	16.65	-4.70	17.30
884	0.93	21.22	19.05	5.56				
					876	-17.28	-0.52	17.29
					943	-21.14	-12.84	24.74
					3080	18.57	-23.84	30.22
885	1.07	18.74	0.00	0.00				
					886	35.08	-35.13	49.65
					924	6.02	-19.47	20.38
					3090	18.15	-16.37	24.45
886	1.07	18.69	6.26	1.82				
					885	-35.06	35.17	49.66
887	1.09	18.71	7.75	2.26				
					864	6.48	12.37	13.97
					894	8.22	1.43	8.34
					907	-20.68	38.75	43.93
888	0.55	23.37	0.19	0.05				
					882	5.24	36.19	36.57
					3124	-5.39	-36.45	36.85
889	1.12	16.10	0.00	0.00				
					857	-49.82	24.60	55.56
					890	57.42	-76.90	95.97
					891	-30.39	21.09	36.99
					1313	-0.11	13.32	13.32
					3329	25.82	25.30	36.15
890	1.13	15.59	0.00	0.00				
					845	38.57	-39.92	55.50
					889	-57.19	77.99	96.71
					3330	17.50	21.66	27.84
891	1.12	16.71	0.00	0.00				
					857	-46.28	17.05	49.33

					889	30.50	-20.87	36.96
					3331	14.83	13.59	20.12
893	1.20	4.79	1.68	0.49				
					895	-18.27	-42.69	46.43
					922	-18.50	-15.99	24.45
					3138	-43.92	-5.15	44.22
					3140	-39.04	-44.57	59.25
894	1.08	18.26	0.00	0.00				
					887	-8.06	-1.88	8.28
					3030	2.39	-0.74	2.50
					3033	6.32	0.57	6.35
895	1.24	4.53	0.00	0.00				
					893	19.08	43.65	47.64
					1036	-22.02	-44.14	49.33
					3137	1.64	0.28	1.66
896	1.24	19.62	5.60	1.63				
897	1.24	19.64	0.00	0.00	897	-5.74	-3.68	6.81
					848	7.45	112.75	113.00
					896	5.80	3.51	6.78
					902	20.64	-65.65	68.81
					975	-38.14	-108.73	115.23
898	1.19	17.12	2.43	0.71				
					909	35.84	56.60	66.99
					974	-37.79	-67.66	77.50
899	1.19	14.65	0.00	0.00				
					847	14.36	39.14	41.69
					879	-9.03	-54.35	55.10
					3118	12.85	-23.85	27.09
900	1.08	15.54	0.00	0.00				
					863	6.79	10.20	12.25
					909	-8.38	-13.99	16.31
					3123	6.12	-3.01	6.82
901	1.29	17.10	0.00	0.00				
					858	7.04	-36.62	37.29
					902	-9.26	34.17	35.41
					3035	3.21	0.07	3.21
902	1.28	17.73	8.97	2.62				
					897	-18.88	67.79	70.37
					901	9.59	-33.95	35.27
903	1.34	15.40	0.00	0.00				
					881	2.53	14.86	15.07
					914	-29.42	147.36	150.27
					3128	2.56	0.44	2.60
904	1.04	13.12	0.00	0.00				
					916	-78.80	-53.53	95.27
					1565	73.69	51.82	90.09
					3046	3.46	-0.16	3.46
905	1.06	15.53	0.00	0.00				

					862	-5.83	4.74	7.52
					3121	3.27	-3.21	4.58
					3157	2.25	-0.95	2.44
906	1.05	21.24	7.00	2.04				
					836	18.39	-12.22	22.08
					907	21.65	-15.42	26.59
					918	-0.02	-83.19	83.19
					920	-31.19	385.76	387.01
					972	-10.00	-341.43	341.58
907	1.06	19.96	22.69	6.62				
					836	-27.77	20.87	34.74
					887	21.04	-37.84	43.30
					906	-21.40	15.43	26.39
908	1.06	14.55	0.00	0.00				
					730	-4.87	10.63	11.70
					3048	7.37	-3.48	8.15
					3050	-5.48	-17.36	18.20
909	1.11	15.55	2.71	0.79				
					847	-11.31	-34.97	36.75
					874	36.47	65.64	75.09
					898	-34.79	-52.75	63.18
					900	8.69	13.69	16.22
					3126	8.21	-11.70	14.30
910	1.02	12.49	2.43	0.71				
					911	26.20	-1.41	26.24
					3047	-32.19	-5.47	32.65
911	1.02	12.43	0.00	0.00				
					910	-26.19	1.41	26.23
					1565	20.57	-0.98	20.59
					3049	5.60	0.62	5.63
912	1.29	15.76	30.35	8.85				
					872	-19.98	-4.23	20.42
					913	-10.55	-7.14	12.74
913	1.30	15.79	0.00	0.00				
					912	10.56	7.10	12.73
					3028	-10.28	-4.83	11.36
914	1.34	15.41	5.23	1.52				
					843	-15.47	25.00	29.40
					858	-4.14	21.86	22.25
					903	29.44	-147.30	150.21
915	1.10	15.12	14.57	4.25				
					916	-34.28	-0.56	34.28
					3050	19.33	20.57	28.23
916	1.10	16.05	10.37	3.02				
					904	80.25	60.18	100.31
					915	34.44	0.81	34.45
					976	-128.11	-128.64	181.55
917	0.83	16.54	0.00	0.00				
					859	-24.18	-55.09	60.16

					3124	23.89	54.03	59.07
					3127	1.91	-0.64	2.01
918	1.20	19.87	0.00	0.00				
					848	-9.99	-98.39	98.90
					906	2.57	94.22	94.25
					919	11.46	-5.46	12.70
919	1.20	19.81	7.56	2.21				
					918	-11.45	5.42	12.67
920	0.87	26.37	0.00	0.00				
					906	54.41	-316.46	321.11
					921	46.64	-70.32	84.38
					3083	-36.49	264.14	266.65
921	0.87	26.20	9.34	2.72				
					920	-46.45	70.51	84.44
922	1.20	4.79	0.00	0.00				
					893	18.50	16.00	24.46
					923	4.16	0.80	4.24
923	1.20	4.73	5.32	1.55				
					922	-4.16	-0.98	4.27
924	1.09	18.15	0.00	0.00				
					857	5.17	-52.32	52.58
					885	-5.81	19.20	20.06
					925	10.11	-49.59	50.61
925	1.09	18.12	3.45	1.01				
					924	-10.09	49.61	50.63
926	0.93	22.89	0.00	0.00				
					927	10.92	1.29	11.00
					946	125.53	149.49	195.21
					2999	4.25	-0.64	4.29
					3056	-135.12	-159.88	209.33
927	0.93	22.77	10.09	2.94				
					926	-10.75	-1.75	10.89
928	0.84	22.22	0.00	0.00				
					929	10.99	1.47	11.09
					931	-48.08	-173.99	180.51
					938	42.57	166.86	172.20
929	0.84	22.05	10.18	2.97				
					928	-10.83	-1.96	11.01
931	0.93	22.71	10.46	3.05				
					928	51.63	190.72	197.58
					943	20.74	-19.55	28.50
					950	-79.86	-177.50	194.64
932	1.00	20.43	20.64	6.02				
					849	70.55	-35.57	79.01
					933	-90.79	28.90	95.28
933	1.00	23.72	0.00	0.00				
					932	93.12	-25.15	96.45
					947	-4.14	24.75	25.09
					960	-19.81	2.36	19.95

					968 -119.59 -123.91 172.21
					3063 51.68 -0.22 51.68
934	0.77	20.88	0.00	0.00	
					937 132.93 258.34 290.53
					938 -134.46 -271.23 302.73
					3057 14.93 -8.19 17.03
935	0.61	16.16	0.00	0.00	
					937 -112.85 -194.79 225.12
					942 138.24 243.77 280.23
					942 138.24 243.77 280.23
					942 138.23 243.77 280.24
					942 138.23 243.77 280.24
					970 -383.41 -591.52 704.91
936	0.67	18.29	8.97	2.62	
					937 -7.61 -5.23 9.23
937	0.67	18.34	0.00	0.00	
					934 -126.98 -222.90 256.53
					935 117.08 220.31 249.49
					936 7.66 5.08 9.19
938	0.82	22.10	2.15	0.63	
					928 -41.62 -162.57 167.82
					934 137.73 292.66 323.45
					3060 -100.31 -130.33 164.46
939	1.37	13.80	0.00	0.00	
					870 57.55 48.98 75.57
					948 39.39 11.95 41.16
					973 -189.36 -43.55 194.30
					1056 28.07 -23.55 36.64
					3147 61.69 -49.09 78.84
940	1.00	22.24	0.00	0.00	
					941 110.31 27.90 113.78
					945 -19.17 14.57 24.08
					963 -93.42 -204.54 224.87
941	0.99	21.07	0.00	0.00	
					940 -109.73 -26.16 112.80
					3058 28.40 -6.81 29.21
					3061 84.37 13.39 85.43
942	0.35	19.07	0.00	0.00	
					882 -47.80 -36.03 59.86
					935 -72.05 -144.27 161.26
					935 -72.05 -144.27 161.26
					935 -72.06 -144.27 161.26
					935 -72.06 -144.27 161.26
943	0.93	21.94	0.00	0.00	
					884 21.16 13.22 24.95
					931 -20.21 18.50 27.40
945	0.99	22.85	0.00	0.00	
					940 20.24 -17.47 26.74
					3063 -35.57 -0.02 35.57

946	0.87	22.43	3.74	1.09	3064	22.68	-6.67	23.64
					926	-118.78	-141.42	184.68
					3060	117.16	136.21	179.66
947	1.00	23.85	0.00	0.00	933	4.53	-25.63	26.03
					960	-7.74	-9.19	12.02
					3065	48.87	-36.67	61.10
948	1.34	12.98	0.00	0.00	939	-38.40	-14.15	40.92
					1056	21.97	-37.31	43.30
					3146	-19.15	-75.11	77.51
950	0.96	23.24	0.00	0.00	931	81.35	184.47	201.61
					964	-77.31	-77.31	109.33
951	1.02	24.50	19.89	5.80	960	66.94	103.48	123.24
955	1.31	17.16	0.00	0.00	881	38.42	18.29	42.55
					2357	-22.01	-23.60	32.27
					2360	-15.92	35.08	38.53
960	1.00	23.94	0.00	0.00	933	20.03	-3.00	20.25
					947	8.10	8.12	11.47
					951	-66.18	-101.35	121.05
					961	-108.57	-117.35	159.87
					3056	144.55	170.58	223.59
961	1.04	25.61	0.00	0.00	960	108.94	124.81	165.67
					963	183.40	-95.39	206.72
					965	32.93	-1.03	32.95
					970	-29.20	279.16	280.68
					971	-101.00	107.79	147.71
					988	-171.58	-318.75	361.99
962	0.99	29.33	0.00	0.00	833	-720.50	-233.78	757.48
					971	702.47	-113.83	711.63
963	1.06	23.59	0.00	0.00	804	93.93	-139.91	168.52
					940	93.91	219.18	238.45
					961	-181.14	91.55	202.96
964	0.99	24.64	0.00	0.00	880	86.19	143.76	167.62
					950	77.46	81.33	112.32
					969	129.99	-387.20	408.44
					971	-291.75	40.50	294.55
965	1.04	25.53	0.00	0.00	809	63.96	-126.28	141.56
					961	-32.37	-1.43	32.40

966	1.25	21.10	90.21	26.31	968	341.16	-166.82	379.76
					972	30.64	-299.03	300.60
967	1.36	17.64	0.00	0.00	843	41.11	75.42	85.90
					973	133.89	-102.06	168.35
					975	-176.46	205.25	270.68
968	1.04	25.51	0.00	0.00	2361	4.39	-125.11	125.19
					933	119.88	132.23	178.48
969	1.18	20.54	0.00	0.00	965	-341.15	166.88	379.78
					857	133.20	153.65	203.35
					964	-115.88	438.25	453.31
					972	-59.48	-244.04	251.19
					984	-468.49	191.93	506.28
					1372	256.51	-206.49	329.30
					1374	286.31	-233.49	369.45
					1388	183.98	-309.87	360.37
970	0.91	27.14	0.00	0.00	3100	-195.01	320.01	374.75
					935	396.94	984.01	1061.05
					961	36.31	-269.49	271.92
971	0.98	28.85	0.00	0.00	971	-427.98	-741.88	856.48
					830	-373.47	-195.78	421.68
					831	-251.28	-279.80	376.07
					961	107.47	-126.91	166.30
					962	-697.13	118.17	707.07
					964	296.81	-32.53	298.59
					970	437.50	806.95	917.91
					974	250.33	-374.31	450.30
972	1.25	21.09	0.00	0.00	3100	208.56	-285.15	353.28
					906	13.08	408.23	408.44
					966	-30.57	299.16	300.72
					969	63.43	231.34	239.88
					1373	170.55	-298.55	343.83
973	1.38	15.44	0.00	0.00	3204	-280.25	-419.30	504.33
					939	189.56	49.35	195.88
					967	-134.98	74.42	154.14
					974	-178.06	575.27	602.19
974	1.24	18.44	0.00	0.00	1085	121.61	-236.73	266.14
					898	38.00	71.87	81.30
					971	-225.53	470.21	521.50
975	1.30	20.41	0.00	0.00	973	187.23	-533.27	565.18

					897 38.39 114.33 120.60
					967 178.96 -216.83 281.15
					3204 -211.43 158.31 264.13
976	1.15	18.04	0.00	0.00	
					916 128.64 138.50 189.02
					1229 -124.10 -75.24 145.12
982	1.16	24.12	0.00	0.00	
					983 -878.50 181.73 897.10
					984 501.79 -204.90 542.01
					1247 484.07 -125.94 500.19
983	1.13	29.73	0.00	0.00	
					832 -846.07 -410.04 940.20
					982 943.55 -298.50 989.64
					986 -596.36 -81.37 601.88
					987 606.59 258.30 659.29
984	1.16	24.00	0.00	0.00	
					969 470.35 -160.31 496.92
					982 -501.57 206.00 542.23
986	1.13	29.86	0.00	0.00	
					834 -652.52 -294.82 716.03
					983 597.71 79.72 603.00
987	1.10	27.05	0.00	0.00	
					817 432.82 -78.64 439.91
					983 -562.79 -378.10 678.01
					988 213.62 358.93 417.69
988	1.10	27.02	0.00	0.00	
					961 172.81 340.93 382.23
					987 -213.48 -358.20 416.99
996	1.19	4.54	0.00	0.00	
					1080 8.89 -5.79 10.61
997	2.01	-10.03	0.00	0.00	
					1049 14.22 93.97 95.04
998	1.50	-6.63	0.00	0.00	
					1051 6.14 21.07 21.95
999	1.55	-1.77	0.00	0.00	
					1052 6.47 97.57 97.79
1000	1.42	1.95	0.00	0.00	
					1037 -0.38 -8.95 8.96
1001	1.64	11.07	0.00	0.00	
					1070 33.47 145.31 149.12
1002	1.49	11.23	0.00	0.00	
					1070 32.27 49.42 59.02
1003	1.54	10.76	0.00	0.00	
					1070 74.26 200.00 213.34
1004	1.61	15.19	0.00	0.00	
					1086 119.48 268.17 293.58
1005	1.68	14.92	0.00	0.00	
					1086 57.95 204.91 212.94
1006	1.67	-8.89	0.00	0.00	

1007	1.93	-9.17	0.00	0.00	1026	7.48	11.70	13.89
1011	1.31	9.67	0.00	0.00	1026	7.31	96.83	97.10
					1027	-6.10	-1.87	6.38
					1028	0.65	-0.62	0.90
					3135	2.20	-0.14	2.20
1012	1.43	-1.08	5.14	1.50	1020	15.64	-7.11	17.18
					1037	-22.73	5.53	23.39
1013	1.49	-3.23	2.80	0.82	1018	-39.11	64.31	75.27
					1026	29.53	-66.40	72.67
1014	1.44	1.70	5.42	1.58	1037	-6.19	-1.37	6.34
1015	1.43	-3.12	4.84	1.25	1016	-13.05	-0.40	13.06
1016	1.43	-3.05	0.00	0.00	1015	13.07	0.42	13.08
					1017	-4.14	-8.67	9.61
					1020	-11.81	6.61	13.53
1017	1.43	-3.05	3.27	0.95	1016	4.11	8.54	9.48
					1035	-4.44	-8.84	9.89
1018	1.48	-2.58	0.00	0.00	1013	39.43	-63.53	74.77
					1024	131.35	37.34	136.56
					1042	11.54	8.20	14.16
					1082	-184.28	63.65	194.97
1019	1.40	-6.46	0.00	0.00	1021	-29.92	39.99	49.95
					1032	23.81	8.75	25.37
					1054	0.15	-71.83	71.83
1020	1.43	-1.98	5.04	1.47	1012	-15.68	6.62	17.02
					1016	11.61	-7.69	13.93
1021	1.37	-2.82	0.00	0.00	1019	31.27	-38.19	49.36
					3154	-25.14	-12.14	27.92
					3160	-50.71	29.56	58.69
1022	1.37	3.60	17.00	4.96	1036	-25.88	-8.88	27.36
					3156	-2.84	-2.36	3.69
1023	1.35	-5.96	0.00	0.00	1025	-48.91	28.84	56.78
					1030	40.66	-32.05	51.77
1024	1.45	-4.08	0.00	0.00	1018	-129.57	-33.51	133.84
					3173	6.84	1.77	7.07

					3180	117.42	31.68	121.62
1025	1.35	-5.23	0.00	0.00				
					1023	49.11	-28.35	56.71
					1045	-95.53	11.94	96.28
					3174	4.78	1.70	5.08
1026	1.63	-9.79	0.00	0.00				
					1006	-7.47	-11.29	13.54
					1007	-7.08	-81.95	82.26
					1013	-24.75	73.47	77.53
					1044	-0.60	-78.45	78.45
					3176	31.74	99.59	104.53
1027	1.32	9.84	4.76	1.39				
					1011	6.09	1.36	6.24
					1056	-16.36	-54.07	56.49
					3139	2.68	6.88	7.38
1028	1.31	9.64	1.21	0.35				
1029	1.41	-7.74	0.00	0.00	1011	-0.68	0.09	0.68
					1033	27.95	51.92	58.97
					1076	-112.67	-4.52	112.76
					3176	-152.49	-181.52	237.07
1030	1.36	-7.38	0.00	0.00				
					1023	-40.31	32.89	52.03
					1033	-3.27	-46.31	46.42
					3177	-21.12	-8.23	22.66
1031	1.30	10.14	0.00	0.00				
					870	-12.90	-1.53	12.99
					3136	-5.79	-10.07	11.62
					3139	-0.30	-8.03	8.04
1032	1.39	-6.85	8.59	2.51				
					1019	-23.80	-8.88	25.40
					3155	-21.58	-9.74	23.67
1033	1.39	-7.65	0.00	0.00				
					1029	-27.42	-51.17	58.05
					1030	3.45	46.74	46.87
					3178	-27.30	-4.07	27.60
1034	1.44	-3.29	3.92	1.14				
1035	1.45	-3.10	0.00	0.00	1035	-5.61	-1.72	5.87
					1017	4.19	7.82	8.87
					1034	5.40	1.06	5.50
					1042	-9.87	-8.36	12.94
1036	1.38	4.10	18.86	5.50				
					895	24.73	47.34	53.41
					1022	26.00	8.77	27.44
					1083	-129.08	-54.66	140.17
					3153	57.41	-25.98	63.01
1037	1.45	1.99	7.56	2.21				
					1000	0.38	9.19	9.20

					1012	22.92	-6.71	23.88
					1014	5.99	0.18	5.99
					1038	1.77	0.69	1.90
					1084	-45.47	1.46	45.49
1038	1.45	1.99	5.60	1.63				
					1037	-1.80	-0.84	1.99
1039	1.36	-3.83	0.00	0.00				
					1040	5.48	3.22	6.35
					1066	-63.26	-121.52	137.00
1040	1.35	-3.84	18.40	5.37	3179	24.88	-6.68	25.76
					1039	-5.49	-3.25	6.37
1041	1.38	-7.76	3.74	1.09				
					1046	99.26	21.25	101.51
1042	1.46	-2.90	0.00	0.00	3180	-115.45	-23.41	117.79
					1018	-11.71	-9.06	14.81
					1035	9.72	7.66	12.38
1043	1.46	-2.90	1.77	0.52	1043	-0.57	-1.26	1.38
					1042	0.57	1.26	1.38
1044	1.65	-10.23	0.00	0.00				
					1026	1.12	79.10	79.11
					1048	-11.83	-78.14	79.03
					3175	4.63	-0.68	4.68
1045	1.35	-5.07	0.00	0.00	3181	2.02	-0.22	2.03
					1025	95.63	-11.72	96.34
					1075	-54.64	-107.08	120.21
1046	1.37	-8.42	0.00	0.00	3179	-26.06	5.70	26.68
					1041	-98.82	-20.08	100.84
					1047	-289.37	-71.78	298.14
1047	1.37	-8.38	0.28	0.08	2243	-96.39	-28.58	100.54
					1046	289.41	72.02	298.24
1048	1.71	-11.24	0.00	0.00				
					1044	13.38	80.08	81.19
1049	1.74	-11.23	0.00	0.00	1049	-17.45	-81.47	83.32
					997	-14.02	-81.10	82.30
1051	1.49	-6.76	0.00	0.00	1048	17.50	82.41	84.25
					998	-6.13	-20.85	21.73
					1054	-85.01	-77.22	114.84
1052	1.48	-1.82	0.00	0.00	1077	56.26	87.19	103.76
					999	-6.27	-93.42	93.63
					1055	-69.99	91.17	114.93

1053	1.41	-4.46	0.00	0.00	3165	43.92	-13.71	46.01
					1057	101.03	9.22	101.45
					1075	-27.68	-2.30	27.78
1054	1.50	-6.64	0.00	0.00	2257	-101.50	-16.43	102.82
					1019	0.08	76.65	76.65
					1051	85.38	77.57	115.36
					3158	-42.29	35.13	54.97
1055	1.48	-1.43	0.00	0.00	3163	-42.38	35.56	55.32
					1052	70.31	-90.87	114.89
					3162	-2.59	-2.45	3.56
					3163	87.47	-74.83	115.11
1056	1.37	10.39	0.00	0.00	3166	-159.70	167.77	231.62
					939	-26.61	15.90	31.00
					948	-20.37	31.82	37.78
					1027	16.48	56.45	58.81
					1070	9.05	-37.32	38.40
					1071	177.41	90.82	199.31
					2503	-81.46	-80.02	114.18
1057	1.40	-4.79	0.00	0.00	2505	-76.44	-35.23	84.17
					1053	-100.75	-8.93	101.15
					3187	-94.41	-111.25	145.91
1058	1.46	-6.83	0.00	0.00	3188	17.97	-69.01	71.31
					1077	-71.67	-94.84	118.87
					3164	-79.20	-26.20	83.42
1059	1.48	-2.02	12.05	3.51	3188	-1.01	71.42	71.42
1060	1.21	4.46	33.90	9.89	3165	-109.18	-22.05	111.39
					1061	132.59	195.39	236.13
1061	1.20	4.46	25.12	7.33	1063	-185.58	-161.39	245.94
					1060	-131.09	-193.32	233.58
1062	1.19	4.47	5.42	1.58	1079	84.12	170.31	189.95
1063	1.26	5.87	0.00	0.00	1079	-148.82	-231.48	275.19
					1060	189.08	171.75	255.44
1066	1.43	-2.44	0.00	0.00	1071	-192.93	-175.70	260.94
					1072	-2.11	-5.64	6.02
					1039	63.64	129.87	144.63
					1075	72.05	-14.69	73.53
					3189	-135.92	8.49	136.18

1067	1.44	1.59	7.19	2.10	
					1073 -177.98 -14.31 178.55
1068	1.34	8.25	0.19	0.05	3189 148.41 -3.10 148.44
1069	1.40	9.10	0.00	0.00	1071 -9.28 -14.83 17.50
					368 61.63 91.71 110.50
					1070 -20.90 -257.77 258.62
					1071 32.00 55.95 64.45
					1085 -131.46 -74.29 151.00
					3149 31.81 53.51 62.25
1070	1.41	9.06	3.64	1.06	
					1001 -33.15 -123.90 128.26
					1002 -32.22 -45.49 55.75
					1003 -73.34 -180.89 195.19
					1056 -9.09 32.00 33.26
					1069 21.21 259.23 260.10
					3147 -53.15 47.22 71.10
					3166 178.64 -139.50 226.65
1071	1.34	8.27	41.74	12.18	
					1056 -176.12 -83.88 195.08
					1063 195.93 192.15 274.42
					1068 9.21 14.31 17.02
					1069 -32.48 -60.59 68.75
					3149 -32.53 -61.39 69.47
1072	1.26	5.87	1.31	0.38	
1073	1.45	2.07	0.00	0.00	1063 1.96 4.90 5.27
1075	1.42	-3.89	0.00	0.00	1067 178.15 15.32 178.81
					2506 -148.68 59.54 160.16
					1045 54.94 113.39 126.00
					1053 27.13 0.21 27.13
					1066 -71.76 14.08 73.12
1076	1.42	-4.25	0.00	0.00	1029 113.04 11.46 113.62
					2253 -123.14 19.54 124.68
1077	1.48	-6.76	0.00	0.00	1051 -56.01 -87.01 103.48
					1058 72.28 95.54 119.80
					1078 -3.18 -5.60 6.44
1078	1.48	-6.73	0.00	0.00	1077 1.88 2.44 3.09
1079	1.19	4.49	0.00	0.00	1061 -83.63 -169.67 189.16
					1062 148.87 231.74 275.44
					1080 -104.02 -140.70 174.98
1080	1.19	4.51	0.00	0.00	996 -8.89 5.79 10.61

1082	1.44	4.59	0.00	0.00	1079	104.04	140.81	175.08
					1018	185.18	-38.96	189.23
					1083	-206.03	-9.09	206.23
					1084	24.79	-66.99	71.43
1083	1.45	8.97	0.00	0.00	2240	-26.54	68.30	73.27
					1036	129.79	68.50	146.76
					1082	198.59	-33.80	201.45
1084	1.45	3.70	0.00	0.00	1085	-334.30	-14.35	334.61
					1037	45.51	-0.11	45.51
					1082	-39.48	-1.53	39.51
1085	1.46	12.93	0.00	0.00	2507	-20.41	5.26	21.08
					973	-121.76	212.03	244.50
					1069	132.12	86.79	158.08
					1083	334.56	6.27	334.62
					1086	-186.78	-182.98	261.47
1086	1.47	12.98	0.00	0.00	2502	-204.37	-175.47	269.37
					1004	-117.97	-239.48	266.96
					1005	-56.60	-177.02	185.85
1087	1.28	21.74	60.14	17.54	1085	186.72	182.50	261.10
1097	1.34	6.11	0.00	0.00	3204	-37.95	-67.74	77.64
1098	1.29	5.84	0.00	0.00	1213	2.12	45.97	46.02
1099	1.33	22.52	0.00	0.00	1129	0.57	21.73	21.74
1100	1.44	21.94	0.00	0.00	1155	92.19	58.79	109.34
1101	1.27	22.83	0.00	0.00	1155	92.20	124.89	155.23
1107	1.29	4.97	0.00	0.00	1155	92.19	25.97	95.78
					1108	-7.60	-0.01	7.60
1108	1.29	4.98	4.39	1.28	1154	14.00	-16.73	21.82
1109	1.11	6.11	0.00	0.00	1157	-27.84	13.52	30.95
					1107	7.60	0.01	7.60
					1110	-2.58	-2.98	3.94
1110	1.11	6.12	0.00	0.00	1161	1.16	-2.25	2.53
1111	1.38	3.44	2.89	0.84	1192	-8.26	-5.49	9.92
					1109	2.57	2.93	3.90

1112	1.39	3.69	0.00	0.00	1162	-8.97	-0.67	8.99
					1144	-23.80	16.59	29.01
					1156	11.08	-19.31	22.26
1114	1.09	4.66	5.14	1.50	1162	8.17	0.88	8.22
1115	1.06	6.00	0.00	0.00	1117	-43.08	-53.91	69.01
					1116	3.01	1.53	3.37
1116	1.06	5.99	5.70	1.66	1170	-98.75	-47.27	109.48
1117	1.09	4.68	0.00	0.00	1181	86.98	42.97	97.02
					1115	-3.01	-1.55	3.38
1118	1.07	4.70	0.00	0.00	1114	43.08	53.95	69.04
					1177	-21.41	-23.55	31.83
					1119	0.78	-1.76	1.92
1119	1.07	4.70	3.45	1.01	1147	-15.04	-38.99	41.79
1120	1.28	6.00	5.60	1.63	1153	-27.06	-19.48	33.34
					1118	-0.78	1.71	1.88
1121	1.09	6.63	0.00	0.00	1131	-1.56	-0.88	1.79
					1157	-4.94	-1.10	5.06
					1122	-51.58	-57.91	77.55
1122	1.09	6.64	5.60	1.63	1142	-26.92	-69.03	74.09
1123	1.08	6.10	1.68	0.49	1204	-21.00	22.83	31.02
1125	1.08	6.18	0.37	0.11	1121	51.59	57.93	77.57
1126	1.07	6.05	0.00	0.00	1127	-12.52	-6.58	14.14
1127	1.08	6.12	0.00	0.00	1128	-9.00	-4.17	9.91
					1195	-77.91	-76.32	109.06
					1123	12.52	6.56	14.13
1128	1.08	6.20	0.00	0.00	1128	-46.36	-38.60	60.32
					1195	28.32	29.18	40.66
					1125	9.00	4.15	9.91
1129	1.26	5.85	10.83	3.16	1127	46.45	38.76	60.50
					1173	-59.77	-48.79	77.15
					1098	-0.55	-21.22	21.23
					1130	20.14	-21.52	29.48
					1144	13.64	-83.48	84.59

					1160	40.44	64.64	76.25
					1189	27.29	-114.77	117.97
					1213	-10.61	-27.19	29.19
					1236	-111.43	155.55	191.34
1130	1.27	5.25	11.21	3.27				
					1129	-20.02	21.59	29.44
					1150	8.95	-24.67	26.24
1131	1.28	6.07	0.00	0.00				
					1120	1.50	0.14	1.51
					1132	-6.14	-0.82	6.20
					1157	-11.55	-2.88	11.91
1132	1.28	6.08	3.27	0.95				
1133	1.08	6.83	0.00	0.00	1131	6.14	0.79	6.19
					1170	102.51	47.81	113.11
					1173	24.88	-19.30	31.49
					1230	-137.65	-65.32	152.36
1134	1.13	12.22	5.60	1.63				
1135	1.13	12.24	0.00	0.00	1135	-113.37	-170.20	204.50
					1134	113.40	170.36	204.65
					1137	20.04	10.69	22.71
					1155	-69.44	-81.54	107.10
1136	1.08	7.22	15.88	4.63				
1137	1.12	11.52	6.44	1.88	1204	-20.68	-9.45	22.74
					1135	-19.93	-10.81	22.67
					1344	41.00	25.20	48.12
					1350	-30.45	-20.86	36.91
1138	1.24	12.68	11.02	3.21				
					1158	-37.23	16.07	40.55
					1302	23.87	-24.56	34.25
1139	1.11	5.06	0.00	0.00				
					1175	39.70	-13.87	42.06
					1192	-41.12	12.34	42.93
1140	1.28	6.36	0.00	0.00				
1141	1.13	6.60	0.00	0.00	1157	-12.28	-6.90	14.09
					1149	-66.76	-68.17	95.42
					1168	55.11	63.69	84.23
					1397	2.63	1.30	2.94
1142	1.10	6.73	0.00	0.00				
					1121	27.01	69.56	74.62
					1182	-41.88	-72.97	84.13
					1197	7.68	1.35	7.79
1143	1.27	11.26	10.27	3.00				
					1151	65.16	-61.94	89.90
1144	1.39	3.90	8.69	2.53	1155	-76.41	57.15	95.42

					1112	23.83	-16.57	29.02
					1129	-11.97	90.88	91.66
					1190	5.40	-11.48	12.68
					3332	-26.12	-65.11	70.15
1145	1.29	7.13	3.08	0.90				
					1157	18.20	4.04	18.64
					1187	-27.30	-8.81	28.69
					1200	2.91	-0.24	2.92
1147	1.07	4.71	6.26	1.82				
					1118	15.04	39.00	41.80
1148	1.12	6.64	0.00	0.00				
					1149	-27.94	-64.97	70.72
					1173	26.06	62.97	68.15
1149	1.14	6.89	1.12	0.33				
					1141	67.33	69.40	96.69
					1148	28.17	66.16	71.90
					1171	5.38	1.17	5.50
					1177	33.80	28.04	43.92
					1218	-30.42	-43.08	52.74
					1232	-106.11	-26.27	109.32
1150	1.30	4.27	13.91	4.06				
					1130	-8.75	24.69	26.19
					1154	-8.65	15.12	17.42
1151	1.31	8.64	25.22	7.35				
					1143	-64.20	66.19	92.21
					1187	33.50	8.89	34.66
					1196	4.74	0.06	4.75
1152	1.05	5.67	22.88	6.67				
					1184	32.22	12.30	34.49
					1204	-72.51	-30.31	78.59
1153	1.08	5.07	0.00	0.00				
					1118	27.10	19.61	33.45
					1176	-32.39	-22.88	39.66
					3103	1.88	-0.28	1.90
1154	1.29	4.37	0.00	0.00				
					1107	-13.94	16.61	21.69
					1150	8.66	-15.16	17.46
					3104	7.57	0.60	7.59
1155	1.24	14.83	4.30	1.25				
					1099	-92.06	-42.59	101.44
					1100	-91.97	-96.74	133.48
					1101	-92.08	-12.50	92.92
					1135	71.62	91.43	116.14
					1143	77.66	-51.51	93.19
					1158	39.77	-16.43	43.03
					1234	72.93	-88.58	114.74
1156	1.41	2.44	14.57	4.25				
					1112	-11.02	18.86	21.84
					1205	-4.01	32.24	32.49

1157 1.28 6.38 28.67 8.36

1158 1.24 13.46 2.99 0.87

1159 1.08 5.21 0.00 0.00

1160 1.22 5.04 0.00 0.00

1161 1.11 6.10 0.00 0.00

1162 1.38 3.46 0.00 0.00

1163 1.07 5.67 0.00 0.00

1164 1.04 4.99 18.30 5.34

1165 1.04 5.16 5.42 1.58

1166 1.04 4.99 3.27 0.95

1167 1.10 6.13 0.19 0.05

1168 1.10 6.15 0.00 0.00

1169 1.07 6.54 8.31 2.42

1170 1.08 6.62 0.00 0.00

1171 1.14 6.82 6.26 1.82

1172 1.05 5.56 1.40 0.41

1107 28.08 -13.33 31.09
1120 4.87 -0.10 4.87
1131 11.52 2.45 11.78
1140 12.29 6.88 14.08
1145 -18.21 -4.46 18.75
1182 -59.49 171.26 181.30

1138 37.36 -15.81 40.57
1155 -39.53 16.97 43.02

1176 -7.00 -2.87 7.56

1129 -39.89 -62.20 73.89
1193 33.50 60.16 68.86
3105 4.54 0.32 4.55

1109 -1.16 2.21 2.49
3106 3.05 0.82 3.16

1111 8.96 0.64 8.99
1112 -8.21 -1.33 8.32
3195 1.61 0.06 1.61

1168 -52.39 -60.12 79.74
1172 49.04 58.71 76.50

1179 -53.37 -9.41 54.19

1181 -18.61 -6.01 19.56

1183 -77.97 -64.14 100.97

1168 -6.20 -2.00 6.51

1141 -54.24 -61.84 82.25
1163 53.27 62.02 81.75
1167 6.20 1.98 6.50

1170 -10.20 -3.14 10.67

1115 99.49 48.90 110.85
1133 -102.29 -47.28 112.69
1169 10.21 3.07 10.66

1149 -5.38 -1.31 5.54

1163 -48.20 -57.77 75.23
1209 8.69 9.09 12.58

1173 1.08 6.26 0.00 0.00

1174 1.05 5.51 4.02 1.17

1175 1.12 3.75 4.86 1.42

1176 1.08 5.23 0.00 0.00

1177 1.10 5.01 12.79 3.73

1179 1.04 5.01 0.00 0.00

1181 1.05 5.18 0.00 0.00

1182 1.21 8.50 3.83 1.12

1183 1.04 5.00 0.00 0.00

1184 1.05 5.62 0.00 0.00

1187 1.30 7.42 7.47 2.18

1188 1.05 5.55 0.00 0.00

1189 1.32 4.70 10.27 3.00

1190 1.39 3.66 31.75 9.26

1128 59.82 48.92 77.27

1133 -24.76 19.45 31.49

1148 -25.64 -61.03 66.20

1188 -8.93 -2.58 9.30

1139 -39.55 14.43 42.10

1193 19.93 -20.79 28.80

3107 1.80 1.45 2.31

1153 32.41 22.96 39.72

1159 6.99 2.85 7.55

1201 -67.43 -76.61 102.06

1117 21.45 23.69 31.96

1149 -33.45 -26.60 42.74

1164 53.40 9.43 54.22

1181 -80.17 -39.26 89.27

1183 21.01 20.64 29.45

1115 -86.16 -41.13 95.47

1165 18.62 6.02 19.57

1179 80.47 39.69 89.72

1142 43.43 80.68 91.63

1157 61.87 -159.24 170.84

1235 -110.17 49.12 120.62

1166 77.98 64.19 101.00

1179 -21.00 -20.62 29.44

1152 -32.21 -12.27 34.47

1188 33.82 16.16 37.48

1145 27.32 8.76 28.69

1151 -33.39 -8.76 34.52

1174 8.94 2.57 9.30

1184 -33.78 -16.17 37.45

1209 -6.51 -32.61 33.26

1129 -26.21 120.35 123.17

1190 -2.78 -89.05 89.09

1203 17.91 -34.17 38.57

1144 -5.47 11.02 12.30

1189 4.47 93.04 93.15

1192	1.11	6.39	0.00	0.00	3332	-18.75	-26.34	32.33
					1109	8.22	5.10	9.67
					1139	41.28	-11.71	42.91
					1201	48.78	45.34	66.60
					1237	-100.34	-72.03	123.52
1193	1.12	3.48	0.00	0.00	1160	-32.52	-55.51	64.34
					1175	-19.92	20.81	28.81
					1194	-59.83	-48.39	76.95
1194	1.12	3.49	8.31	2.42	1193	59.84	48.41	76.97
1195	1.07	6.06	0.00	0.00	1126	77.92	76.37	109.11
					1127	-28.25	-29.07	40.53
1196	1.31	8.42	5.04	1.47	1151	-4.75	-0.69	4.80
1197	1.10	6.71	13.07	3.81	1142	-7.68	-1.37	7.80
1200	1.29	7.04	3.36	0.98	1145	-2.98	-0.35	3.00
1201	1.08	5.26	0.00	0.00	1176	67.43	76.70	102.13
					1192	-48.38	-43.48	65.05
					1202	-3.20	-0.56	3.25
1202	1.08	5.27	0.00	0.00	1201	3.20	0.54	3.24
1203	1.37	3.07	0.00	0.00	1189	-17.79	34.46	38.78
					1205	6.24	-32.48	33.08
					3197	-6.52	3.88	7.58
1204	1.08	7.30	0.00	0.00	1121	21.08	-22.63	30.93
					1136	20.69	9.45	22.74
					1152	73.90	33.13	80.99
					1239	-114.94	-69.45	134.29
1205	1.38	2.90	0.00	0.00	1156	4.06	-32.36	32.61
					1203	-6.22	32.45	33.05
					1206	0.71	-0.73	1.02
1206	1.38	2.89	2.34	0.68	1205	-0.73	0.54	0.91
1209	1.05	5.55	0.00	0.00	1172	-8.69	-9.09	12.58
					1188	6.51	32.62	33.27
					1210	-44.84	-43.66	62.58
1210	1.05	5.56	11.67	3.40	1209	44.84	43.68	62.60
1213	1.28	6.12	0.00	0.00				

					1097	-2.02	-44.01	44.06
					1129	10.63	27.63	29.60
					1217	-6.51	72.93	73.22
1217	1.20	7.77	5.04	1.47				
					1213	7.92	-70.66	71.11
					1218	-14.04	69.81	71.21
1218	1.19	8.26	0.00	0.00				
					1149	30.55	45.54	54.84
					1217	14.50	-68.94	70.45
					1219	22.67	5.87	23.42
					1221	4.96	1.00	5.06
					1232	-82.43	70.07	108.19
1219	1.18	8.18	25.31	7.38				
					1218	-22.65	-6.06	23.45
1220	1.19	8.22	3.36	0.98				
					1221	-12.99	-9.20	15.92
1221	1.19	8.24	0.00	0.00				
					1218	-4.97	-1.25	5.13
					1220	12.97	9.07	15.83
1229	1.16	18.66	0.00	0.00				
					976	125.03	70.50	143.53
					1248	-460.26	36.27	461.69
					2201	339.18	-66.28	345.59
1230	1.13	11.58	0.00	0.00				
					1133	138.04	80.15	159.63
					1232	264.83	-315.19	411.68
					1609	-78.57	363.24	371.64
					2201	-331.23	-109.69	348.92
1231	1.25	15.41	0.00	0.00				
					1233	-253.84	-163.52	301.95
					1235	250.87	155.82	295.32
1232	1.16	9.92	0.00	0.00				
					1149	106.38	32.40	111.21
					1218	82.59	-66.19	105.84
					1230	-262.89	323.83	417.11
					1235	-136.84	-86.91	162.11
					1236	110.44	-178.27	209.70
					1237	97.30	25.87	100.68
1233	1.28	16.83	3.92	1.14				
					467	-258.22	-154.62	300.98
					1231	254.78	163.40	302.68
					2900	-1.03	-12.20	12.24
1234	1.26	13.81	0.00	0.00				
					1155	-72.76	91.65	117.02
					1235	165.98	180.65	245.33
					1381	-87.14	-108.79	139.39
1235	1.19	11.43	0.00	0.00				
					1182	110.46	-42.62	118.40
					1231	-248.75	-153.29	292.19

						1232	135.97	75.66	155.61
						1234	-165.27	-187.71	250.09
						1644	165.07	332.81	371.50
1236	1.21	7.82	0.00	0.00					
						1129	111.66	-145.07	183.06
						1232	-111.54	167.76	201.45
1237	1.15	8.51	0.00	0.00					
						1192	100.59	78.00	127.28
						1232	-99.36	-42.99	108.26
1239	1.14	11.02	0.00	0.00					
						1204	115.53	80.48	140.80
						1609	-96.83	156.54	184.06
						1644	-19.73	-187.73	188.76
1247	1.16	22.36	0.00	0.00					
						982	-437.07	-83.41	444.96
						1248	482.14	-49.81	484.71
1248	1.16	22.25	0.00	0.00					
						1229	461.87	-7.37	461.93
						1247	-481.97	50.69	484.63
1261	1.32	13.41	0.00	0.00					
						1318	-0.04	-0.27	0.28
1262	1.45	18.56	0.00	0.00					
						1385	51.51	85.36	99.70
1263	1.50	18.44	0.00	0.00					
						1385	51.77	152.75	161.29
1264	1.45	18.57	0.00	0.00					
						1386	51.51	82.45	97.22
1265	1.53	18.36	0.00	0.00					
						1386	51.96	198.42	205.11
1266	1.39	18.67	0.00	0.00					
						1387	47.13	3.02	47.23
1267	1.52	18.37	0.00	0.00					
						1387	51.93	197.26	203.98
1268	1.12	9.76	5.42	1.58					
						1323	-6.09	-2.65	6.64
1269	1.75	17.09	0.00	0.00					
						1327	23.89	212.37	213.71
1270	1.60	18.80	0.00	0.00					
						1365	78.50	181.95	198.16
1271	1.66	18.73	0.00	0.00					
						1365	79.60	275.00	286.29
1272	1.50	15.96	0.00	0.00					
						1327	0.17	7.78	7.79
1273	1.56	17.18	0.00	0.00					
						1365	5.46	121.10	121.22
1274	1.13	9.97	0.00	0.00					
						1275	-65.84	-116.88	134.15
						1323	-141.35	-215.72	257.91
						1390	-31.39	-64.99	72.17

1275	1.13	9.98	5.51	1.61
1276	1.10	10.13	0.00	0.00
1277	1.23	11.61	0.00	0.00
1278	1.23	11.47	10.74	3.13
1279	1.15	15.51	0.00	0.00
1280	1.18	11.13	1.77	0.52
1281	1.37	13.47	53.33	15.55
1282	1.27	11.41	26.05	7.60
1283	1.34	15.30	10.93	3.19
1284	1.21	11.16	47.81	13.95
1285	1.33	12.82	8.03	2.34
1286	1.20	11.37	10.18	2.97
1287	1.37	13.17	51.18	14.93
1288	1.17	10.71	34.37	10.02
1289	1.16	14.25	18.12	5.28

1274	65.86	116.95	134.22
1346	-127.78	-157.20	202.58
1278	10.06	1.06	10.12
1340	-21.66	-120.56	122.49
1341	-8.88	-14.03	16.61
1277	-10.04	-1.20	10.11
1289	31.52	-19.07	36.84
1299	26.15	30.56	40.22
1372	-67.81	-130.51	147.07
3079	5.03	17.34	18.06
1286	-68.00	-94.31	116.27
1324	-2.45	-2.62	3.59
1345	63.19	89.66	109.69
1287	18.11	-8.62	20.05
1307	-40.20	35.78	53.82
1308	71.61	11.63	72.55
1311	-45.18	35.67	57.57
1321	49.63	53.20	72.75
1384	-112.25	39.62	119.03
1317	-19.92	12.16	23.33
1338	-23.57	22.51	32.59
1355	15.57	19.93	25.29
3029	-18.62	-16.08	24.60
1324	6.81	34.33	35.00
1331	-56.09	1.49	56.11
1298	-5.90	-25.92	26.58
1347	-4.33	17.55	18.08
1280	69.16	95.35	117.79
1302	-78.64	-98.33	125.91
1281	-18.06	8.40	19.92
1303	-4.20	20.56	20.98
1336	-29.88	30.60	42.77
1331	-104.70	-102.13	146.26
1351	65.20	82.14	104.87

					1279	-31.31	19.46	36.86
					1290	12.51	-27.15	29.89
1290	1.17	14.01	0.00	0.00				
					1289	-12.45	27.19	29.91
					1326	44.22	-8.28	44.99
					1332	38.06	-51.93	64.39
					1374	-109.78	-137.25	175.75
					3081	33.69	20.21	39.29
1291	1.23	11.57	23.25	6.78				
					1310	-48.08	-83.18	96.07
					1316	22.99	72.13	75.71
1292	1.40	15.48	37.73	11.00				
					1293	-28.67	95.57	99.77
					1294	-9.80	-50.76	51.70
1293	1.37	16.21	0.00	0.00				
					1292	29.24	-93.31	97.79
					1322	41.28	17.37	44.78
					1360	-21.66	-195.28	196.48
					1373	-81.40	-4.59	81.53
					3029	17.71	7.92	19.40
1294	1.45	15.47	44.64	13.02				
					1292	10.33	51.64	52.66
					1327	-55.77	-67.79	87.78
1295	1.32	11.77	44.27	12.91				
					1321	-46.38	-15.29	48.83
					1335	9.43	-50.15	51.03
					1338	-9.79	117.55	117.96
1296	1.22	12.81	18.49	5.39				
					1297	-2.86	-40.51	40.61
					1305	-4.14	67.11	67.24
					1328	-13.11	-38.93	41.07
1297	1.23	12.75	21.11	6.16				
					1296	2.94	40.64	40.75
					1309	34.54	-35.54	49.56
					1343	-58.88	-11.77	60.04
1298	1.34	12.83	23.72	6.92				
					1285	5.96	25.83	26.50
					1314	4.68	-23.25	23.72
					1336	-34.59	-10.12	36.04
1299	1.08	14.95	5.14	1.50				
					1279	-24.70	-29.01	38.10
					3077	-21.36	-38.91	44.39
1300	1.15	13.94	0.00	0.00				
					1306	-11.30	-10.86	15.67
					3078	0.33	-8.94	8.95
					3087	4.86	0.57	4.90
1301	1.13	15.94	2.89	0.84				
					1356	-2.38	14.73	14.92
					3079	-0.62	-17.24	17.25

1302	1.25	12.33	18.21	5.31	
					1138 -23.80 24.60 34.23
					1286 79.98 103.20 130.56
					1304 24.17 37.70 44.79
					1342 -100.73 -75.37 125.81
1303	1.36	13.35	27.92	8.14	
					1287 4.27 -20.80 21.23
					1336 -32.86 10.82 34.59
1304	1.23	12.00	27.36	7.98	
					1302 -24.01 -37.34 44.39
					1331 -3.43 28.99 29.20
1305	1.18	13.27	13.91	4.06	
					1296 4.55 -65.52 65.67
					1306 -18.17 60.83 63.48
1306	1.16	14.02	0.00	0.00	
					845 -30.00 54.97 62.63
					1300 11.38 10.77 15.67
					1305 18.53 -59.53 62.35
1307	1.36	13.94	6.07	1.77	
					1281 40.32 -35.46 53.69
					1311 -47.57 29.34 55.89
1308	1.35	11.79	53.51	15.61	
					1281 -71.18 -9.80 71.85
					1321 -20.14 54.29 57.90
					1335 36.14 11.16 37.82
1309	1.24	11.84	12.98	3.79	
					1297 -34.32 36.11 49.82
					1341 18.79 19.37 26.99
1310	1.27	12.24	23.72	6.92	
					1291 48.71 86.24 99.05
					1318 -72.68 -93.96 118.79
1311	1.36	14.31	39.32	11.47	
					1281 45.39 -35.07 57.36
					1307 47.65 -29.09 55.83
					1337 35.24 -29.52 45.97
					1378 -183.52 -227.05 291.95
1312	1.25	11.51	27.83	8.12	
					1334 4.19 73.56 73.68
					1338 -42.82 -7.65 43.49
					1355 8.63 -15.13 17.42
1313	1.11	16.20	0.00	0.00	
					889 0.19 -13.57 13.58
					1356 34.86 -51.45 62.15
1314	1.37	12.44	14.29	4.17	
					1298 -4.59 22.82 23.27
					1337 -10.40 -28.86 30.67
1315	1.30	13.52	52.67	15.36	
					1317 48.76 29.15 56.81
					1321 54.96 -81.83 98.57

1316	1.19	11.35	19.80	5.78	1379	-167.46	-262.02	310.96
					1291	-22.50	-70.15	73.67
					1320	1.65	62.09	62.11
1317	1.27	11.87	9.15	2.67	1282	19.99	-12.31	23.48
					1315	-48.31	-27.75	55.71
					1339	19.32	37.70	42.36
1318	1.32	13.42	38.66	11.28	1261	0.04	0.27	0.28
					1310	73.77	99.11	123.55
					1330	2.58	-1.89	3.20
					1347	21.82	-12.99	25.40
					1380	-139.24	-133.66	193.01
1320	1.17	11.49	39.60	11.55	1316	-1.47	-61.40	61.42
					1323	105.80	112.98	154.78
					1389	-148.76	-261.60	300.94
1321	1.33	12.44	38.76	11.30	1281	-49.13	-51.25	70.99
					1295	46.52	15.69	49.10
					1308	20.41	-53.37	57.14
					1315	-54.44	84.23	100.29
1322	1.35	15.77	0.00	0.00	1293	-40.92	-17.06	44.33
					1349	36.47	13.72	38.96
					3085	-1.01	-5.09	5.19
1323	1.13	9.99	29.14	8.50	1268	6.08	2.37	6.53
					1274	141.40	215.98	258.15
					1320	-104.57	-106.12	148.98
					2909	-0.66	-1.29	1.45
1324	1.18	11.18	28.86	8.42	1280	2.51	1.76	3.07
					1284	-6.58	-34.03	34.66
					1353	-24.82	23.23	34.00
1325	1.17	13.45	1.77	0.52	1326	-14.84	-7.35	16.56
1326	1.17	13.45	0.00	0.00	1290	-44.13	8.52	44.95
					1325	14.85	7.33	16.56
					1353	37.25	-10.73	38.76
1327	1.48	15.96	9.81	2.86	1269	-23.62	-178.37	179.93
					1272	-0.17	-7.68	7.68
					1294	56.13	69.09	89.01
					1365	-46.44	-18.94	50.15
1328	1.25	12.61	11.86	3.46	1296	13.58	39.49	41.76

1329	1.26	12.83	0.00	0.00	1329	-27.22	-8.94	28.65
					1328	27.31	8.98	28.75
					1349	-34.66	-14.98	37.76
1330	1.32	12.95	2.52	0.74	3088	0.62	-3.48	3.53
					1318	-2.38	-0.45	2.42
1331	1.22	12.24	6.44	1.88	1284	56.31	-0.77	56.32
					1288	105.95	108.73	151.81
					1304	3.53	-29.07	29.28
					1338	-35.54	-98.96	105.14
					1381	-140.24	-176.87	225.72
1332	1.21	11.77	33.43	9.75	1290	-37.31	54.80	66.30
					1334	-0.26	-75.44	75.44
1333	1.22	11.69	3.64	1.06	1334	-11.24	-10.72	15.53
1334	1.22	11.71	0.00	0.00	1312	-3.84	-72.22	72.32
					1332	0.34	75.79	75.79
					1333	11.25	10.71	15.53
1335	1.35	11.31	46.41	13.54	1295	-9.21	50.88	51.71
					1308	-36.07	-11.02	37.71
1336	1.36	13.86	0.00	0.00	1287	30.02	-30.37	42.70
					1298	34.76	10.17	36.22
					1303	32.95	-10.82	34.68
					1382	-101.86	-90.60	136.33
1337	1.38	12.53	25.22	7.35	1311	-34.89	30.34	46.24
					1314	10.46	28.74	30.59
1338	1.26	12.53	19.89	5.80	1282	23.74	-22.42	32.65
					1295	10.86	-112.33	112.85
					1312	42.98	8.09	43.73
					1331	36.20	101.22	107.50
					1383	-141.93	-195.36	241.47
1339	1.25	11.58	14.19	4.14	1317	-19.12	-37.35	41.96
					1340	4.57	32.24	32.56
1340	1.23	11.62	2.15	0.63	1277	21.66	120.66	122.59
					1339	-4.48	-32.15	32.46
					1341	-8.08	-12.28	14.70
1341	1.24	11.76	0.00	0.00	1277	8.94	13.78	16.43
					1309	-18.77	-19.39	26.99

					1340	8.12	11.96	14.46
					3082	3.32	0.48	3.35
1342	1.26	12.83	0.00	0.00				
					1302	101.05	76.91	126.99
					3353	-99.97	-74.54	124.69
1343	1.25	15.35	0.00	0.00				
					1297	59.50	14.15	61.15
					1388	-70.37	-219.46	230.47
1344	1.10	10.15	8.12	2.37				
					1137	-40.70	-24.10	47.30
					1346	-15.19	-69.12	70.77
1345	1.15	10.54	24.56	7.16				
					1280	-62.33	-86.74	106.81
					1346	37.52	79.75	88.14
1346	1.10	10.15	0.00	0.00				
					1276	127.81	157.37	202.73
					1344	15.19	69.17	70.81
					1345	-36.56	-76.63	84.91
1347	1.33	12.95	0.00	0.00				
					1285	4.38	-17.78	18.31
					1318	-21.74	12.81	25.23
					1348	15.06	-0.35	15.06
1348	1.33	12.86	17.18	5.01				
					1347	-15.05	0.26	15.05
1349	1.26	13.02	0.00	0.00				
					1322	-34.66	-12.53	36.86
					1329	34.80	15.10	37.94
					3093	1.16	-0.82	1.42
1350	1.13	11.76	0.00	0.00				
					1137	30.50	20.96	37.01
					3081	-31.87	-20.18	37.72
					3092	1.56	-0.56	1.66
1351	1.16	10.43	15.04	4.39				
					1288	-64.96	-81.09	103.90
					1390	44.69	68.65	81.91
1353	1.17	11.79	0.00	0.00				
					1324	24.92	-23.12	33.99
					1326	-37.06	11.18	38.71
					1354	-5.19	-16.52	17.32
1354	1.17	11.79	5.70	1.66				
					1353	5.19	16.50	17.30
1355	1.26	11.09	24.75	7.22				
					1282	-15.50	-20.09	25.37
					1312	-8.61	14.73	17.06
1356	1.11	16.18	11.11	3.24				
					1301	2.45	-15.04	15.24
					1313	-34.86	51.48	62.17
1357	1.49	17.11	17.56	5.12				
					1365	-19.84	-16.75	25.96

1359	1.47	16.28	43.89	12.80	
					388 -36.93 -23.57 43.81
					1364 -6.86 10.24 12.32
1360	1.46	16.43	0.00	0.00	
					1293 22.25 207.97 209.16
					1363 -18.48 -41.96 45.85
1361	1.41	16.68	15.13	4.41	
					1362 45.48 144.59 151.57
					1365 -63.47 -159.52 171.68
1362	1.39	16.62	0.00	0.00	
					1361 -45.00 -143.21 150.11
					1378 35.97 -97.80 104.20
1363	1.47	16.45	20.26	5.91	
					1360 18.40 40.92 44.86
					1364 13.19 -19.98 23.94
					1365 -54.27 -36.38 65.33
1364	1.47	16.37	8.12	2.37	
					1359 6.68 -11.91 13.66
					1363 -13.52 18.79 23.15
1365	1.49	17.18	0.00	0.00	
					422 -38.93 -50.64 63.88
					1270 -77.79 -167.14 184.36
					1271 -78.21 -245.29 257.45
					1273 -5.23 -116.00 116.12
					1327 46.49 20.13 50.66
					1357 19.70 15.70 25.19
					1361 65.44 166.43 178.83
					1363 53.74 34.03 63.61
1372	1.23	17.07	0.00	0.00	
					969 -256.57 205.45 328.69
					1279 68.28 140.61 156.31
					1381 184.93 -247.29 308.79
1373	1.37	17.47	0.00	0.00	
					972 -175.57 282.03 332.21
					1293 81.50 6.40 81.75
					1375 89.55 -163.46 186.38
1374	1.24	16.36	0.00	0.00	
					969 -287.28 238.43 373.34
					1290 110.20 150.03 186.15
					1381 172.00 -244.24 298.72
1375	1.39	17.01	0.00	0.00	
					1373 -93.57 152.19 178.66
					1378 118.02 -188.46 222.36
					1384 246.27 142.70 284.62
					1385 -93.07 -61.39 111.49
					1386 -92.93 -97.21 134.48
					1387 -90.86 -21.42 93.35
1376	1.38	15.37	55.19	16.10	
					1378 -334.64 -439.83 552.66

1378	1.42	16.09	0.00	0.00	1379	265.63	374.57	459.19
					469	-417.98	-511.90	660.87
					1311	184.40	243.27	305.26
					1362	-35.86	100.37	106.58
					1375	-123.21	171.93	211.52
					1376	335.40	446.70	558.61
					1382	79.32	118.90	142.92
1379	1.36	15.08	0.00	0.00	1315	168.00	279.37	326.00
					1376	-265.59	-372.87	457.79
					1383	224.21	483.84	533.27
					1388	-118.91	322.32	343.55
1380	1.39	16.08	0.00	0.00	1318	139.87	147.33	203.15
					1382	64.17	-167.82	179.67
					2026	-209.37	317.29	380.15
1381	1.29	14.55	0.00	0.00	1234	84.10	92.53	125.04
					1331	140.56	192.78	238.59
					1372	-190.15	240.33	306.46
					1374	-177.67	235.94	295.36
					1383	-56.65	-593.31	596.01
					2021	174.30	-50.18	181.38
1382	1.40	15.84	51.74	15.09	1336	102.15	97.37	141.13
					1378	-81.63	-128.37	152.12
					1380	-65.80	161.71	174.58
1383	1.33	14.52	0.00	0.00	1338	142.63	211.38	255.00
					1379	-224.67	-476.34	526.67
					1381	56.78	604.60	607.26
					1384	-138.95	-210.25	252.01
					2020	160.70	60.59	171.74
1384	1.35	15.09	0.00	0.00	1281	112.40	-36.12	118.06
					1375	-251.65	-155.97	296.07
					1383	136.07	201.39	243.05
1385	1.39	17.23	0.00	0.00	1262	-51.28	-80.67	95.59
					1263	-51.22	-141.18	150.18
					1375	93.07	61.90	111.78
1386	1.39	17.23	0.00	0.00	1264	-51.29	-77.99	93.35
					1265	-51.10	-180.43	187.52
					1375	92.93	97.96	135.03
1387	1.39	17.22	0.00	0.00	1266	-49.19	-1.91	49.22
					1267	-51.07	-179.35	186.48

1388	1.32	16.07	0.00	0.00	1375	90.86	21.78	93.43
					969	-182.41	313.12	362.38
					1343	71.01	231.45	242.09
					1379	115.72	-327.82	347.65
1389	1.28	14.06	0.00	0.00	1320	149.38	292.50	328.43
					2021	-149.19	-89.08	173.76
1390	1.15	10.34	0.00	0.00	1274	31.66	66.48	73.63
					1351	-44.60	-68.30	81.58
					1391	-7.70	-10.29	12.85
1391	1.15	10.34	7.84	2.29	1390	7.70	10.29	12.85
1395	1.06	5.82	1.49	0.44	852	-24.86	-2.25	24.96
					3326	-28.23	-0.56	28.24
1396	1.24	22.11	2.34	0.68	842	37.05	-12.74	39.18
					3327	66.67	-15.85	68.53
1397	1.12	6.60	5.60	1.63	1141	-2.65	-1.33	2.96
1401	1.27	20.98	0.00	0.00	1542	366.41	328.05	491.80
1402	1.23	20.23	0.00	0.00	1542	219.99	27.81	221.74
1403	1.25	21.35	0.00	0.00	1542	379.90	121.11	398.74
1407	1.14	23.32	0.00	0.00	1509	99.92	18.90	101.69
1408	1.24	22.61	0.00	0.00	1509	99.90	99.32	140.87
1409	1.13	20.63	0.00	0.00	1509	149.77	5.09	149.85
1410	1.19	21.62	0.00	0.00	1508	169.56	154.22	229.20
1411	1.05	22.23	0.00	0.00	1508	218.67	-154.17	267.56
1412	1.16	20.66	0.00	0.00	1508	354.08	254.11	435.83
1414	1.14	15.88	3.08	0.90	1494	35.37	15.84	38.76
1415	1.31	13.88	0.00	0.00	1494	24.84	102.71	105.67
1416	1.17	14.18	0.00	0.00	1493	35.82	19.29	40.69
1417	1.23	14.08	0.00	0.00	1493	59.70	99.26	115.83
1418	1.02	10.67	13.27	3.87				

					1435 -53.53 -49.61 72.99
					1674 -9.43 -10.87 14.39
1421	1.02	9.90	23.75	6.93	
					1430 7.53 -5.55 9.35
					1435 -32.83 -3.14 32.98
1422	1.06	13.65	12.25	3.57	
					1426 -5.14 -3.03 5.97
					1429 -7.66 -1.63 7.83
1423	1.05	12.11	12.92	3.77	
					1427 -81.10 -23.60 84.46
					1428 67.02 18.05 69.41
1424	1.06	13.23	25.36	7.40	
					1427 -93.49 -30.03 98.19
					1436 66.78 20.20 69.77
1425	1.09	19.00	0.00	0.00	
					804 -786.13 44.15 787.37
					1427 174.47 39.73 178.94
					1483 221.84 -250.11 334.31
					1664 176.41 17.97 177.32
					1744 208.39 70.34 219.95
1426	1.06	13.84	0.00	0.00	
					1422 5.00 2.49 5.59
					1675 81.72 31.11 87.44
					1744 -115.17 -91.94 147.37
1427	1.07	14.22	0.00	0.00	
					1423 81.56 26.68 85.81
					1424 93.76 31.76 98.99
					1425 -174.15 -24.63 175.88
1428	1.04	11.31	53.68	15.66	
					1423 -66.90 -17.17 69.07
					1467 12.89 1.41 12.96
1429	1.06	13.83	6.18	1.80	
					1422 7.59 1.34 7.71
					1654 -13.88 -3.30 14.27
1430	1.02	9.78	17.45	5.09	
					1421 -7.59 5.38 9.30
					1520 -10.05 -10.64 14.64
1431	1.05	9.81	0.00	0.00	
					1449 116.53 49.69 126.69
					1453 -16.69 -72.81 74.70
					1476 -108.74 -15.97 109.91
					1477 -93.38 -54.81 108.28
					1478 29.83 49.63 57.91
1432	1.04	9.80	29.74	8.68	
					1434 20.17 -22.63 30.32
					1633 -52.80 11.63 54.06
1433	1.04	11.30	14.60	4.26	
					1436 -67.07 -19.08 69.73
					1438 50.28 12.23 51.75

1434 1.04 9.59 10.68 3.12

1435 1.02 10.68 11.66 3.40

1436 1.05 12.40 0.00 0.00

1437 1.04 11.76 25.50 7.44

1438 1.04 10.90 11.31 3.30

1439 1.06 12.61 14.22 4.15

1440 1.06 12.64 0.00 0.00

1441 1.03 8.17 12.36 3.60

1442 1.02 6.95 16.96 4.95

1443 1.02 6.96 0.00 0.00

1444 1.02 6.99 0.00 0.00

1445 1.05 11.31 0.00 0.00

1446 1.02 7.36 23.98 6.99

1447 1.08 9.89 12.15 3.54

1448 1.04 8.95 0.00 0.00

1432 -20.17 22.66 30.34

1478 -54.13 -75.86 93.19

1418 53.53 49.64 73.01

1421 32.80 3.28 32.97

1675 -69.32 -23.83 73.30

1424 -66.56 -19.24 69.28

1433 67.29 20.32 70.29

1633 44.44 5.13 44.74

1676 -71.68 -15.08 73.25

1433 -50.22 -11.94 51.62

1633 -9.10 -46.37 47.26

1440 -29.83 -10.92 31.76

1439 29.41 9.54 30.91

1476 105.67 24.94 108.58

1484 -156.14 -53.24 164.97

1562 36.40 17.56 40.41

1678 -52.46 -23.11 57.32

1443 -8.84 -3.39 9.47

1444 -46.66 -5.70 47.01

1442 8.84 3.38 9.46

1444 -55.51 -27.28 61.85

1452 6.48 6.17 8.95

1442 46.43 5.16 46.72

1443 55.52 27.30 61.87

1549 -61.52 -21.83 65.28

1446 99.75 34.35 105.50

1745 -101.83 -39.75 109.31

1445 -99.22 -26.68 102.74

1451 22.37 4.36 22.79

1567 13.41 2.61 13.66

1453 25.69 75.90 80.13

1500 -114.75 -132.19 175.05

1454 -66.09 -30.42 72.76

1678 56.71 24.34 61.71

1449	1.02	7.51	14.38	4.20				
					1431	-115.23	-43.98	123.34
					1549	23.26	1.64	23.32
1450	1.02	7.18	7.14	2.08				
					1562	-37.97	-17.84	41.95
					1567	-48.35	-20.78	52.63
1451	1.02	7.35	0.00	0.00				
					1446	-22.37	-4.36	22.79
					1456	40.75	12.00	42.48
1452	1.02	6.90	10.48	3.06				
					1443	-6.51	-6.29	9.05
					1568	-82.21	-30.51	87.69
1453	1.07	9.80	11.24	3.28				
					1431	16.91	73.70	75.62
					1447	-25.58	-75.22	79.45
1454	1.04	9.11	12.01	3.50				
					1448	66.13	30.64	72.89
					1477	-75.71	-32.60	82.43
1455	1.08	17.74	0.00	0.00				
					1508	17.44	-99.75	101.26
					1664	-23.66	49.40	54.77
1456	1.02	7.17	0.00	0.00				
					1451	-40.72	-11.90	42.42
					1568	40.06	11.51	41.69
1457	1.06	14.42	0.00	0.00				
					730	-8.26	9.49	12.59
					1654	7.88	-10.31	12.97
1458	1.03	12.09	17.75	5.18				
					1470	62.63	33.74	71.14
					1654	-81.31	-40.39	90.79
1459	1.05	13.70	2.01	0.58				
					1654	-59.77	-29.59	66.69
					1660	56.82	27.01	62.91
1461	1.02	10.90	27.82	8.11				
					1472	46.55	46.69	65.93
					1596	-76.41	-57.00	95.33
1462	0.99	10.37	0.00	0.00				
					1463	7.82	40.40	41.15
					1469	-37.64	-72.92	82.06
1463	0.98	10.35	20.04	5.85				
					1462	-7.78	-40.18	40.92
					1590	-12.02	34.74	36.76
1464	1.09	11.18	13.94	4.07				
					1494	-124.36	-77.31	146.43
					1655	30.00	14.35	33.25
1465	1.01	10.22	13.93	4.06				
					1473	-12.87	-33.30	35.71
					1630	-5.36	24.21	24.79
1466	1.07	13.24	0.00	0.00				

					1467	98.27	76.06	124.27
					1501	-27.02	-58.16	64.14
					1509	-118.77	-64.25	135.03
1467	1.04	11.09	17.64	5.14				
					1428	-12.92	-1.57	13.01
					1466	-98.24	-70.32	120.82
					1481	51.70	46.33	69.42
					1520	41.23	19.84	45.75
1468	1.04	11.24	15.09	4.40				
					1501	-95.59	-89.06	130.65
					1674	20.04	13.01	23.89
					1747	56.39	-9.99	57.27
1469	0.99	10.38	0.00	0.00				
					1462	37.65	72.97	82.11
					1663	-21.19	-55.08	59.02
1470	1.02	11.09	14.17	4.13				
					1458	-62.38	-32.42	70.31
					1471	47.36	27.50	54.76
1471	1.01	10.60	13.83	4.03				
					1470	-47.22	-26.99	54.39
					1663	-15.48	-31.75	35.32
1472	1.01	10.58	13.06	3.81				
					1461	-46.45	-46.15	65.48
					1746	-16.80	-11.72	20.49
1473	1.02	10.30	23.97	6.99				
					1465	12.91	33.45	35.86
					1481	-40.28	-43.80	59.51
1475	1.06	12.34	0.00	0.00				
					1477	107.07	21.36	109.18
					1484	-111.31	-31.94	115.80
1476	1.06	12.39	0.00	0.00				
					1431	108.90	21.04	110.91
					1440	-105.64	-24.94	108.54
1477	1.05	9.83	0.00	0.00				
					1431	93.39	54.86	108.32
					1454	75.92	33.69	83.06
					1475	-106.94	-16.51	108.21
					1482	3.15	40.63	40.75
					1485	1.74	-13.79	13.90
					1486	-28.60	-65.48	71.45
1478	1.04	9.60	15.41	4.49				
					1431	-29.70	-49.09	57.38
					1434	54.14	75.90	93.23
1479	1.07	10.27	14.03	4.09				
					1655	-62.97	-43.85	76.74
					1726	46.47	37.94	59.99
1481	1.03	10.40	13.98	4.08				
					1467	-51.37	-45.10	68.36
					1473	40.33	43.98	59.67

1482 1.04 9.91 9.29 2.71

1483 1.12 17.54 0.00 0.00

1484 1.07 12.71 0.00 0.00

1485 1.06 9.71 14.60 4.26

1486 1.07 10.03 12.02 3.50

1488 1.09 10.07 24.83 7.24

1489 1.09 10.42 23.86 6.96

1490 1.10 10.69 9.02 2.63

1491 1.09 10.24 25.14 7.33

1492 1.12 15.81 0.00 0.00

1493 1.14 11.68 0.00 0.00

1494 1.10 11.47 0.00 0.00

1477 -3.07 -40.46 40.57
 1496 -6.25 37.59 38.11

1425 -221.28 252.40 335.66
 1484 314.71 167.87 356.68
 1558 -91.00 -386.81 397.37

1440 156.20 53.39 165.07
 1475 111.45 32.18 116.00
 1483 -312.86 -134.39 340.51
 1501 -72.01 -29.66 77.88
 1745 83.67 16.73 85.33

1477 -1.73 13.56 13.67
 1726 -80.33 -62.67 101.89

1477 28.86 66.55 72.54
 1489 -41.36 -70.42 81.67

1491 -119.57 -115.64 166.34
 1500 78.97 98.92 126.58

1486 41.62 71.80 82.99
 1497 -65.79 -78.93 102.76

1494 -65.85 -20.25 68.89
 1666 52.64 14.50 54.61

1488 119.80 113.17 164.80
 1493 -94.52 -106.03 142.05
 1666 -51.67 -16.29 54.18

1494 109.24 26.04 112.30
 1509 -107.68 41.15 115.27

1416 -35.71 -17.27 39.67
 1417 -59.16 -89.62 107.39
 1491 95.72 112.68 147.85
 1497 65.70 82.62 105.56
 1537 -52.56 -9.51 53.42
 1667 -16.81 -80.26 82.00

1414 -35.31 -12.65 37.51
 1415 -24.55 -85.54 88.99
 1464 125.35 67.57 142.40
 1490 66.03 21.13 69.33
 1492 -108.82 -17.37 110.20
 1495 -23.62 -22.74 32.79

1495 1.11 11.62 22.35 6.52

1496 1.03 10.15 14.73 4.30

1497 1.12 11.15 0.42 0.12

1498 0.29 -6.80 24.79 7.23

1499 0.68 6.36 0.00 0.00

1500 1.08 9.92 12.44 3.63

1501 1.07 13.24 0.00 0.00

1502 1.15 14.18 15.39 4.49

1503 0.99 10.75 0.00 0.00

1504 0.78 7.66 16.30 4.75

1505 1.08 10.17 14.85 4.33

1507 1.08 10.07 0.00 0.00

1508 1.12 17.27 0.00 0.00

1494 23.65 22.79 32.84

1510 -45.15 -28.67 53.48

1482 6.34 -37.34 37.87

1747 -82.42 -15.75 83.92

1489 66.29 81.46 105.03

1493 -65.23 -80.62 103.70

1513 -134.28 -217.60 255.70

1526 117.77 264.94 289.94

1539 -8.53 -54.74 55.39

1513 18.30 55.67 58.60

1669 -18.92 -56.00 59.11

1447 114.77 132.33 175.17

1488 -78.34 -104.00 130.20

1466 27.03 58.18 64.15

1468 95.77 95.67 135.37

1484 72.54 28.95 78.10

1509 -162.99 -73.10 178.63

1518 -13.48 -20.82 24.81

1730 -2.32 15.89 16.06

1569 -3.23 -6.56 7.31

1597 3.24 6.07 6.88

1515 83.66 204.98 221.39

1590 -100.25 -210.13 232.82

1525 12.39 3.53 12.88

1741 -36.84 -17.07 40.60

1516 -8.64 -3.44 9.30

1517 3.43 4.89 5.97

1522 3.44 6.19 7.08

1410 -168.89 -131.67 214.15

1411 -217.76 183.63 284.85

1412 -353.16 -223.09 417.73

1455 -11.34 78.28 79.10

1509 43.79 -14.49 46.12

1512 334.72 361.57 492.72

1534 -103.86 -497.43 508.16

1649 205.77 -32.76 208.36

1509	1.12	16.49	0.00	0.00	1731	267.86	-34.57	270.08
					1407	-99.40	-6.74	99.63
					1408	-99.25	-79.55	127.20
					1409	-149.17	5.70	149.28
					1466	121.31	68.52	139.33
					1492	108.17	-40.88	115.64
					1501	167.57	81.01	186.12
					1508	-43.76	15.15	46.31
1510	1.13	12.93	1.98	0.58	1495	45.50	29.87	54.43
					1521	-49.04	-31.81	58.46
1511	0.95	13.44	0.00	0.00	1512	-174.88	-581.49	607.22
					1513	174.48	549.59	576.62
1512	1.04	14.47	0.00	0.00	1508	-324.10	-333.59	465.11
					1511	183.18	632.11	658.11
					1609	147.08	-302.95	336.76
1513	0.66	6.12	11.60	3.38	1498	189.46	557.57	588.87
					1499	-18.03	-54.20	57.12
					1511	-170.13	-366.02	403.63
					1514	-13.14	-69.64	70.87
					1581	0.69	-57.87	57.88
1514	0.70	6.19	0.00	0.00	1513	13.72	72.96	74.24
					1608	-6.55	-41.08	41.60
					1707	-7.39	-32.25	33.09
1515	0.50	-0.10	12.51	3.65	1504	-69.93	-121.66	140.32
					1540	57.41	117.77	131.02
1516	1.08	10.12	0.00	0.00	1507	8.66	3.38	9.30
					1525	-12.19	-7.07	14.09
1517	1.04	8.49	3.40	0.99	1507	-3.43	-4.61	5.74
1518	1.16	14.35	5.27	1.54	1502	13.70	20.79	24.90
					1648	-20.30	-23.37	30.96
1519	1.13	13.27	0.00	0.00	1521	-0.28	-16.48	16.48
					1589	-2.82	20.35	20.54
1520	1.03	9.95	31.61	9.22	1430	10.04	10.46	14.50
					1467	-40.94	-19.06	45.16
1521	1.14	13.26	0.00	0.00	1510	49.15	32.15	58.73
					1519	0.31	16.43	16.44

1522	1.03	8.48	3.40	0.99
1523	1.03	7.27	6.13	1.79
1524	0.88	8.37	14.71	4.29
1525	1.08	10.15	0.00	0.00
1528	1.15	13.31	6.44	1.88
1529	1.05	8.86	2.91	0.85
1530	1.04	8.89	2.91	0.85
1531	0.95	10.04	0.00	0.00
1532	1.12	16.88	0.00	0.00
1533	1.12	16.33	0.00	0.00
1534	1.13	17.37	0.00	0.00
1535	1.02	11.76	75.51	22.02
1536	1.16	14.04	57.23	16.69
1537	1.14	12.39	12.31	3.59
1539	0.33	-7.23	10.62	3.10
1540	0.36	-6.52	29.44	8.59
1541	1.20	15.27	0.06	0.02
1587	-47.80	-46.82	66.91	
1507	-3.43	-5.80	6.74	
1525	-6.17	-5.42	8.21	
1531	-102.27	-145.43	177.79	
1656	86.82	140.41	165.09	
1505	-12.38	-3.55	12.88	
1516	12.19	7.05	14.08	
1523	6.17	6.00	8.61	
1536	-72.33	-16.74	74.24	
1537	64.22	13.91	65.71	
1741	-2.94	-3.84	4.84	
1741	-2.94	-4.41	5.30	
1524	105.51	159.56	191.29	
1535	-105.58	-159.60	191.36	
1534	-185.49	-237.44	301.30	
1535	183.52	200.91	272.11	
1536	101.15	-92.25	136.90	
1649	-122.99	41.38	129.76	
1508	104.90	502.62	513.44	
1532	185.87	238.28	302.20	
1542	-288.54	-738.63	792.98	
1531	108.16	174.49	205.29	
1532	-182.80	-167.34	247.83	
1528	72.47	17.61	74.58	
1533	-100.97	99.74	141.93	
1708	-29.17	-92.19	96.69	
1493	52.65	10.00	53.59	
1528	-64.01	-12.99	65.31	
1498	10.26	62.80	63.63	
1540	-21.06	-66.06	69.33	
1515	-51.46	-81.09	96.04	
1539	22.15	72.62	75.92	

					1554	18.02	30.83	35.71
					1563	-21.89	-32.15	38.89
1542	1.23	18.67	0.00	0.00				
					1401	-365.65	-301.71	474.05
					1402	-219.81	-21.74	220.89
					1403	-379.33	-101.63	392.70
					1534	295.00	798.02	850.80
					1555	13.39	-480.97	481.16
					1556	273.55	-733.75	783.08
					1558	236.74	489.84	544.04
					1591	251.66	414.90	485.26
					1601	334.67	213.19	396.80
					1662	-391.10	-166.63	425.12
					1725	-53.76	-506.60	509.45
1544	1.22	15.47	16.24	4.74				
					1561	28.19	27.76	39.57
					1605	-45.16	-31.92	55.30
1545	0.77	6.23	0.00	0.00				
					1548	18.77	38.39	42.73
					1640	-46.41	-104.01	113.89
					1669	26.32	64.29	69.46
1546	1.19	15.04	0.00	0.00				
					1637	8.14	21.92	23.39
					1657	-8.93	-22.16	23.89
1547	1.20	15.39	5.83	1.70				
					1557	-26.30	-33.36	42.48
					1563	19.16	31.36	36.75
1548	0.75	5.74	0.00	0.00				
					1545	-18.56	-37.38	41.73
					1707	17.90	37.08	41.17
1549	1.02	7.51	9.92	2.89				
					1444	61.63	22.43	65.58
					1449	-23.26	-1.64	23.32
1550	1.17	14.66	0.00	0.00				
					1552	102.45	78.64	129.15
					1559	-105.91	-80.96	133.31
1551	1.18	14.93	7.64	2.23				
					1559	-29.67	-26.45	39.74
					1648	19.22	22.59	29.66
1552	1.15	13.56	17.04	4.97				
					1550	-101.92	-75.32	126.73
					1587	19.23	19.76	27.57
1554	1.18	15.02	14.00	4.08				
					1541	-18.01	-30.77	35.65
					1559	-3.03	22.57	22.77
1555	1.25	18.48	0.00	0.00				
					349	-92.37	-555.17	562.80
					1542	-11.35	482.23	482.37
					1557	101.96	30.78	106.51

1556	1.29	17.21	0.00	0.00	
					345 265.97 -773.39 817.85
					1542 -267.35 769.15 814.29
1557	1.24	15.99	21.09	6.15	
					1547 26.76 33.92 43.21
					1555 -101.81 -25.97 105.07
					1605 29.91 48.68 57.13
1558	1.20	18.18	0.00	0.00	
					1483 94.71 400.21 411.26
					1542 -235.20 -481.18 535.58
					1637 139.78 36.80 144.55
1559	1.18	15.03	0.00	0.00	
					1550 106.11 82.14 134.18
					1551 29.67 26.48 39.77
					1554 3.03 -22.58 22.78
					1637 -175.82 -105.07 204.83
1560	1.11	15.87	0.00	0.00	
					1580 124.92 113.72 168.93
					1591 -49.99 -74.98 90.11
					1649 -94.37 -23.20 97.18
1561	1.21	15.30	16.50	4.81	
					1544 -28.04 -27.66 39.39
					1657 11.38 22.63 25.33
1562	1.02	7.65	0.00	0.00	
					1441 -36.33 -17.25 40.22
					1450 38.01 18.11 42.11
1563	1.20	15.31	0.00	0.00	
					1541 21.89 32.18 38.92
					1547 -19.12 -31.32 36.69
1565	1.01	11.45	0.00	0.00	
					904 -72.98 -48.43 87.58
					911 -20.49 0.86 20.51
					1737 39.33 12.87 41.38
1566	1.00	10.94	16.31	4.76	
					1569 7.66 6.93 10.33
					1736 -25.27 -12.22 28.07
1567	1.02	7.19	12.70	3.70	
					1446 -13.44 -2.71 13.71
					1450 48.35 20.80 52.64
1568	1.02	6.92	7.41	2.16	
					1452 82.22 30.55 87.71
					1456 -40.04 -11.38 41.63
1569	1.00	10.82	4.72	1.38	
					1503 3.34 5.73 6.64
					1566 -7.67 -7.10 10.45
1571	0.97	6.92	0.87	0.25	
					1617 10.23 33.88 35.39
					1743 -12.72 -35.80 37.99
1572	1.00	7.10	10.08	2.94	

1573	1.13	12.80	0.00	0.00	1621	18.26	62.12	64.75
					1750	-30.25	-66.99	73.50
					1574	65.51	67.70	94.21
					1609	164.65	133.02	211.67
					1749	-232.78	-165.92	285.87
1574	1.08	10.50	23.85	6.96	1573	-65.39	-62.35	90.35
					1741	39.16	15.67	42.18
1575	0.97	6.90	0.25	0.07	1579	-12.43	-46.09	47.73
					1618	10.20	43.95	45.12
1576	0.84	2.63	0.00	0.00	1577	-3.61	-67.20	67.30
					1581	3.39	71.92	72.00
1577	1.20	3.45	6.16	1.80	1576	3.77	96.00	96.07
1578	0.99	7.24	0.00	0.00	1611	-63.18	-187.09	197.47
					1613	59.47	183.22	192.63
1579	1.00	7.05	16.45	4.80	1575	12.63	47.26	48.92
					1750	-30.13	-53.07	61.03
1580	1.06	12.94	31.35	9.14	1560	-124.66	-102.35	161.30
					1596	53.72	44.55	69.78
1581	0.75	4.94	0.00	0.00	1513	0.58	64.96	64.96
					1576	-0.49	-64.45	64.45
1582	1.04	6.82	3.30	0.96	1598	4.51	-29.79	30.13
					1612	-10.40	26.12	28.12
1583	1.07	5.85	18.57	5.42	1611	-47.63	85.40	97.79
					1652	26.67	-92.96	96.71
1584	0.73	5.63	9.23	2.69	1607	-22.96	-48.58	53.73
					1608	5.07	40.35	40.67
1585	0.72	5.87	7.82	2.28	1588	-56.17	-279.69	285.28
					1658	47.57	276.53	280.59
1587	1.15	13.56	11.82	3.45	1521	48.16	47.64	67.75
					1552	-19.23	-19.76	27.57
1588	0.84	6.19	25.12	7.33	1585	64.02	328.00	334.19
					1606	0.57	28.22	28.22
					1613	-54.56	-155.67	164.96
					1615	-44.70	-133.82	141.09

1589	1.02	14.15	5.15	1.50	1616	-42.25	-123.83	130.84
1590	0.97	10.69	73.46	21.43	1519	2.82	-18.32	18.54
					1463	12.08	-34.43	36.49
					1504	110.17	265.89	287.80
					1591	-206.59	-272.65	342.08
1591	1.11	15.88	0.00	0.00	1597	-24.26	-22.02	32.76
					1542	-245.49	-384.21	455.94
1592	1.17	14.00	26.11	7.61	1560	49.99	75.01	90.14
1593	1.02	7.30	0.00	0.00	1590	207.79	333.03	392.54
1594	1.02	7.32	0.00	0.00	1602	-25.87	4.32	26.23
1596	1.06	12.93	0.00	0.00	1594	-81.67	-45.99	93.73
1597	0.97	10.69	0.00	0.00	1612	8.96	-27.52	28.94
1598	1.05	6.62	0.00	0.00	1593	81.68	46.03	93.76
1599	1.06	6.29	8.56	2.50	1750	-110.13	-74.99	133.23
1601	1.18	15.67	0.00	0.00	1461	77.53	61.89	99.20
1602	1.17	14.81	0.00	0.00	1580	-53.71	-44.53	69.77
1603	1.17	12.62	69.91	20.39	1503	-3.09	-6.98	7.63
1605	1.24	15.98	0.00	0.00	1590	24.26	22.03	32.77
1606	0.84	6.19	4.78	1.39	1582	-4.48	29.92	30.25
1607	0.82	6.12	0.00	0.00	1599	3.85	-30.01	30.25
					1598	-3.75	30.13	30.36
					1650	-4.21	-32.32	32.60
					1542	-332.22	-204.03	389.87
					1602	329.72	200.66	385.97
					1592	25.88	-3.95	26.18
					1601	-329.59	-198.10	384.54
					1603	69.09	-10.60	69.90
					1749	231.76	163.83	283.82
					1602	-69.03	13.30	70.30
					1544	45.39	32.42	55.78
					1557	-29.90	-48.66	57.12
					1588	-0.57	-28.21	28.22
					1607	24.99	55.22	60.61

					1584	25.36	54.63	60.23
					1606	-24.56	-54.11	59.42
1608	0.73	5.65	3.04	0.89				
					1514	7.25	42.74	43.35
					1584	-5.05	-40.29	40.61
1609	1.11	11.92	0.00	0.00				
					1230	79.18	-359.26	367.88
					1239	96.87	-156.64	184.18
					1512	-141.29	318.50	348.43
					1573	-165.12	-134.33	212.85
					1611	123.85	134.27	182.67
					1619	101.67	7.22	101.93
					1731	-223.58	29.87	225.56
					1750	125.83	140.16	188.36
1611	1.03	7.57	12.16	3.55				
					1578	64.31	194.13	204.50
					1583	48.37	-81.25	94.56
					1609	-123.42	-114.95	168.66
1612	1.03	6.99	0.00	0.00				
					1582	10.42	-26.07	28.07
					1593	-8.94	27.64	29.05
1613	0.97	7.09	0.00	0.00				
					1578	-58.37	-178.29	187.61
					1588	59.92	179.81	189.53
1615	0.93	6.53	12.90	3.76				
					1588	48.76	148.82	156.60
					1621	-63.64	-154.87	167.43
1616	0.91	6.66	0.00	0.00				
					1588	44.51	134.00	141.20
					1621	-27.50	-103.00	106.61
					1696	-19.41	-31.67	37.14
1617	0.96	6.88	0.00	0.00				
					1571	-10.17	-33.66	35.16
					1618	-25.46	-59.05	64.31
					1621	22.42	128.65	130.59
					2160	-77.85	-130.15	151.66
1618	0.96	6.89	0.31	0.09				
					1575	-10.11	-43.55	44.71
					1617	25.47	59.11	64.36
1619	1.11	10.35	0.00	0.00				
					1609	-105.13	-20.24	107.06
					1620	103.49	65.10	122.26
1620	1.07	7.59	21.12	6.16				
					1619	-103.33	-58.26	118.62
					1622	26.78	5.47	27.34
					1629	25.78	17.37	31.08
					1641	-33.63	-61.00	69.66
					1734	37.15	17.12	40.91
1621	0.96	6.88	0.00	0.00				

					1572	-17.79	-59.75	62.34
					1615	64.36	159.35	171.85
					1616	28.59	108.72	112.41
					1617	-22.40	-128.56	130.49
					1748	-12.19	-37.10	39.05
1622	1.07	7.57	0.00	0.00				
					1620	-26.78	-5.47	27.34
					1659	34.12	13.62	36.74
1623	1.07	7.19	12.08	3.52				
					1639	18.35	6.67	19.53
					1734	-45.68	-25.93	52.52
1624	1.04	5.79	1.26	0.37				
					1631	-12.64	-11.02	16.77
					1635	7.62	6.50	10.01
1625	1.04	5.62	13.13	3.83				
					1634	-21.99	-9.35	23.90
					1636	2.70	-0.94	2.85
1626	1.07	7.03	15.29	4.46				
					1659	-38.18	-17.78	42.12
					1673	20.71	11.06	23.48
1627	1.05	5.97	27.63	8.06				
					1635	19.69	0.42	19.70
					1743	-50.56	-11.52	51.86
1628	1.01	6.75	5.84	1.70				
					1743	-18.49	-39.95	44.02
					1748	11.68	37.55	39.33
1629	1.06	7.13	16.24	4.74				
					1620	-25.67	-17.12	30.85
					1645	9.30	12.18	15.32
1630	1.01	10.26	14.30	4.17				
					1465	5.37	-24.20	24.79
					1663	-18.67	21.21	28.26
1631	1.05	6.03	10.56	3.08				
					1624	12.61	10.93	16.69
					1673	-24.09	-15.18	28.48
1632	1.04	5.48	12.35	3.60				
					1635	-10.47	-4.45	11.38
					1636	-4.20	-0.59	4.24
1633	1.04	10.90	12.43	3.62				
					1432	52.99	-10.82	54.08
					1437	-44.39	-4.69	44.63
					1438	9.10	46.38	47.27
1634	1.04	5.70	8.06	2.35				
					1625	21.99	9.36	23.90
					1645	-27.42	-8.93	28.84
1635	1.04	5.74	20.22	5.90				
					1624	-7.63	-6.55	10.06
					1627	-19.68	-0.42	19.69
					1632	10.45	4.28	11.29

1636	1.04	5.55	0.00	0.00
1637	1.18	15.06	0.00	0.00
1638	1.18	9.36	6.95	2.03
1639	1.07	7.07	0.93	0.27
1640	0.81	6.44	13.06	3.81
1641	1.09	7.87	0.00	0.00
1642	1.10	8.00	4.64	1.35
1643	1.15	10.69	0.00	0.00
1644	1.16	10.97	0.00	0.00
1645	1.05	6.90	0.00	0.00
1648	1.16	14.44	0.00	0.00
1649	1.12	16.36	0.00	0.00
1650	1.21	7.14	4.27	1.25
1651	1.16	4.97	14.92	4.35
1652	1.08	5.40	18.00	5.25
1654	1.06	14.29	10.12	2.95

1625	-2.74	0.72	2.84
1632	4.16	0.46	4.19
1546	-8.07	-22.02	23.45
1558	-139.61	-28.74	142.54
1559	175.85	105.22	204.93
1642	40.03	69.37	80.09
2121	-48.04	-72.70	87.14
1623	-18.35	-6.69	19.54
1699	17.98	7.35	19.42
1545	48.45	109.61	119.84
1656	-89.13	-139.93	165.90
1620	33.87	62.06	70.70
1642	-36.16	-64.76	74.17
1638	-38.91	-64.15	75.03
1641	36.27	65.28	74.68
1644	-150.98	-158.65	219.01
1645	145.19	196.38	244.22
1235	-163.90	-328.64	367.24
1239	19.93	184.11	185.19
1643	151.17	157.73	218.48
1629	-9.34	-12.21	15.37
1634	27.49	9.33	29.03
1643	-144.62	-170.74	223.76
1743	46.31	36.68	59.08
1518	20.33	23.38	30.98
1551	-19.22	-22.57	29.65
1508	-204.00	30.50	206.26
1533	123.00	-41.38	129.78
1560	94.69	17.48	96.29
1599	4.26	36.96	37.21
1652	-8.03	134.62	134.86
1583	-26.34	94.45	98.05
1651	8.44	-125.67	125.95

					1429	13.85	2.98	14.17
					1457	-7.87	10.17	12.86
					1458	82.07	44.41	93.32
					1459	59.92	30.30	67.14
					1664	-156.48	-49.45	164.10
1655	1.09	11.18	12.82	3.74				
					1464	-30.00	-14.34	33.25
					1479	63.32	45.37	77.89
1656	0.81	6.46	12.58	3.67				
					1524	-84.72	-127.45	153.04
					1640	89.18	140.13	166.10
1657	1.20	15.17	2.77	0.81				
					1546	8.98	21.95	23.72
					1561	-11.34	-22.71	25.38
1658	0.19	4.40	2.83	0.82				
					1526	11.89	73.25	74.21
					1585	-14.72	-74.11	75.56
1659	1.07	7.46	0.00	0.00				
					1622	-34.11	-13.57	36.71
					1626	38.25	18.06	42.30
1660	1.04	12.38	16.97	4.95				
					1459	-56.45	-25.60	61.98
					1679	39.36	20.35	44.31
1662	1.26	21.47	0.00	0.00				
					1542	391.79	190.04	435.45
1663	1.01	10.60	9.64	2.81				
					1469	21.37	56.04	59.98
					1471	15.48	31.76	35.33
					1630	18.69	-21.16	28.23
					1679	-33.87	-18.21	38.45
					1746	-2.55	-18.91	19.08
1664	1.08	17.75	0.00	0.00				
					1425	-175.90	-23.23	177.42
					1455	23.66	-49.39	54.76
					1654	156.65	60.14	167.80
1666	1.09	10.38	6.30	1.84				
					1490	-52.59	-14.25	54.48
					1491	51.70	16.40	54.24
1667	1.16	11.49	0.00	0.00				
					1493	17.35	81.47	83.30
					1668	-16.39	-70.90	72.77
1668	1.36	13.23	3.00	0.87				
					1667	16.70	83.75	85.40
1669	0.74	6.15	4.92	1.43				
					1499	20.79	60.63	64.10
					1545	-25.38	-61.81	66.81
1673	1.06	6.33	5.76	1.68				
					1626	-20.71	-11.06	23.47
					1631	24.09	15.24	28.51

1674	1.03	10.75	11.60	3.38	1700	-8.57	-5.15	10.00
					1418	9.40	10.79	14.31
1675	1.03	11.66	12.22	3.56	1468	-20.01	-13.02	23.87
					1426	-81.09	-27.70	85.69
1676	1.05	12.39	12.15	3.55	1435	69.52	25.07	73.90
					1437	71.80	15.85	73.53
1678	1.04	8.56	6.99	2.04	1744	-83.69	-19.12	85.85
					1441	52.55	23.51	57.57
1679	1.02	11.44	5.54	1.62	1448	-56.60	-23.91	61.44
					1660	-39.08	-19.70	43.76
1696	0.92	6.52	0.00	0.00	1663	34.05	18.70	38.84
					1616	19.66	31.85	37.43
1697	1.03	11.40	8.75	2.55	1697	-18.40	-22.96	29.43
					1696	18.46	27.55	33.16
1699	1.06	6.77	4.66	1.36	1639	-17.91	-7.43	19.39
					1700	12.51	4.77	13.39
1700	1.06	6.61	5.13	1.50	1673	8.61	4.76	9.84
					1699	-12.47	-4.91	13.40
1707	0.74	5.69	10.12	2.95	1514	8.20	33.93	34.91
					1548	-17.71	-36.64	40.70
1708	1.17	14.10	0.00	0.00	1536	29.29	92.78	97.30
					1709	-29.74	-123.82	127.35
1709	1.24	14.73	6.68	1.95	1708	30.11	131.71	135.11
					349	-53.72	-511.18	513.99
1725	1.26	18.64	0.00	0.00	1542	57.08	510.10	513.28
					1479	-46.24	-37.22	59.36
1726	1.06	9.73	7.55	2.20	1485	80.35	62.72	101.93
					1502	2.51	-16.22	16.41
1730	1.14	14.40	38.65	11.27	1731	-40.36	41.41	57.83
					1508	-263.73	34.91	266.03
1731	1.12	15.43	0.00	0.00	1609	226.78	-28.72	228.59
					1730	40.39	-39.97	56.83
1734	1.07	7.25	0.00	0.00				

					1620	-37.12	-16.94	40.80
					1623	45.70	25.99	52.57
1736	1.01	11.41	22.11	6.45				
					1566	25.42	12.32	28.25
					1737	-101.58	-53.84	114.97
1737	1.01	11.44	3.32	0.97				
					1565	-39.33	-12.86	41.37
					1736	101.60	53.90	115.01
1741	1.08	10.26	0.00	0.00				
					1505	36.85	17.11	40.63
					1529	2.94	4.04	5.00
					1530	2.94	4.65	5.50
					1574	-39.12	-15.54	42.09
1743	1.05	6.89	12.01	3.50				
					1571	13.61	37.78	40.16
					1627	50.65	12.20	52.10
					1628	19.00	41.17	45.34
					1645	-46.31	-36.66	59.06
1744	1.06	13.86	26.63	7.77				
					1425	-207.95	-49.99	213.87
					1426	115.19	92.04	147.44
					1676	84.11	21.40	86.79
1745	1.07	12.69	10.60	3.09				
					1445	102.59	40.61	110.33
					1484	-83.66	-16.72	85.31
1746	1.01	10.59	12.41	3.62				
					1472	16.81	11.72	20.49
					1663	2.59	18.90	19.07
1747	1.03	10.17	11.52	3.36				
					1468	-56.12	10.90	57.17
					1496	82.43	15.78	83.93
1748	0.97	6.94	0.00	0.00				
					1621	12.27	37.40	39.36
					1628	-11.03	-36.19	37.84
1749	1.15	14.20	0.00	0.00				
					1573	234.56	167.85	288.43
					1602	-231.02	-163.27	282.89
1750	1.02	7.34	0.00	0.00				
					1572	30.56	68.35	74.88
					1579	30.33	53.97	61.91
					1594	110.14	75.07	133.29
					1609	-125.21	-118.85	172.64
1770	1.67	32.14	0.00	0.00				
					1846	43.47	65.34	78.48
1771	1.75	31.22	0.00	0.00				
					1847	41.45	127.24	133.82
1772	1.62	31.78	0.00	0.00				
					1846	134.70	96.11	165.47
1773	1.70	33.16	0.00	0.00				

1774	1.67	32.60	0.00	0.00	1935	394.77	440.70	591.66
1775	1.67	29.65	0.00	0.00	1935	264.75	283.35	387.79
1776	1.62	30.52	0.00	0.00	1967	152.68	675.85	692.88
1777	1.76	30.51	0.00	0.00	1888	26.27	25.98	36.95
1778	1.66	31.25	0.00	0.00	1888	28.31	118.06	121.41
1779	1.69	29.65	0.00	0.00	1888	46.39	62.58	77.90
1780	1.62	32.00	0.00	0.00	1888	32.14	144.27	147.80
1781	1.70	35.15	0.00	0.00	1888	160.23	80.14	179.15
1782	1.69	35.06	0.00	0.00	1970	709.38	774.47	1050.25
1783	1.64	32.93	0.00	0.00	1970	679.79	677.38	959.67
1784	1.62	32.49	0.00	0.00	1846	110.57	75.45	133.86
1785	1.62	31.32	0.00	0.00	1847	110.45	46.60	119.88
1800	1.60	29.01	2.52	1.07	1935	63.22	46.05	78.22
1803	1.61	29.05	12.42	5.29	1879	-4.42	-4.39	6.23
1806	1.58	29.10	30.75	13.10	1840	-24.90	-94.55	97.78
1809	1.56	29.02	21.87	9.32	1879	10.94	56.30	57.35
1813	1.56	28.86	15.60	6.64	1858	-64.72	8.25	65.24
1816	1.56	28.76	12.56	5.35	1870	32.73	-42.99	54.03
1817	1.56	28.76	12.56	5.35	1813	33.45	-10.65	35.11
1823	1.51	27.42	40.63	17.31	1846	-164.54	-37.23	168.69
					1876	92.35	-19.75	94.44
					1809	-33.46	10.58	35.09
					1853	-7.95	-75.81	76.23
					1894	-13.46	-77.49	78.65
					1876	44.06	22.30	49.38
					1888	-78.87	-121.01	144.45
					1876	44.49	22.01	49.64
					1888	-78.14	-121.50	144.46
					1832	-44.15	-43.76	62.16

					1835	-15.49	-38.54	41.54
					1861	47.91	16.37	50.63
					1873	26.32	7.90	27.48
					1911	-8.83	2.10	9.08
					1954	-49.50	-135.88	144.61
1826	1.57	28.86	17.84	7.60				
					1847	-63.82	-37.53	74.04
					1853	21.62	3.28	21.87
					1888	-60.94	-153.74	165.38
					1894	17.17	3.35	17.49
1829	1.55	28.57	55.93	23.83				
					1846	-70.18	-24.77	74.43
					1897	11.93	-16.61	20.45
1832	1.54	28.14	37.95	16.17				
					1823	44.57	44.42	62.92
					1876	-83.25	-71.39	109.67
1835	1.52	27.47	46.10	19.64				
					1823	15.68	37.51	40.65
					1850	-60.96	-62.98	87.65
1838	1.57	28.78	32.49	13.84				
					1882	-14.48	-47.19	49.36
					1888	-25.95	-0.02	25.95
1840	1.64	29.14	16.95	7.22				
					1803	25.18	95.89	99.14
					1918	-40.53	117.58	124.37
1843	1.56	28.61	0.93	0.40				
					1867	-33.06	-38.22	50.54
					1897	29.77	2.91	29.91
1846	1.58	29.94	24.77	10.55				
					1770	-43.47	-60.20	74.25
					1772	-134.48	-89.60	161.60
					1783	-110.29	-67.11	129.10
					1809	169.78	13.17	170.29
					1829	70.83	26.19	75.51
					1891	20.91	-14.12	25.23
1847	1.58	29.45	0.00	0.00				
					1771	-41.00	-113.75	120.91
					1784	-110.22	-39.74	117.17
					1826	64.03	38.15	74.53
					1864	89.06	44.45	99.53
					1905	-6.34	-99.75	99.95
1850	1.53	27.92	42.03	17.91				
					1835	61.15	63.67	88.28
					1876	-60.20	-53.26	80.38
					1897	-57.49	-58.57	82.07
					1921	14.18	37.56	40.15
1853	1.57	28.83	41.74	17.78				
					1813	8.39	69.95	70.45
					1826	-21.26	-9.67	23.36

1856 1.58 29.90 33.22 14.15

1858 1.59 30.11 0.00 0.00

1861 1.50 26.78 48.17 20.52

1864 1.57 29.13 23.50 10.01

1867 1.56 28.78 33.53 14.28

1870 1.59 28.81 45.85 19.53

1873 1.50 26.88 26.53 11.30

1876 1.56 28.70 43.93 18.71

1879 1.61 29.04 25.49 10.86

1882 1.61 28.84 43.67 18.60

1885 1.59 28.51 48.69 20.74

1888 1.57 28.88 52.04 22.17

1858 -40.26 -40.07 56.80

1891 4.49 -12.00 12.81

1806 64.93 -7.62 65.38

1856 40.33 40.21 56.95

1882 117.21 -129.97 175.01

1963 -219.29 -159.73 271.29

1823 -47.71 -16.14 50.37

1847 -88.66 -44.31 99.12

1867 64.75 33.37 72.85

1843 33.20 38.29 50.68

1864 -64.48 -32.97 72.42

1806 -32.61 43.16 54.09

1882 -13.18 -63.52 64.87

1823 -26.18 -8.39 27.49

1809 -93.79 8.80 94.20

1816 -44.80 -27.92 52.79

1817 -44.80 -27.92 52.79

1832 83.51 72.80 110.79

1850 60.51 54.44 81.39

1897 15.72 6.89 17.16

1800 4.60 3.97 6.08

1803 -10.85 -56.16 57.20

1945 -15.92 75.11 76.77

1838 14.97 47.42 49.72

1858 -116.06 133.84 177.15

1870 13.45 64.02 65.41

1885 34.39 50.19 60.84

1947 11.25 87.65 88.37

1882 -34.18 -49.70 60.32

1888 -17.80 27.56 32.81

1776 -26.27 -24.53 35.94

1777 -28.31 -104.83 108.59

1778 -46.39 -57.46 73.85

1779 -31.81 -134.28 138.00

1780 -159.86 -69.34 174.25

1816 78.79 116.55 140.68

1817 78.79 116.55 140.68

					1826	60.53	151.07	162.74
					1838	28.15	-8.50	29.40
					1885	15.69	-35.37	38.69
1891	1.58	29.86	28.66	12.21				
					1846	-19.79	10.63	22.47
					1856	-4.48	11.75	12.57
1894	1.57	28.84	30.86	13.14				
					1813	13.09	74.34	75.49
					1826	-17.60	-5.73	18.51
1897	1.56	28.45	0.00	0.00				
					1829	-11.96	16.41	20.30
					1843	-29.75	-2.96	29.90
					1850	57.81	59.46	82.93
					1876	-15.77	-7.15	17.32
					1973	3.37	-20.84	21.11
1900	1.54	25.91	0.00	0.00				
					380	186.34	121.72	222.57
					1933	-183.98	69.14	196.54
1901	1.59	27.79	30.21	12.87				
					1937	109.79	-105.62	152.35
					1947	-148.90	31.74	152.24
1902	1.59	30.00	0.28	0.12				
					1931	49.58	24.44	55.28
					1935	-48.74	-92.37	104.45
1903	1.51	27.59	34.67	14.77				
					1911	10.05	26.08	27.95
					1933	-46.77	-78.69	91.54
1905	1.61	29.52	0.00	0.00				
					1847	6.34	101.78	101.98
					1918	-9.97	126.47	126.86
1907	1.60	29.71	12.42	5.29				
					1918	49.15	-129.69	138.69
					1935	-62.47	53.48	82.24
1909	1.58	28.90	35.49	15.12				
					1945	-35.77	-22.48	42.25
1911	1.51	27.53	0.00	0.00				
					1823	8.83	-2.08	9.07
					1903	-10.05	-26.01	27.88
1913	1.56	30.05	29.55	12.59				
					1925	86.44	-64.55	107.88
					1957	-114.48	-132.31	174.96
1915	1.56	28.91	22.32	9.51				
					1927	100.21	80.96	128.83
					1935	-143.77	-124.08	189.91
					1943	19.84	-7.45	21.19
1916	1.57	27.30	0.00	0.00				
					1923	20.18	-58.08	61.49
					1960	-20.61	-151.10	152.50
1918	1.61	29.57	0.00	0.00				

1921	1.52	27.76	0.00	0.00	1840	40.53	-114.77	121.72
					1905	10.05	-126.04	126.44
					1907	-49.05	130.36	139.28
					1850	-14.18	-37.23	39.84
1923	1.57	27.15	70.46	30.02	1933	12.21	-5.90	13.56
					1916	-20.12	58.43	61.80
1925	1.57	29.65	29.33	12.50	1942	-53.84	-129.73	140.46
					1913	-86.30	65.40	108.28
1927	1.54	28.17	0.00	0.00	1931	56.68	-85.69	102.74
					1915	-99.86	-78.56	127.06
					1933	65.74	50.20	82.71
1931	1.58	29.36	33.40	14.23	1939	31.82	-9.77	33.29
					1902	-49.46	-23.69	54.84
1933	1.52	27.70	0.00	0.00	1925	-56.56	86.44	103.30
					1947	71.51	-62.92	95.26
					1900	183.98	-62.63	194.35
1935	1.59	30.06	5.99	2.55	1903	46.93	79.35	92.19
					1921	-12.21	5.91	13.57
					1927	-65.60	-49.26	82.04
					1945	-92.94	-98.57	135.48
					1965	-56.12	-125.30	137.30
					1773	-393.24	-393.89	556.59
1937	1.59	27.48	47.44	20.21	1774	-264.75	-259.31	370.59
					1785	-63.15	-43.91	76.92
1939	1.54	28.08	32.99	14.05	1902	48.79	92.68	104.73
					1907	62.56	-52.91	81.94
1941	1.59	27.33	35.85	15.27	1915	144.63	129.98	194.46
					1945	146.54	45.93	153.57
					1947	112.02	7.45	112.27
1942	1.58	27.21	0.00	0.00	1967	197.16	89.19	216.40
					1901	-109.58	106.53	152.83
					1941	63.35	45.90	78.23
					1927	-31.82	9.82	33.30
					1937	-63.31	-45.61	78.03
					1942	27.80	39.11	47.98
					1923	53.94	130.38	141.10
					1941	-27.77	-38.88	47.77
					1944	-22.01	-54.12	58.43

1943 1.56 28.82 20.39 8.69

1944 1.60 27.43 0.00 0.00

1945 1.58 29.21 0.00 0.00

1947 1.59 28.73 0.00 0.00

1954 1.56 28.09 0.00 0.00

1957 1.61 31.41 0.00 0.00

1960 1.61 27.50 0.00 0.00

1963 1.61 31.29 0.00 0.00

1965 1.56 28.27 0.00 0.00

1967 1.58 29.01 0.00 0.00

1969 1.60 28.25 0.00 0.00

1915 -19.83 7.48 21.20

1942 22.03 54.76 59.03

1960 -22.30 -70.93 74.35

1879 15.92 -74.03 75.72

1909 35.82 22.78 42.45

1933 93.88 104.96 140.82

1935 -146.17 -43.45 152.49

1882 -11.25 -86.30 87.03

1901 149.48 -29.30 152.32

1931 -71.24 64.09 95.83

1935 -111.63 -4.82 111.74

1969 44.97 -48.16 65.89

1823 49.50 140.97 149.41

1965 -48.79 25.47 55.04

1913 114.48 138.83 179.95

1963 220.06 -291.90 365.56

1970 -331.32 63.75 337.39

588 684.32 223.79 719.99

1916 20.61 155.08 156.44

1944 22.35 71.36 74.78

1969 -203.48 78.13 217.96

1970 -522.89 59.85 526.30

1858 219.29 166.78 275.50

1957 -219.86 292.84 366.19

463 526.35 830.05 982.87

1933 56.12 128.69 140.39

1954 48.80 -25.29 54.97

1967 -88.92 -81.33 120.50

1970 -468.13 -140.23 488.68

1973 -72.21 -83.12 110.10

1775 -151.42 -636.77 654.53

1935 -196.97 -84.79 214.45

1965 89.13 83.66 122.25

1969 157.87 -182.33 241.18

1973 71.09 62.97 94.97

1947 -44.95 48.96 66.46

1960 203.89 -75.23 217.32

1967 -157.47 186.80 244.31

1970 1.61 32.19 0.00 0.00

1781 -706.85 -695.83 991.87
1782 -677.64 -610.85 912.32
1957 331.73 -59.14 336.96
1960 526.11 -16.87 526.38
1965 471.52 177.21 503.72

1973 1.56 28.40 0.00 0.00

1897 -3.37 20.94 21.21
1965 72.25 83.56 110.46
1967 -70.96 -61.53 93.92

1997 1.53 19.67 0.00 0.00

2006 62.37 283.67 290.45

1998 1.48 21.62 0.00 0.00

2023 217.78 302.90 373.06

1999 1.46 20.12 0.00 0.00

2023 179.77 401.58 439.98

2000 1.30 12.24 49.50 14.44

2009 -13.70 -24.63 28.19
2010 -69.89 -34.31 77.86
2014 -23.29 -54.21 59.00

2001 1.31 12.92 52.30 15.25

2010 107.18 10.17 107.66
2012 2.10 42.24 42.29
2020 -167.87 -88.04 189.55

2002 1.31 12.58 24.28 7.08

2005 -95.50 -50.95 108.25
2009 64.35 31.71 71.74

2003 1.30 12.82 42.03 12.26

2004 -54.52 29.72 62.09
2007 8.23 -52.73 53.36

2004 1.29 13.21 54.17 15.80

2003 54.59 -29.29 61.95
2015 25.85 -38.10 46.04
2021 -136.54 43.22 143.22

2005 1.32 13.30 34.55 10.08

2002 95.85 52.68 109.37
2006 -86.89 -8.75 87.33
2007 76.09 61.86 98.06
2013 92.15 59.02 109.43
2022 -196.25 30.39 198.59

2006 1.37 18.25 0.00 0.00

1997 -62.08 -252.39 259.91
2005 88.58 16.75 90.15
2023 -32.33 -16.07 36.10

2007 1.31 12.63 42.03 12.26

2003 -8.12 53.23 53.85
2005 -75.82 -60.19 96.80
2011 106.06 33.62 111.26
2013 -83.88 -66.33 106.94

2008	1.30	12.24	79.38	23.15	
					2011 -120.51 -82.68 146.14
2009	1.30	12.29	55.10	16.07	2014 -26.95 -60.34 66.08
					2000 13.72 24.72 28.27
2010	1.30	12.31	50.43	14.71	2002 -64.16 -31.21 71.35
					2000 69.93 34.43 77.94
2011	1.31	12.51	0.00	0.00	2001 -106.99 -9.00 107.37
					2007 -106.01 -33.37 111.13
2012	1.30	12.94	23.35	6.81	2008 120.66 83.64 146.81
					2001 -2.07 -42.04 42.09
2013	1.32	12.94	13.07	3.81	2015 -24.62 25.33 35.32
					2005 -91.93 -58.09 108.75
2014	1.30	12.24	7.47	2.18	2007 84.08 67.23 107.66
					2000 23.30 54.25 59.04
2015	1.30	13.03	5.60	1.63	2008 26.96 60.37 66.12
					2004 -25.82 38.30 46.19
2020	1.33	14.37	0.00	0.00	2012 24.63 -25.26 35.28
					1383 -160.94 -61.34 172.23
2021	1.29	14.44	0.00	0.00	2001 168.16 93.71 192.51
					1381 -174.45 49.74 181.40
					1389 148.66 87.43 172.46
					2004 136.70 -40.05 142.45
2022	1.32	15.79	0.00	0.00	2024 -99.49 -38.13 106.54
					2005 197.10 -21.78 198.30
					2024 130.02 163.44 208.85
2023	1.38	18.94	0.00	0.00	2026 -352.70 -371.08 511.95
					461 142.05 126.70 190.35
					1998 -215.26 -271.67 346.61
					1999 -177.70 -375.91 415.80
					2006 32.39 16.59 36.39
2024	1.29	15.03	0.00	0.00	2026 182.03 25.71 183.84
					2021 99.67 39.40 107.18
					2022 -129.25 -158.13 204.24
					2200 6.06 181.31 181.41
2025	1.44	19.04	0.00	0.00	3351 17.74 -47.01 50.25
					2026 399.01 601.51 721.82

2026 1.37 17.05 0.00 0.00

1380 209.57 -312.93 376.62
2022 355.66 391.00 528.56
2023 -181.11 -19.51 182.16
2025 -397.58 -556.27 683.75

2101 1.26 11.58 0.00 0.00

2120 1.12 81.93 81.94

2102 1.29 14.15 0.00 0.00

2120 99.85 144.52 175.66

2103 1.28 18.12 0.00 0.00

2200 402.67 411.45 575.71

2104 1.52 9.90 0.00 0.00

2121 0.13 105.28 105.28

2105 1.37 9.91 0.00 0.00

2121 0.39 61.76 61.77

2106 1.53 9.91 0.00 0.00

2121 0.31 114.24 114.24

2107 1.30 9.92 0.00 0.00

2121 0.04 53.50 53.50

2120 1.21 11.62 0.00 0.00

2101 -1.01 -78.33 78.34
2102 -99.47 -131.20 164.64
2121 115.50 -64.40 132.23
2150 9.17 1.95 9.37
2151 51.34 42.36 66.55
2153 30.93 15.49 34.60
2200 -113.62 21.50 115.64

2121 1.22 10.07 30.63 8.93

1638 48.65 75.55 89.86
2104 0.14 -84.70 84.70
2105 -0.20 -54.95 54.95
2106 0.00 -91.10 91.10
2107 0.08 -50.14 50.14
2120 -115.04 68.29 133.78
2122 35.21 80.29 87.68

2122 1.17 10.24 0.00 0.00

2121 -33.46 -76.94 83.90
2151 -17.45 -22.84 28.75
2155 29.28 19.83 35.36
2157 23.02 16.73 28.46
2161 -3.76 59.32 59.44

2150 1.20 11.27 9.34 2.72

2120 -9.16 -1.89 9.35

2151 1.18 10.60 36.42 10.62

2120 -51.03 -40.59 65.20
2122 17.52 23.23 29.09
2152 12.45 -3.40 12.91
2154 -15.84 10.20 18.84

2152 1.18 10.29 21.67 6.32

2153	1.19	10.50	21.85	6.37	2151 -12.44 3.47 12.91
					2153 -9.38 -9.59 13.42
					2120 -30.78 -14.67 34.10
2154	1.18	11.03	25.40	7.41	2152 9.40 9.68 13.49
					2151 15.86 -10.05 18.78
					2156 63.18 44.96 77.54
2155	1.16	9.87	24.56	7.16	2201 -103.11 23.90 105.84
					2122 -29.23 -19.51 35.14
2156	1.15	9.81	27.46	8.01	2156 4.68 12.74 13.57
					2154 -62.78 -42.70 75.93
					2155 -4.67 -12.66 13.49
					2157 -4.03 -12.49 13.12
2157	1.16	9.85	19.70	5.75	2158 43.17 59.23 73.29
					2122 -22.97 -16.46 28.26
2158	1.13	9.30	24.28	7.08	2156 4.04 12.56 13.19
					2156 -42.90 -57.76 71.94
2159	1.11	9.07	8.50	2.48	2159 18.52 50.98 54.24
					2158 -18.29 -49.72 52.98
2160	1.08	9.06	11.86	3.46	2160 9.44 47.15 48.09
					1617 82.23 150.02 171.08
					2159 -9.27 -46.26 47.18
2161	1.14	10.56	28.76	8.39	2161 -84.75 -106.82 136.36
					2122 3.99 -57.99 58.13
					2160 86.23 114.72 143.52
2200	1.20	15.55	0.00	0.00	2202 -118.02 -49.44 127.96
					2024 -4.10 -167.59 167.64
					2103 -394.35 -368.29 539.58
					2120 113.83 -13.55 114.63
					2201 101.23 241.92 262.25
					2202 117.83 70.84 137.48
2201	1.16	15.14	0.00	0.00	1229 -336.63 80.76 346.18
					1230 332.98 126.27 356.12
					2154 103.31 -16.25 104.58
					2200 -100.22 -234.80 255.29
2202	1.19	15.09	0.00	0.00	2161 118.32 60.96 133.11
					2200 -117.63 -69.44 136.60
2231	1.51	1.91	0.00	0.00	

2232	1.47	2.18	0.00	0.00
2235	1.70	-5.30	0.00	0.00
2236	1.53	-5.25	0.00	0.00
2237	1.61	-3.84	0.00	0.00
2240	1.42	4.86	0.00	0.00
2241	1.44	0.79	0.00	0.00
2242	1.46	-5.18	0.00	0.00
2243	1.38	-7.68	0.00	0.00
2244	1.43	-4.22	0.00	0.00
2251	1.42	-3.92	21.48	6.26
2252	1.42	-3.96	46.69	13.62
2253	1.43	-3.61	24.28	7.08
2254	1.42	-4.03	28.95	8.44
2241	49.31	122.13	131.71	
2241	203.34	164.62	261.62	
2242	-0.52	123.27	123.27	
2242	0.67	372.55	372.55	
2242	40.85	160.23	165.36	
1082	24.34	-79.64	83.28	
2241	452.38	-70.34	457.82	
2501	-481.19	177.34	512.83	
2231	-49.10	-115.05	125.08	
2232	-202.96	-156.30	256.17	
2240	-451.55	103.50	463.26	
2253	430.11	-19.53	430.56	
2260	261.71	22.81	262.70	
2235	0.68	-106.03	106.03	
2236	-0.22	-354.53	354.53	
2237	-40.30	-143.97	149.50	
2243	95.22	107.30	143.46	
2244	-16.83	50.63	53.35	
2255	-18.33	56.82	59.70	
2261	-30.29	54.67	62.50	
1046	96.99	30.06	101.54	
2242	-94.67	-97.73	136.07	
2242	17.31	-49.29	52.24	
2255	-7.34	15.61	17.25	
2256	-40.14	23.41	46.47	
2253	-80.00	5.81	80.21	
2255	23.44	-20.36	31.05	
2256	-81.15	-35.63	88.63	
2269	-12.09	-11.58	16.74	
2253	-55.89	-16.45	58.26	
1076	123.50	-18.58	124.89	
2241	-424.45	52.13	427.64	
2251	80.16	-5.38	80.34	
2252	56.05	16.87	58.53	
2256	93.03	-4.16	93.12	
2261	37.77	-53.83	65.76	

					2255	-0.15	-26.20	26.20
					2257	-80.98	30.63	86.58
					2259	9.39	-30.72	32.12
					2262	-8.95	-8.42	12.29
2255	1.43	-4.18	0.00	0.00				
					2242	18.90	-55.28	58.42
					2244	7.35	-15.59	17.24
					2251	-23.39	20.50	31.10
					2254	0.22	26.39	26.39
					2259	9.15	33.93	35.14
2256	1.43	-3.85	28.95	8.44				
					2244	40.25	-23.12	46.42
					2251	81.20	35.77	88.73
					2253	-92.97	4.55	93.08
2257	1.41	-3.50	42.03	12.26				
					1053	101.63	17.63	103.15
					2254	81.11	-29.83	86.43
					2258	-227.89	-0.53	227.89
2258	1.42	-2.46	22.41	6.54				
					2257	228.51	4.65	228.56
					2260	-254.46	-12.54	254.76
2259	1.42	-4.16	30.82	8.99				
					2254	-9.35	30.83	32.22
					2255	-9.10	-33.79	35.00
2260	1.43	-1.21	15.88	4.63				
					2241	-260.28	-13.55	260.63
					2258	255.33	18.18	255.97
2261	1.43	-3.91	15.88	4.63				
					2242	30.93	-53.01	61.37
					2253	-37.63	54.21	65.99
2262	1.42	-4.01	7.47	2.18				
					2254	8.95	8.43	12.30
2269	1.43	-3.91	12.14	3.54				
					2251	12.09	11.59	16.75
2351	1.38	21.74	0.00	0.00				
					2354	80.01	38.81	88.93
2352	1.37	20.60	0.00	0.00				
					2354	152.12	81.63	172.64
2353	1.34	18.85	0.00	0.00				
					2354	-0.02	-0.43	0.43
2354	1.34	18.85	0.00	0.00				
					574	-43.24	-48.48	64.96
					2351	-79.70	-33.81	86.58
					2352	-151.75	-75.57	169.53
					2353	0.02	0.43	0.43
					2355	108.95	45.98	118.25
					2356	90.34	44.33	100.63
					2363	73.41	68.85	100.65
2355	1.34	18.38	38.66	11.28				

					2354 -108.76 -44.85 117.65
					2357 70.79 40.09 81.35
2356	1.33	17.94	22.60	6.59	
					2354 -90.01 -42.40 99.50
					2357 67.24 37.74 77.10
2357	1.32	17.28	0.00	0.00	
					955 22.17 22.85 31.84
					2355 -70.46 -38.13 80.11
					2356 -67.05 -36.62 76.40
					2358 80.05 80.74 113.70
					2359 37.30 31.42 48.77
2358	1.22	12.82	78.45	22.88	
					2357 -79.72 -68.77 105.29
2359	1.31	16.95	34.93	10.19	
					2357 -37.23 -31.00 48.45
					2364 1.32 17.42 17.47
2360	1.30	17.46	0.00	0.00	
					955 16.26 -36.49 39.95
					2361 -11.31 -114.80 115.35
					2362 -22.26 -28.42 36.10
					2363 -24.47 -32.74 40.87
					2364 31.63 -15.88 35.39
2361	1.36	17.61	0.00	0.00	
					967 -4.43 124.27 124.35
					2360 11.52 120.01 120.56
2362	1.31	17.57	0.00	0.00	
					2360 22.29 28.57 36.23
					2363 -30.20 -43.56 53.00
					3275 4.15 -6.06 7.35
2363	1.31	17.63	20.17	5.88	
					2354 -72.98 -65.58 98.12
					2360 24.52 33.01 41.12
					2362 30.22 43.69 53.13
2364	1.30	16.96	33.99	9.91	
					2359 -1.32 -17.40 17.45
					2360 -31.58 16.20 35.49
2476	1.04	38.87	90.00	0.00	
					3402 276.98 -139.96 310.33
					3409 935.29 309.08 985.04
					3411 308.36 -424.01 524.28
					3436 204.40 198.64 285.02
					3489 1346.24 118.80 1351.47
2491	1.44	35.28	0.00	0.00	
					2582 779.02 961.24 1237.28
2492	1.41	35.39	0.00	0.00	
					2498 791.89 882.27 1185.53
2498	1.34	32.79	0.00	0.00	
					356 531.05 -684.67 866.48
					2492 -789.88 -803.47 1126.71

2499	1.43	32.36	0.00	0.00	2499 55.46 -845.15 846.97
					2520 -514.95 806.19 956.62
					2526 713.48 140.57 727.19
					2582 -16.37 -321.42 321.84
					356 858.14 -436.44 962.75
					2498 -52.26 899.96 901.47
2500	1.55	25.09	0.00	0.00	3501 -805.12 447.28 921.02
					475 -41.60 170.08 175.09
					3429 -60.32 -118.83 133.27
2501	1.39	11.95	0.00	0.00	3450 89.36 -202.75 221.56
					2240 489.54 -114.33 502.72
					2871 -525.72 268.73 590.42
					3438 -209.96 -47.82 215.34
					3456 112.14 -0.30 112.14
2502	1.53	15.47	0.00	0.00	3480 130.68 0.34 130.68
					1085 205.05 171.23 267.14
					2503 167.23 -56.73 176.59
					3438 78.63 233.25 246.15
2503	1.56	12.49	219.00	46.40	3440 -455.90 505.93 681.03
					1056 89.09 90.23 126.80
					2502 -166.81 66.46 179.56
					2504 22.78 5.75 23.49
					3458 -101.11 155.28 185.30
2504	1.55	12.18	23.90	6.90	3462 -62.09 -4.99 62.29
2505	1.43	11.90	10.90	1.80	2503 -22.72 -5.60 23.40
					1056 78.58 37.12 86.91
2506	1.45	3.47	44.10	13.00	3462 -89.17 -36.76 96.45
					1073 150.01 -56.57 160.32
					3456 -95.55 94.69 134.52
					3472 -21.27 52.15 56.32
2507	1.45	4.00	0.00	0.00	3483 -9.77 11.84 15.35
					1084 15.52 -25.52 29.87
					3480 -15.44 21.08 26.13
2520	1.23	36.54	0.00	0.00	3483 -2.30 23.78 23.89
					2498 521.07 -708.72 879.66
					3408 578.34 395.82 1130.81
2526	1.32	28.80	0.00	0.00	3425 537.18 709.69 890.07
					2498 -710.23 -89.26 715.82

					2870 196.50 -51.21 203.06
					3403 -519.25 788.44 944.06
					3440 1029.48 -424.99 1113.75
2582	1.36	32.82	44.40	29.50	
					2491 -776.92 -878.69 1172.90
					2498 16.49 326.91 327.33
					3418 -29.72 87.87 92.76
					3425 -0.87 34.85 34.86
					3427 18.26 32.92 37.65
					3428 369.68 -139.36 395.08
					3442 336.14 -311.93 458.57
2852	1.24	25.12	0.00	0.00	
					2870 -246.13 -479.89 539.33
2870	1.32	27.47	0.00	0.00	3470 350.20 736.95 815.93
					2526 -361.17 256.37 442.91
					2852 189.92 698.68 724.03
2871	1.31	25.42	256.00	40.80	2871 650.58 199.91 680.61
					2501 536.45 -141.51 554.80
					2870 -650.32 -174.57 673.34
2900	1.28	16.83	0.00	0.00	3473 820.95 439.92 931.39
					1233 0.35 7.01 7.02
2901	1.29	16.83	0.00	0.00	2901 -0.93 -16.65 16.67
2903	1.31	14.55	0.00	0.00	2900 0.94 16.76 16.78
2905	1.30	14.72	0.00	0.00	3353 -0.60 -0.54 0.81
					2906 -5.43 -15.35 16.29
2906	1.30	14.74	0.00	0.00	3352 2.93 7.24 7.81
					2905 5.41 15.33 16.25
					2907 -10.23 7.40 12.63
2907	1.29	14.97	0.00	0.00	3353 4.72 -23.68 24.15
					2906 10.23 -7.34 12.59
2909	1.13	10.00	0.00	0.00	3351 -17.88 -19.29 26.30
2996	0.99	16.84	8.55	2.49	1323 0.62 1.20 1.35
					869 -5.76 31.04 31.57
2997	0.92	15.79	1.84	0.54	3041 -2.80 -33.28 33.39
2998	0.96	18.75	12.74	3.72	3120 -0.36 -1.69 1.72
					3109 -34.67 -11.64 36.57
					3248 23.28 5.80 23.99

2999	0.93	22.83	3.30	0.96				
3000	1.35	15.48	8.89	2.59	926	-4.20	0.30	4.21
					418	-239.22	-211.82	319.52
3001	1.17	9.73	0.00	0.00	3006	231.47	213.11	314.63
					409	133.71	96.01	164.61
3002	1.35	20.02	3.37	0.98	3186	2.96	0.44	2.99
					376	-132.86	44.86	140.22
3003	1.43	17.53	1.72	0.50	427	173.03	116.88	208.81
3004	1.15	9.32	0.00	0.00	386	2.42	4.58	5.18
					372	136.18	159.91	210.04
3006	1.27	13.01	3.37	0.98	3266	0.70	0.30	0.76
					400	227.56	198.69	302.09
3007	1.42	22.55	4.23	1.23	3000	-225.22	-190.30	294.85
					375	-145.22	-62.84	158.24
3008	1.34	19.06	5.88	1.71	402	144.14	70.93	160.65
3009	1.34	19.21	0.00	0.00	427	-5.07	2.14	5.50
					411	-41.44	-8.08	42.22
3010	1.43	17.66	0.00	0.00	3193	42.92	11.31	44.39
					587	44.97	38.79	59.39
3011	1.39	18.75	2.65	0.77	3012	-49.22	-28.99	57.12
					3264	12.12	-1.98	12.29
3012	1.45	17.97	2.58	0.75	406	-188.68	-39.74	192.82
					431	192.44	57.34	200.80
3013	1.32	11.43	15.20	4.43	419	-46.24	-21.27	50.90
					3010	49.66	29.74	57.89
3014	1.46	24.47	0.00	0.00	570	-20.49	-2.16	20.61
					3194	6.93	33.81	34.51
					135	180.65	-171.35	248.99
3015	1.47	30.75	0.00	0.00	463	-319.36	9.65	319.50
					3054	29.27	9.87	30.89
3016	1.28	10.55	5.30	1.55	3133	110.29	163.17	196.95
					3205	2.60	88.20	88.24
					3017	-0.14	-1.55	1.56

3017	1.28	10.55	0.93	0.27	3194	-7.50	-2.07	7.78
3018	1.31	15.50	14.84	4.33	3016	0.14	1.52	1.52
3019	1.32	16.04	2.29	0.67	3254	-15.89	-5.35	16.77
3020	1.30	15.15	12.90	3.76	3254	-3.40	-1.93	3.91
3021	1.30	14.51	3.01	0.88	3022	4.60	-0.41	4.62
3022	1.30	14.89	1.58	0.46	3254	-19.26	-4.85	19.86
3023	1.30	14.70	0.00	0.00	3023	-3.66	-2.50	4.43
3024	1.33	17.06	4.95	1.44	3020	-4.58	0.41	4.60
3025	1.31	16.25	3.01	0.88	3023	2.89	0.22	2.90
3026	1.29	13.97	4.37	1.27	3021	3.66	2.52	4.44
3027	1.30	16.35	3.08	0.90	3022	-2.89	-0.10	2.89
3028	1.30	15.99	6.67	1.94	3193	-6.29	-3.31	7.11
3029	1.34	15.32	0.00	0.00	858	-3.78	-25.15	25.44
3030	1.08	18.10	1.93	0.56	842	-36.26	-19.76	41.30
3031	1.30	12.45	2.94	0.86	879	31.88	20.21	37.75
3032	1.30	15.04	4.37	1.27	844	-3.30	5.98	6.83
3033	1.07	17.97	6.09	1.78	844	-17.02	-5.41	17.85
3034	1.29	15.90	4.23	1.23	913	10.27	4.70	11.29
3035	1.29	17.08	2.80	0.81	1283	18.64	16.09	24.62
3037	1.37	22.03	0.00	0.00	1293	-17.49	-8.17	19.31
					3097	2.90	0.00	2.90
					894	-2.32	0.46	2.37
					871	-2.60	0.06	2.60
					873	-4.14	-0.81	4.22
					894	-6.22	-0.81	6.28
					881	-4.16	-0.68	4.22
					901	-3.20	-0.10	3.20
					3038	7.05	-2.97	7.65
					3039	3.12	-6.51	7.22

3038	1.37	21.95	9.39	2.74	3133	-44.89	-130.98	138.46
3039	1.38	21.87	0.00	0.00	3037	-7.11	2.80	7.65
3040	1.37	21.58	3.44	1.00	3037	-3.11	6.55	7.25
3041	1.03	15.68	0.28	0.08	3040	3.04	-0.25	3.05
3042	0.37	52.57	3.07	0.90	3039	-3.10	0.10	3.10
3043	1.06	15.07	1.12	0.33	849	-4.64	-32.78	33.10
3044	1.05	15.55	2.79	0.81	2996	3.62	34.60	34.79
3045	0.62	25.44	4.97	1.45	866	-29.90	13.32	32.73
3046	1.04	13.07	4.02	1.17	883	23.28	-14.31	27.32
3047	1.03	14.54	7.71	2.25	849	-0.82	15.28	15.30
3048	1.06	14.54	9.22	2.69	853	-0.49	-14.60	14.61
3049	1.02	12.40	6.71	1.96	730	28.57	-14.35	31.97
3050	1.09	14.77	13.80	4.03	738	-31.27	14.47	34.46
3051	1.37	22.01	18.35	5.35	880	-37.27	-86.22	93.93
3052	1.36	21.75	0.00	0.00	882	31.76	85.44	91.15
053	1.36	21.62	13.69	3.99	904	-3.50	-0.35	3.52
3054	1.46	23.86	0.00	0.00	849	-40.34	-7.63	41.05
3055	1.45	23.65	0.00	0.00	910	32.47	6.33	33.09
					908	-7.37	3.47	8.14
					911	-5.60	-0.64	5.63
					908	5.57	17.48	18.35
					915	-19.26	-20.38	28.04
					3052	40.33	26.85	48.45
					3133	-114.28	-173.91	208.10
					3051	-40.42	-26.72	48.45
					3053	34.65	13.99	37.37
					3052	-34.73	-13.97	37.43
					3068	13.60	-0.80	13.63
					3014	-29.26	-9.52	30.77
					3055	27.09	21.88	34.82
					3054	-27.07	-21.94	34.84

					3067	12.10	-6.30	13.64
					3141	-1.99	-6.13	6.44
3056	0.95	23.04	0.00	0.00				
					926	137.90	163.91	214.20
					960	-139.54	-159.89	212.22
3057	0.77	20.84	9.11	2.66				
					934	-14.92	8.17	17.01
3058	0.99	20.66	28.22	8.23				
					772	-1.27	-12.07	12.14
					941	-28.30	6.59	29.06
3059	0.99	20.64	24.25	7.07				
					772	-26.90	16.87	31.76
3060	0.85	22.28	8.61	2.51				
					938	104.48	135.76	171.31
					946	-115.06	-133.47	176.22
3061	0.99	20.99	24.53	7.16				
					941	-84.28	-13.29	85.33
					3109	49.13	15.98	51.67
					3111	9.31	1.82	9.49
3062	1.01	21.67	4.64	1.35				
					777	47.30	28.49	55.21
					780	-54.40	-24.59	59.70
3063	0.99	23.04	14.31	4.17				
					933	-51.23	0.24	51.23
					945	35.81	-0.40	35.82
3064	0.99	22.82	19.22	5.61				
					945	-22.67	6.66	23.62
3065	1.00	23.83	21.96	6.41				
					947	-48.86	36.68	61.10
3067	1.45	23.61	4.73	1.38				
					3055	-12.12	6.26	13.64
					3070	8.60	-8.83	12.32
3068	1.36	21.57	0.00	0.00				
					3053	-13.64	0.77	13.66
					3271	8.68	-10.23	13.42
3070	1.45	23.57	11.18	3.26				
					3067	-8.64	8.73	12.28
3071	1.22	19.46	4.59	1.34				
					848	-4.73	-0.58	4.76
3072	1.08	14.71	3.47	1.01				
					853	3.23	-5.77	6.61
					3267	-6.59	5.89	8.84
3073	1.07	17.22	0.78	0.23				
					864	-18.63	4.69	19.21
					3098	6.64	0.33	6.64
					3152	12.53	-6.44	14.09
3074	1.09	15.77	1.34	0.39				
					865	-0.78	4.77	4.84
3075	0.96	18.56	2.46	0.72				

3076	0.92	21.38	6.72	1.96	869	-2.65	0.35	2.68
3077	1.08	14.96	3.36	0.98	876	-6.72	-1.53	6.89
3078	1.15	13.93	3.47	1.01	1299	21.36	38.92	44.40
3079	1.14	15.65	1.79	0.52	1300	-0.33	8.94	8.94
					1279	-4.92	-17.38	18.06
					1301	0.71	17.23	17.25
					3198	2.36	-0.17	2.37
3080	0.94	20.49	6.27	1.83	868	11.62	-25.02	27.58
					884	-18.47	24.21	30.45
3081	1.16	13.29	1.90	0.56	1290	-33.57	-19.78	38.96
					1350	32.12	21.09	38.42
3082	1.24	11.69	3.81	1.11	1341	-3.31	-0.64	3.37
3083	0.57	43.11	6.61	1.93	841	-83.60	157.97	178.73
					920	72.61	-158.52	174.36
3084	0.34	58.22	3.59	1.05	866	-4.14	-0.72	4.21
3085	1.35	15.76	2.69	0.78	1322	1.01	5.06	5.16
3086	1.09	15.65	1.01	0.29	852	24.35	-4.49	24.76
					865	-27.40	10.17	29.22
3087	1.15	13.81	5.04	1.47	1300	-4.86	-0.72	4.92
3088	1.26	12.81	3.70	1.08	1329	-0.62	3.44	3.50
3089	1.08	14.29	2.69	0.78	856	-2.79	-0.26	2.80
3090	1.07	18.61	4.14	1.21	864	3.29	-9.28	9.84
					885	-18.14	16.39	24.45
3091	1.11	17.77	2.80	0.82	860	-3.18	0.89	3.31
3092	1.13	11.72	2.24	0.65	1350	-1.57	0.40	1.62
3093	1.26	12.96	1.46	0.43	1349	-1.22	0.44	1.29
3097	1.34	15.20	3.30	0.96	3029	-3.00	-0.20	3.01
3098	1.06	16.96	4.03	1.18	3073	-6.66	-0.36	6.67
					3099	2.64	-0.27	2.65

3099	1.06	16.75	2.24	0.65			
3100	1.13	22.30	0.00	0.00	3098	-2.73	0.07 2.73
					969	196.78	-308.74 366.12
3101	1.64	-10.56	3.94	1.15	971	-201.61	327.80 384.84
3102	1.36	-7.48	5.53	1.61	3175	-5.87	-0.53 5.89
3103	1.08	4.90	2.07	0.60	3177	-10.63	-2.67 10.96
3104	1.28	3.91	0.00	0.00	1153	-1.99	-0.19 2.00
					1154	-7.64	-1.00 7.71
3105	1.22	4.99	5.65	1.65	3272	5.50	0.26 5.51
3106	1.10	6.07	3.66	1.07	1160	-4.57	-0.43 4.59
3107	1.12	3.75	8.60	2.51	1161	-3.06	-0.91 3.20
3109	0.97	19.11	0.00	0.00	1175	-1.80	-1.46 2.32
					2998	34.72	11.88 36.69
					3061	-48.80	-14.28 50.85
3110	0.97	18.96	13.69	3.99	3110	14.20	2.54 14.42
3111	0.98	20.48	9.22	2.69	3109	-14.26	-2.67 14.51
3113	0.73	17.14	1.84	0.54	3061	-9.40	-2.05 9.62
3114	0.73	16.97	3.75	1.09	3124	-1.63	-0.62 1.74
3118	1.19	14.63	1.51	0.44	3124	-3.40	-1.34 3.65
3119	1.16	14.65	2.56	0.75	899	-12.85	23.85 27.09
3120	0.92	15.77	2.70	0.79	847	-2.58	-0.41 2.61
					859	-9.23	4.52 10.27
3121	1.06	15.49	1.51	0.44	2997	0.36	1.66 1.70
3122	0.42	30.91	3.68	1.07	905	-3.26	3.18 4.55
3123	1.08	15.49	3.35	0.98	883	-16.62	4.76 17.29
3124	0.73	17.53	2.17	0.63	900	-6.12	2.98 6.81
					888	12.11	47.28 48.80
					917	-20.21	-48.12 52.20
					3113	1.52	0.43 1.58

3126	1.11	15.52	1.84	0.54	3114	3.34	1.24	3.56
3127	0.83	16.44	1.12	0.33	909	-8.21	11.70	14.29
3128	1.33	15.38	2.37	0.69	917	-1.90	0.53	1.97
3130	1.39	-0.70	3.18	0.93	903	-2.54	-0.66	2.62
3132	1.38	-7.58	3.94	1.15	3185	-7.19	-1.61	7.37
3133	1.37	22.06	0.00	0.00	3134	-5.55	-1.31	5.70
3134	1.38	-7.37	11.06	3.22	3014	-110.00	-148.86	185.09
3135	1.31	9.62	3.04	0.89	3037	44.89	131.20	138.67
3136	1.30	10.14	5.33	1.55	3051	114.36	174.39	208.54
3137	1.24	4.50	2.47	0.72	3132	5.34	1.16	5.46
3138	1.28	9.26	5.61	1.64	3244	-17.17	-3.77	17.58
3139	1.31	9.90	3.04	0.89	1011	-2.24	-0.08	2.25
3140	1.20	4.80	6.37	1.86	1031	5.79	10.06	11.61
3141	1.45	23.64	3.58	1.04	895	-1.67	-0.46	1.73
3146	1.35	12.98	2.76	0.81	870	-51.54	-8.63	52.26
3147	1.40	10.42	7.23	2.11	893	46.07	8.24	46.80
3148	1.25	7.12	3.04	0.89	1027	-2.72	-7.20	7.70
3149	1.39	8.92	1.43	0.42	1031	0.25	7.60	7.61
3152	1.07	16.38	1.68	0.49	893	39.04	44.59	59.27
3153	1.38	1.91	1.12	0.33	3055	1.98	6.11	6.43
					948	19.16	75.14	77.54
					939	-60.29	50.23	78.47
					1070	53.28	-47.52	71.40
					373	391.76	353.97	527.99
					1069	-32.04	-54.28	63.03
					1071	31.96	60.31	68.26
					3073	-12.52	6.54	14.12
					3267	10.55	-6.22	12.25
					1036	-56.24	27.74	62.71

3154	1.37	-2.79	0.90	0.26	3160	54.42	-27.99	61.20
3155	1.39	-6.82	1.50	0.44	1021	25.15	12.15	27.93
3156	1.37	3.60	3.15	0.92	1032	21.58	9.74	23.68
3157	1.06	15.24	1.87	0.55	1022	2.83	2.32	3.65
3158	1.50	-6.14	0.90	0.26	905	-2.13	0.04	2.13
3159	1.37	-0.69	2.77	0.81	1054	42.27	-35.36	55.11
3160	1.37	-0.45	0.00	0.00	3163	-42.09	37.40	56.30
3161	1.46	1.81	1.50	0.44	3160	-3.58	-0.43	3.60
3162	1.48	-1.43	2.02	0.59	1021	51.87	-27.79	58.84
3163	1.49	-5.02	3.52	1.03	3153	-53.24	30.07	61.14
3164	1.46	-6.80	2.10	0.61	3159	3.36	0.20	3.36
3165	1.48	-1.97	3.30	0.96	3166	-4.14	-1.33	4.35
3166	1.46	1.87	0.00	0.00	1055	2.36	1.81	2.98
3171	1.38	-0.81	6.28	1.83	1054	42.30	-36.22	55.68
3172	1.34	-5.62	8.71	2.54	1055	-84.39	78.80	115.46
3173	1.43	-4.11	7.12	2.08	3158	42.27	-36.86	56.09
3174	1.35	-5.28	6.28	1.83	1058	79.22	26.22	83.44
3175	1.65	-10.36	1.59	0.46	1052	-43.92	13.62	45.98
3176	1.41	-7.70	10.22	2.98	1059	109.24	22.13	111.45
					1055	166.72	-157.26	229.19
					1070	-166.37	164.04	233.64
					3161	3.73	0.84	3.82
					3185	-8.23	-2.00	8.47
					3246	-9.67	-2.12	9.90
					1024	-6.87	-2.05	7.17
					1025	-4.85	-1.89	5.21
					1044	-4.84	0.27	4.85
					3101	5.62	0.36	5.63
					1026	-24.81	-88.22	91.64
					1029	152.52	181.80	237.31

3177	1.36	-7.36	8.71	2.54				
					1030	21.11	8.23	22.66
3178	1.39	-7.62	6.28	1.83	3102	10.60	2.66	10.93
3179	1.35	-4.33	2.35	0.68	1033	27.31	4.07	27.61
					1039	-24.86	6.73	25.75
3180	1.43	-4.97	3.94	1.15	1045	26.09	-5.60	26.69
					1024	-116.48	-29.61	120.18
3181	1.65	-10.28	3.94	1.15	1041	118.28	29.69	121.95
3182	1.07	-0.71	0.00	0.00	1044	-2.30	-0.31	2.32
					3184	3.49	0.61	3.55
					3191	6.77	1.87	7.02
3183	1.08	-0.16	2.08	0.61	3192	-10.89	-1.99	11.07
3184	1.06	-1.01	3.61	1.05	3192	-2.33	-0.55	2.40
3185	1.39	-0.61	0.00	0.00	3182	-3.61	-0.73	3.68
					3130	7.16	1.59	7.33
					3171	8.19	1.94	8.42
3186	1.17	9.50	3.37	0.98	3245	-14.59	-3.35	14.97
3187	1.40	-4.76	0.00	0.00	3001	-3.00	-0.44	3.04
					1057	94.41	111.36	145.99
3188	1.43	-6.26	0.00	0.00	3246	18.01	72.12	74.34
					1057	-17.24	69.69	71.80
					1058	1.35	-71.13	71.14
3189	1.44	-0.05	0.00	0.00	3244	20.98	63.84	67.20
					1066	136.14	-4.62	136.21
					1067	-148.09	6.19	148.21
3191	1.06	-0.91	6.91	2.02	3245	17.16	85.94	87.64
3192	1.08	-0.07	0.00	0.00	3182	-6.79	-1.87	7.04
					479	-12.89	-1.89	13.03
					3182	10.84	2.02	11.03
3193	1.33	17.23	0.00	0.00	3183	2.23	0.48	2.29
					3009	-42.92	-9.74	44.01
					3024	6.26	3.25	7.05
3194	1.29	11.17	0.00	0.00	3254	36.27	7.20	36.98

3195	1.38	3.44	2.63	0.77	3013	-6.93	-33.05	33.77
					3016	7.46	2.01	7.73
3197	1.37	3.08	3.43	1.00	1162	-1.65	-0.21	1.67
3198	1.14	15.58	2.58	0.75	1203	6.43	-4.44	7.82
3201	1.53	32.72	0.00	0.00	3079	-2.37	0.10	2.38
3202	1.54	32.58	0.00	0.00	3205	880.55	1115.46	1421.13
3203	0.77	-21.58	17.92	5.23	3205	869.12	1238.26	1512.83
					3237	-46.78	-12.55	48.43
3204	1.29	21.76	0.00	0.00	3256	11.57	2.81	11.91
					972	282.36	429.64	514.12
					975	212.53	-159.28	265.59
					1087	37.97	67.73	77.65
3205	1.42	30.73	0.00	0.00	3205	-554.66	-263.18	613.92
					462	644.10	-260.64	694.84
					3015	-2.54	-85.45	85.49
					3201	-856.14	354.12	1324.44
					3202	-841.79	2987.23	1401.66
3206	1.51	22.33	0.00	0.00	3204	557.95	368.23	668.51
					398	161.72	-161.71	228.70
3211	0.77	-18.00	25.32	7.39	472	-155.24	215.65	265.72
					3253	-55.02	-18.19	57.94
3214	0.75	-19.77	0.00	0.00	3262	24.52	5.32	25.09
					3215	45.73	15.70	48.35
3215	0.74	-22.89	14.68	4.28	3220	-47.22	-17.59	50.39
					3214	-45.55	-12.93	47.35
3216	0.71	-27.12	30.47	8.89	3216	30.20	9.84	31.77
3220	0.77	-17.82	7.39	2.16	3215	-31.02	-7.73	31.97
					3214	47.57	19.58	51.45
3221	0.78	-16.12	26.33	7.68	3253	-56.48	-23.18	61.05
3222	0.79	-14.97	17.36	5.07	3225	-30.20	-12.49	32.68
					3223	-95.51	-47.73	106.77
3223	0.79	-14.77	0.00	0.00	3224	61.88	19.55	64.90

					3222	95.58	48.20	107.04	
					3228	18.85	4.32	19.34	
					3230	-257.58	-167.06	307.01	
					3252	26.98	2.07	27.06	
					3253	109.60	43.36	117.86	
3224	0.79	-15.52	11.65	3.40					
					3222	-61.85	-18.91	64.68	
					3225	47.90	12.81	49.58	
3225	0.79	-15.88	22.52	6.57					
					3221	30.18	12.60	32.71	
					3224	-47.88	-12.52	49.49	
3228	0.79	-15.07	20.39	5.95					
					3223	-18.95	-4.27	19.42	
					3236	5.68	0.20	5.68	
					3252	-8.76	-2.14	9.02	
3230	1.06	2.16	0.00	0.00					
					3223	264.10	313.61	410.00	
					3239	-257.70	-206.50	330.23	
3231	1.34	9.89	5.20	1.52					
					285	-5.46	-0.69	5.50	
3232	1.13	1.76	0.00	0.00					
					3233	30.06	-4.77	30.44	
					3235	30.23	7.93	31.25	
					3238	-64.22	-1.25	64.23	
3233	1.13	0.18	26.33	7.68					
					3232	-31.33	4.06	31.60	
					3234	3.96	-4.74	6.18	
3234	1.13	-0.18	4.59	1.34					
					3233	-5.50	3.15	6.34	
3235	1.13	1.60	31.26	9.12					
					3232	-30.36	-7.99	31.39	
3236	0.79	-15.23	6.50	1.89					
					3228	-6.09	-0.27	6.09	
3237	0.79	-20.54	0.00	0.00					
					543	177.62	98.17	202.94	
					3203	47.07	13.51	48.97	
3238	1.13	2.28	0.00	0.00					
					309	-63.02	0.85	63.02	
					3232	64.06	1.50	64.08	
3239	1.10	3.99	0.00	0.00					
					342	-470.62	-795.91	924.64	
					344	196.05	591.69	623.32	
					3230	258.32	221.05	339.99	
3244	1.40	-6.69	2.95	0.86					
					3134	17.14	3.86	17.57	
					3188	-20.89	-62.00	65.42	
3245	1.39	-0.34	2.35	0.68					
					3185	14.56	3.38	14.95	
					3189	-17.05	-83.20	84.93	

3246 1.36 -5.12 0.00 0.00

3248 0.96 18.32 22.91 6.68

3249 1.36 -5.17 5.53 1.61

3251 0.79 -15.05 22.29 6.50

3252 0.79 -14.87 0.00 0.00

3253 0.78 -16.85 0.00 0.00

3254 1.32 16.16 0.00 0.00

3256 0.77 -21.76 17.92 5.23

3262 0.77 -18.28 26.55 7.74

3264 1.43 17.54 3.51 1.02

3265 1.43 17.43 9.75 2.84

3266 1.15 9.33 2.08 0.61

3267 1.07 15.17 3.47 1.01

3271 1.36 21.53 16.13 4.70

3272 1.28 3.84 3.34 0.98

3273 1.28 3.68 3.34 0.98

3275 1.31 17.56 5.30 1.55

3301 1.20 14.33 5.69 1.66

3302 1.08 0.39 14.11 4.11

3172 9.64 2.09 9.86

3187 -17.89 -69.78 72.03

3249 3.80 1.42 4.06

2998 -23.25 -5.62 23.92

3246 -3.83 -1.44 4.09

3252 -26.50 -12.16 29.16

3223 -27.00 -2.03 27.08

3228 8.63 2.10 8.88

3251 26.47 12.23 29.16

3211 55.06 19.27 58.33

3220 56.51 24.25 61.50

3223 -108.79 -38.60 115.44

3018 15.87 5.49 16.80

3019 3.34 1.82 3.80

3020 19.31 5.08 19.97

3193 -36.09 -6.56 36.68

3203 -11.70 -2.82 12.04

3211 -24.58 -5.26 25.13

3010 -12.20 1.99 12.36

3265 7.66 -2.35 8.01

3264 -8.01 1.90 8.23

3004 -0.73 -0.44 0.86

3072 6.55 -5.88 8.80

3152 -10.64 6.26 12.35

3068 -8.71 10.19 13.40

3104 -5.53 -0.29 5.54

3273 2.99 0.33 3.01

3272 -3.18 -0.46 3.22

2362 -4.16 5.97 7.28

371 133.51 180.51 224.51

3303	0.45	-22.50	25.06	7.31	479	-13.60	-3.36	14.01
3326	1.06	5.83	2.80	0.82	10	-57.51	-10.29	58.42
3327	1.24	22.10	2.99	0.87	1395	28.23	0.57	28.24
3328	1.14	13.96	9.53	2.78	1396	-66.67	15.87	68.53
3329	1.03	10.86	25.68	7.49	846	-15.43	-59.69	61.65
3330	1.05	12.14	17.37	5.07	889	-25.81	-21.02	33.29
3331	1.02	10.59	14.76	4.30	890	-17.49	-19.16	25.94
3332	1.42	4.05	0.00	0.00	891	-14.82	-10.92	18.41
3351	1.30	14.99	0.00	0.00	1144	26.41	66.28	71.34
3352	1.29	14.69	11.67	3.40	1190	18.71	26.42	32.38
3353	1.31	14.57	25.68	7.49	2024	-17.65	47.22	50.41
3354	1.44	18.19	14.01	4.09	2907	17.63	18.94	25.88
3355	1.44	17.75	14.01	4.09	3352	9.87	3.44	10.46
3400	1.07	36.80	0.00	0.00	2905	-2.98	-7.28	7.87
3401	1.02	35.86	0.00	0.00	3351	-9.87	-3.38	10.44
3402	1.06	37.06	0.00	0.00	3353	0.25	-25.65	25.65
					1342	101.19	80.09	129.05
					2903	0.55	0.40	0.68
					2906	-4.71	23.80	24.26
					3352	-0.20	25.95	25.95
					3354	-69.65	-68.44	97.65
					3353	72.03	80.34	107.90
					3355	13.91	3.06	14.24
					3354	-13.85	-2.85	14.14
					3401	365.32	844.48	920.11
					3407	-182.37	58.06	191.39
					3408	-892.18	242.45	1647.40
					3417	694.83	929.64	1160.61
					3400	-371.12	-852.38	929.67
					3409	-217.44	17.11	218.11
					3416	924.51	818.98	1235.09
					3493	-358.42	448.89	574.43
					2476	-284.81	87.14	297.85

					3407 -196.06 -587.23 619.09
					3411 -247.45 -154.48 291.71
					3414 713.21 1064.97 1281.73
3403	1.18	34.12	0.00	0.00	
					2526 358.58 -864.02 935.47
					3412 -922.62 670.46 1140.50
					3421 309.36 372.54 484.25
3407	1.07	37.26	0.00	0.00	
					3400 175.13 -92.88 198.24
					3402 192.95 573.39 604.98
					3412 -378.45 -342.54 510.44
3408	1.21	40.47	0.00	0.00	
					2520 1060.07 -374.58 1124.30
					3400 893.64 1512.95 1757.16
					3500 -318.33 -700.77 769.68
3409	1.02	36.40	0.00	0.00	
					2476 -937.93 -290.61 981.92
					3401 208.96 -62.70 218.17
					3435 720.66 396.89 822.72
3411	1.06	37.83	0.00	0.00	
					2476 -311.02 409.02 513.84
					3402 239.40 93.38 256.97
					3412 -525.84 -783.91 943.94
					3434 585.88 376.74 696.56
3412	1.10	39.09	0.00	0.00	
					3403 836.29 -722.36 1105.08
					3407 363.68 271.35 453.75
					3411 520.64 768.00 927.84
3413	0.97	31.65	0.00	0.00	
					3416 449.77 116.62 464.64
					3420 -21.09 -4.31 21.52
					3424 -277.24 -26.27 278.49
					3433 -22.71 -5.80 23.44
					3435 -90.57 -66.87 112.58
					3436 -33.91 -5.54 34.36
					3491 -7.25 -7.14 10.18
3414	0.96	33.53	682.00	371.00	
					3402 -710.33 -931.15 1171.16
					3415 261.49 -448.90 519.51
					3416 38.58 4.92 38.89
					3417 -7.75 -102.17 102.47
					3420 -337.82 -153.14 370.91
					3420 -145.52 -67.87 160.57
					3420 -337.09 -149.44 368.73
					3420 -144.79 -64.17 158.37
					3425 -14.38 -66.22 67.76
					3434 -49.23 -94.87 106.88
					3435 4.84 -10.70 11.75
3415	1.03	30.73	1157.00	466.00	521.00 1572.49

					3414	-256.85	495.07	557.73	
					3416	18.79	347.83	348.34	
					3417	-97.60	106.04	144.12	
					3420	-36.19	7.47	36.95	
					3434	-202.08	43.47	206.71	
					3435	-51.54	100.37	112.83	
					3436	-11.65	6.23	13.21	
3416	0.95	30.98	1674.00	978.00					
					3401	-921.68	-685.80	1148.83	
					3414	-38.31	-3.16	38.44	
					3415	-15.91	-320.34	320.74	
					3417	-151.23	-110.05	187.03	
					3413	-441.92	-109.02	455.17	
					3492	10.51	-3.39	11.04	
					3494	-118.88	-0.89	118.88	
3417	0.99	33.47	802.00	430.00					
					3400	-692.54	-822.35	1075.12	
					3414	8.09	105.30	105.61	
					3415	98.46	-97.21	138.37	
					3416	152.55	121.50	195.02	
					3420	-68.26	-13.69	69.61	
					3424	-274.32	-9.18	274.48	
					3435	11.23	3.11	11.65	
					3494	-42.04	7.30	42.67	
3418	1.19	36.24	232.00	136.00					
					2582	30.39	-74.80	80.74	
					3419	85.29	17.87	87.14	
					3424	-161.18	237.22	286.80	
					3425	9.79	0.40	9.80	
					3427	209.41	-28.91	211.40	
					3502	-407.80	-261.86	484.64	
3419	1.12	28.24	138.00	15.00					
					3418	-82.07	-5.50	82.25	
					3427	-101.22	-123.99	160.06	
					3443	40.72	-71.93	82.65	
					3498	94.28	215.31	235.05	
					3502	-95.21	-13.97	96.23	
3420	1.03	39.76	523.00	143.00	1220.00	1540.03			
					3414	342.21	196.20	394.46	
					3414	146.91	82.80	168.64	
					3414	342.35	198.74	395.86	
					3414	147.05	85.35	170.03	
					3415	36.91	-1.70	36.95	
					3413	21.57	7.70	22.90	
					3417	69.11	21.95	72.51	
					3421	100.26	-97.64	139.95	
					3425	38.15	-63.86	74.39	
					3445	23.67	-19.66	30.78	
					3467	-79.60	9.01	80.11	

3421 1.15 32.92 414.00 198.00

3403 -309.03 -356.64 471.90
3420 -97.44 120.69 155.12
3422 187.59 -160.07 246.61
3425 -23.25 -13.87 27.08
3445 81.81 -10.43 82.48
3467 -281.78 203.54 347.61
3468 25.03 32.84 41.29

3422 1.25 25.53 37.30 20.10

3421 -185.83 184.82 262.09
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3448 238.69 -94.10 256.57

3423 1.39 19.47 14.50 11.70

3438 252.07 -86.09 266.37
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3446 101.00 -107.76 147.69

3424 1.03 43.41 1000.00 613.00

3413 283.08 87.48 296.29
3417 279.79 58.76 285.89
3418 165.45 -201.81 260.96
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3494 17.98 21.94 28.37
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2520 -536.14 -660.58 850.77
2582 1.69 -30.08 30.13
3414 16.04 81.16 82.73
3418 -9.73 -0.12 9.73
3420 -36.69 76.23 84.60
3421 23.43 14.92 27.78
3422 61.45 -47.98 77.96
3424 -334.07 392.40 515.34
3427 10.75 -6.82 12.73
3440 158.31 -164.92 228.61

3427 1.19 30.35 0.00 0.00

2582 -17.16 -28.02 32.86
3418 -207.57 38.19 211.05
3419 100.16 124.06 159.45
3425 -10.31 7.67 12.85
3449 134.41 -117.94 178.82

3428 1.38 30.10 17.30 14.90

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3441 239.92 -129.16 272.48
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3429 1.55 25.12 5.40 -1.30

2500 60.22 118.70 133.11
3430 -62.57 -39.37 73.93

3430 1.56 25.89 0.00 0.00

						3429	66.30	28.47	72.15
						3432	-114.16	-137.64	178.82
						3442	-25.08	227.05	228.43
						3452	83.45	-99.74	130.05
3432	1.57	26.10	0.00	0.00					
						3430	115.10	137.74	179.50
						3453	-14.04	-27.35	30.75
3433	1.03	39.20	1365.00	201.00	1623.00	268.11			
						3413	23.14	9.29	24.93
						3434	101.40	-0.17	101.40
						3436	76.88	38.32	85.91
						3467	-68.28	8.92	68.86
						3468	26.97	0.23	26.97
						3491	27.27	-4.36	27.61
						3492	70.08	23.30	73.85
3434	1.03	34.99	314.00	163.00					
						3411	-585.02	-336.42	674.85
						3414	50.03	102.69	114.23
						3415	203.83	-28.22	205.77
						3433	-100.66	7.58	100.94
						3435	107.20	90.99	140.61
						3468	11.54	0.66	11.56
3435	0.99	32.57	736.00	439.00					
						3409	-719.36	-335.49	793.75
						3414	-4.77	11.04	12.03
						3415	52.21	-94.13	107.64
						3413	90.83	69.32	114.26
						3417	-11.21	-2.91	11.58
						3434	-106.32	-82.78	134.75
						3436	-35.93	-3.79	36.13
3436	1.02	37.48	161.00	220.00					
						2476	-204.25	-189.03	278.30
						3415	12.07	-4.73	12.96
						3413	34.63	9.35	35.87
						3433	-76.62	-39.98	86.42
						3435	36.48	7.04	37.16
						3491	6.49	-4.45	7.87
						3492	30.85	7.39	31.72
3438	1.42	14.55	16.60	11.80					
						2501	205.82	53.49	212.66
						2502	-85.44	-222.42	238.27
						3423	-248.95	109.68	272.04
						3455	98.59	82.92	128.82
3440	1.34	26.01	25.00	12.30					
						2502	471.46	-369.60	599.06
						2526	1328.09	484.24	1136.39
						3422	35.35	131.21	135.89
						3423	376.35	-152.47	406.07
						3425	-150.73	213.36	261.23

					3441	-70.34	-144.75	160.94
					3458	332.49	-100.71	347.40
3441	1.41	26.86	0.00	0.00				
					3428	-237.90	138.99	275.53
					3440	71.68	143.24	160.18
					3442	-13.53	-136.20	136.87
					3457	183.53	-150.22	237.16
3442	1.48	26.76	1.90	1.30				
					2582	-327.65	375.82	498.59
					3430	25.97	-219.94	221.46
					3441	9.09	136.90	137.20
					3463	274.53	-300.00	406.65
3443	1.16	26.92	24.00	52.80				
					3419	-40.58	75.69	85.88
					3444	19.97	-106.14	108.01
					3449	-3.37	-22.45	22.70
3444	1.63	18.95	118.00	45.90				
					3443	-7.10	151.33	151.50
					3449	-25.36	78.61	82.60
					3452	-97.15	77.53	124.29
					3464	-25.73	-122.28	124.96
					3499	35.77	184.83	188.26
3445	1.15	31.39	410.00	73.20				
					3420	-22.75	25.34	34.05
					3421	-81.36	12.58	82.33
					3467	-56.36	41.22	69.83
					3468	26.63	43.76	51.22
3446	1.44	17.34	181.00	112.00				
					3423	-100.74	115.80	153.48
					3447	138.96	-7.59	139.16
					3448	-25.75	56.05	61.68
					3455	36.47	4.64	36.76
					3458	-25.57	32.90	41.67
3447	1.44	14.50	179.00	80.30				
					3446	-138.83	13.84	139.52
					3448	-40.03	94.63	102.75
3448	1.27	22.48	175.00	53.30				
					3422	-237.93	108.77	261.61
					3446	27.05	-47.21	54.41
					3447	46.64	-77.92	90.81
					3458	-10.29	-35.64	37.09
3449	1.26	26.54	148.00	39.70				
					3427	-133.84	134.22	189.55
					3443	3.82	24.31	24.60
					3444	27.44	-57.62	63.82
					3451	-29.22	-39.56	49.19
					3464	-16.37	-100.94	102.26
3450	1.64	23.53	60.60	19.40				
					2500	-88.71	217.18	234.60

					3452	-17.78	39.89	43.68
					3462	48.84	-33.38	59.16
3451	1.39	27.74	46.00	19.50				
					3428	-108.57	29.08	112.40
					3449	31.37	44.39	54.35
					3464	31.25	-92.07	97.23
3452	1.59	25.14	32.80	10.70				
					3430	-83.31	102.23	131.88
					3444	102.04	-64.76	120.86
					3450	18.30	-38.11	42.27
					3453	-140.04	62.30	153.27
					3454	3.62	49.12	49.25
					3464	64.62	-123.14	139.06
3453	1.58	26.20	20.20	9.80				
					3432	14.05	27.49	30.87
					3452	140.48	-59.37	152.51
					3454	164.79	3.95	164.84
3454	1.57	25.18	169.00	59.10				
					3452	-3.56	-48.71	48.84
					3453	-164.16	-0.98	164.16
3455	1.38	12.53	149.00	71.30				
					3438	-98.42	-77.03	124.98
					3446	-35.02	-1.49	35.05
					3456	43.20	-26.68	50.78
					3458	-58.99	34.31	68.24
3456	1.39	9.54	55.00	48.20				
					2501	-111.94	5.01	112.05
					2506	100.88	-80.77	129.23
					3455	-42.23	29.24	51.36
3457	1.49	23.36	87.30	49.40				
					3441	-182.72	169.24	249.06
					3458	59.87	82.72	102.11
					3462	37.68	-106.47	112.94
3458	1.37	22.13	177.00	87.00				
					2503	110.41	-119.60	162.77
					3440	-331.08	125.33	354.01
					3446	26.82	-29.13	39.59
					3448	11.32	38.32	39.95
					3455	63.67	-23.91	68.01
					3457	-56.87	-75.14	94.24
3462	1.68	17.77	110.00	30.10				
					2503	66.24	11.54	67.24
					2505	99.99	53.80	113.55
					3450	-46.52	39.18	60.82
					3457	-30.79	124.33	128.09
					3463	-199.52	186.20	272.91
3463	1.63	21.79	28.40	11.60				
					3442	-272.53	355.31	447.79
					3462	205.31	-166.32	264.22

3464	1.71	18.52	42.20	12.10				
					3464	41.35	-127.61	134.14
					3444	27.96	128.11	131.12
					3449	41.13	132.65	138.88
					3451	-19.78	117.85	119.49
					3452	-53.57	139.94	149.85
					3463	-35.70	136.16	140.76
3465	1.04	12.36	1706.00	530.00	2273.00	802.00		
					3466	740.09	-33.21	740.84
					3467	-318.37	112.24	337.57
					3468	-29.33	18.98	34.93
					3469	79.97	-4.55	80.10
					3488	115.79	56.90	129.02
					3492	-24.92	17.56	30.49
3466	1.05	7.43	119.00	87.90	666.00	367.79		
					3465	-739.39	97.24	745.76
					3487	1767.73	370.65	1806.17
					3490	-481.22	44.51	483.28
3467	1.04	45.68	1324.00	613.00	2851.00	468.40		
					3420	80.43	-0.75	80.43
					3421	289.67	-123.41	314.86
					3433	69.12	-1.16	69.13
					3445	58.79	-23.62	63.36
					3465	327.68	81.14	337.57
					3468	104.41	1.77	104.43
					3469	142.22	25.13	144.42
					3470	404.69	-110.81	419.59
					3492	49.83	7.11	50.34
3468	1.00	28.99	1251.00	125.00				
					3421	-23.73	-27.07	36.00
					3433	-25.68	4.39	26.06
					3434	-11.21	0.53	11.22
					3445	-24.83	-37.20	44.73
					3465	32.27	-9.42	33.62
					3467	-96.74	27.23	100.50
					3470	37.96	-133.57	138.86
					3473	23.69	-24.68	34.21
3469	1.04	6.70	569.00	397.00	511.00	526.53		
					3465	-79.14	12.40	80.10
					3467	-126.36	69.92	144.42
					3470	-241.06	-36.11	243.75
					3476	27.58	-4.47	27.94
					3484	186.88	22.05	188.17
					3496	153.09	67.44	167.28
					3497	20.42	-1.70	20.49
3470	1.19	23.94	332.00	165.00				
					2852	-349.34	-697.79	780.35
					3467	-383.31	289.42	480.30
					3468	-31.00	162.23	165.17

						3469	251.30	121.25	279.02
						3473	198.61	-12.80	199.02
3472	1.21	13.15	301.00	57.40					
						2506	24.85	-39.98	47.07
						3473	-322.89	342.23	470.51
3473	1.18	14.43	203.00	107.00					
						2871	-803.09	-249.36	840.92
						3468	-19.80	35.31	40.48
						3470	-169.46	44.54	175.21
						3472	323.21	-327.50	460.14
						3476	132.87	67.32	148.95
						3478	205.98	21.92	207.14
						3497	135.56	17.97	136.75
3476	1.04	-4.54	1219.00	511.00	1627.00	612.39			
						3469	-26.29	9.81	28.06
						3473	-130.12	-18.03	131.36
						3477	-179.10	38.06	183.10
						3484	209.37	3.99	209.41
						3486	695.55	47.26	697.16
						3497	-158.59	44.42	164.69
3477	1.04	4.63	854.00	345.00	998.00	132.64			
						3476	192.00	1.86	192.01
						3478	-40.93	-170.86	175.69
3478	1.16	5.46	223.00	64.80					
						3473	-202.28	10.26	202.54
						3477	43.68	193.86	198.72
						3480	-70.94	-226.78	237.62
3480	1.38	6.99	75.10	11.60					
						2501	-130.18	10.87	130.64
						2507	15.79	-19.36	24.98
						3478	71.93	271.33	280.70
						3481	112.62	-320.58	339.79
3481	1.45	5.92	144.00	21.20					
						3480	-111.61	337.64	355.61
						3483	142.56	-8.18	142.79
3483	1.44	4.03	134.00	26.10					
						2506	9.83	-11.67	15.26
						2507	2.30	-23.68	23.79
						3481	-141.55	12.81	142.12
3484	1.04	-21.95	1153.00	1008.00	758.00	1396.79			
						3469	-174.55	70.26	188.16
						3476	-200.11	58.56	208.51
						3486	-0.25	0.03	0.26
						3488	-19.36	47.85	51.62
						3496	58.03	191.50	200.10
						3497	-60.89	20.59	64.27
3485	1.02	-29.45	0.00	0.00					
						3486	-968.37	-53.20	969.83
						3495	991.16	148.46	1002.21

3486	1.04	-21.95	436.00	168.00	728.00	513.27		
							3476	-674.93 162.21 694.15
							3484	0.25 -0.03 0.26
							3485	969.72 182.33 986.71
3487	1.01	-12.53	7398.45	1761.00	9000.00	3461.68		
							3466	1323.66 215.40 1711.57
							3488	416.97 1464.88 1523.07
							3489	-180.34 57.26 189.21
							3490	-167.55 181.83 1051.38
							3495	1427.04 373.76 1475.18
3488	0.82	-15.20	763.00	778.00				
							3465	-101.85 2.45 101.88
							3484	19.62 -35.73 40.76
							3487	-393.65 128.54 1237.38
							3491	-82.73 24.44 86.26
							3492	-264.37 51.77 269.39
							3496	30.92 -25.55 40.11
3489	1.03	25.52	2387.44	-175.00				
							2476	8945.97 134.40 1335.48
							3487	181.02 67.47 193.19
							3490	1585.37 -72.92 1587.05
							3491	-4356.88 151.67 1441.29
							3493	-29.27 22.99 37.22
							3495	484.51 189.22 520.15
3490	1.05	14.14	9208.00	1572.00	9638.88	2624.26		
							3466	476.99 3.10 477.00
							3487	1047.13 314.46 1093.33
							3489	-2365.23 391.49 1616.44
							3492	-226.81 109.86 252.02
							3493	-43.59 33.67 55.08
							3495	738.91 246.78 779.03
3491	1.04	34.58	104.00	772.00	2200.00	1434.04		
							3413	7.37 8.05 10.91
							3433	-27.03 6.60 27.83
							3436	-6.42 4.90 8.08
							3488	91.62 60.23 109.64
							3489	1455.76 76.71 1457.78
							3492	375.79 191.95 421.97
							3496	176.03 77.30 192.25
3492	0.97	26.70	0.00	0.00				
							3416	-10.45 4.26 11.28
							3433	-69.11 -7.14 69.47
							3436	-30.38 -1.43 30.42
							3465	26.70 -10.15 28.57
							3467	-46.32 8.89 47.16
							3488	274.51 163.76 319.65
							3490	227.37 -53.67 233.62
							3491	-372.04 -129.42 393.91
3493	0.91	40.78	7865.66	2874.09				

						3401	400.23	-423.74	582.87
						3489	30.41	-12.84	33.01
						3490	47.08	-9.19	47.97
						3494	-277.28	-943.48	983.38
3494	1.00	42.18	1870.00	1068.00	2300.00	1638.00			
						3416	122.79	25.28	125.37
						3417	43.14	-0.86	43.15
						3424	-17.92	-20.93	27.55
						3493	279.30	1043.86	1080.58
						3498	32.48	2.62	32.59
						3502	-22.41	-141.30	143.07
3495	1.00	-47.27	8787.32	6827.00	8799.43	8416.41			
						3485	-974.51	143.55	985.02
						3487	-996.86	500.87	1460.57
						3489	-314.30	394.52	504.41
						3490	-543.00	505.27	741.72
						3496	-372.14	163.53	406.48
3496	0.92	-23.89	0.00	0.00					
						3469	-146.45	17.52	147.50
						3484	-56.87	-167.03	176.45
						3488	-29.81	33.42	44.78
						3491	-138.73	96.30	168.88
						3495	372.41	-2.27	372.42
3497	1.03	-0.41	310.00	210.00	394.60	199.98			
						3469	-19.97	4.20	20.41
						3473	-118.62	15.17	119.59
						3476	160.04	-32.58	163.32
						3484	63.93	3.20	64.01
3498	1.01	26.33	410.00	102.00					
						3419	-94.52	-199.38	220.65
						3494	-31.99	6.36	32.61
						3499	191.91	141.59	238.49
3499	0.96	22.42	205.00	164.00					
						3444	-14.41	-109.64	110.58
						3498	-191.53	-122.08	227.13
3500	1.35	43.50	0.00	0.00					
						3408	304.30	227.86	380.15
						3501	895.84	7579.99	1344.84
						3502	-65.70	188.78	199.89
3501	1.38	36.50	0.00	0.00					
						2499	788.62	-568.13	971.95
						3500	-826.80	785.90	1140.72
3502	1.34	43.70	367.00	247.60					
						3418	417.56	352.52	546.47
						3419	105.18	46.41	114.96
						3424	27.62	342.94	344.05
						3494	24.80	188.66	190.29
						3500	65.74	-186.77	198.00

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PUBLICATIONS AND PRESENTATION

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