SIMULATION OF KAILASHTILLA-I GAS PROCESSING PLANT

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CERTIFICATION OF THESIS WORK

We, the undersigned, certify that **Nahid Sharmin**, candidate for the degree of **Master of Science in Engineering (Chemical)**, has presented her thesis on the subject "**Simulation of Kailashtilla-I Gas Processing Plant**". The thesis is acceptable in form and content, and that the student demonstrated a satisfactory knowledge of the field covered by this thesis in the oral examination held on the 20th April, 1999.

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ABSRACT

Simulation of the Kailashtilla-I gas processing plant (Golapganj, Sylhet) has been carried out by the HYSIM process simulator. First, the simulation of the gas processing plant has been performed to carry out the material and energy balances of the plant based on the design parameters and then the performance of the plant has been studied using the operating data of different hours of a particular day.

Kailashtilla-1 is one of the oldest gas processing plant in Bangladesh. The existing gas processing plant at Kailashtilla-1 consists of pressure reduction system and three flash separators to separate the gas and oil plus a gas dehydration and hydrocarbon recovery system consisting of a silica gel adsorption tower, regeneration and cooling towers and a condensate fractionation column.

During the simulation of the plant, some changes have been made in the process flow diagram due to limitation of the HYSIM simulator, which cannot handle silica gel dehydration operation. The dehydration of the gas has been tried in two different ways, by cooling and by component splitter. The simulation has been performed based on the modified flow diagram with the design data. The gas compositions obtained for two different methods are almost similar. The plant has also been simulated using three sets of operating data from the log sheet. Due to the changes in the process flow diagram some small differences have appeared in material and energy balances.

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CHAPTER-I

INTRODUCTION

The representations of any physical system such as manufacturing plant, an aircraft, a space vehicle or an abstract economic system adequately and realistically by its mathematical model with equations for a detailed study, at a fast rate, using a computer is known as process simulation. Earlier simulators were programs designed to model a specific process or plant. Today, companies in the chemical process industries (CPI) rely heavily on process simulation to maintain and improve their competitive edges.

Kailashtilla-I field was discovered in 1962 by Pakistan Shell Oil Company Limited and went into production in July, 1983 from both upper and lower sands. In this thesis work the simulation of Kailashtilla-I gas processing plant has been performed by the steady-state simulator developed by Hyprotech Limited.

A field visit was made to collect design and operating data of the plant. At first, the simulation of the plant has been carried out using the design data (pressure and temperature) and then the simulation work has been performed with the operating data to study the performance of the plant. There is no dehydration unit available in the HYSIM simulator, therefore some changes have been made in the process flowsheet which have been discussed. The simulated results are different from the actual plant performances. The sales gas compositions obtained from simulation works by component splitter are almost same as that of the gas processing plant. HYSIM only calculates material and energy balances for a process. The length of the pipe (pressure drop due to friction and other losses) or piping heat loss have not been considered by HYSIM during the simulation works.

CHAPTER-II

LITERATURE REVIEW

In future as the energy consumption expands and resources of material and energy become more expensive and less certain, substantial changes are needed in many conventional chemical processing plants. These have to incorporate a high degree of energy integration and achieve greater efficiencies through process modifications, thereby conserving material and energy resources. At the same time safety standards are tightening, therefore, lower temperatures and pressures are desired. Higher reaction rates, fewer stages and smaller plants will reduce burden of the material in the process, leading to safer plants. With the growing consciousness about pollution, it is essential to produce less effluents as well as to treat them properly[(2)].

The last three decades have seen a phenomenal growth in the development and sophistication of electronic computers and their capabilities. This, in turn, has brought new dimensions in the synthesis, design and analysis of systems. The computer aided process simulation is applied successfully in a field such as in the bulk production of chemicals, petrochemicals, fertilizers, pharmaceuticals, etc. The great importance acquired by simulation in this field is due to the growing complexity of the large chemical plants, high degree of automation required in their control and often, an improbable situation of experimenting with the real systems.

2.1. FLOWSHEETING AND THE DESIGN PROCESS

Chemical plant design begins with the creation of a process flowsheet. Prerequisite to the generation of an optimal flowsheet is the simulation of the entire process on the

computer. Figure 2.1. shows a strategy of development from conception to commercialization of a chemical process. The process design effort can be divided into three basic steps [1], process synthesis, process analysis and process optimization.

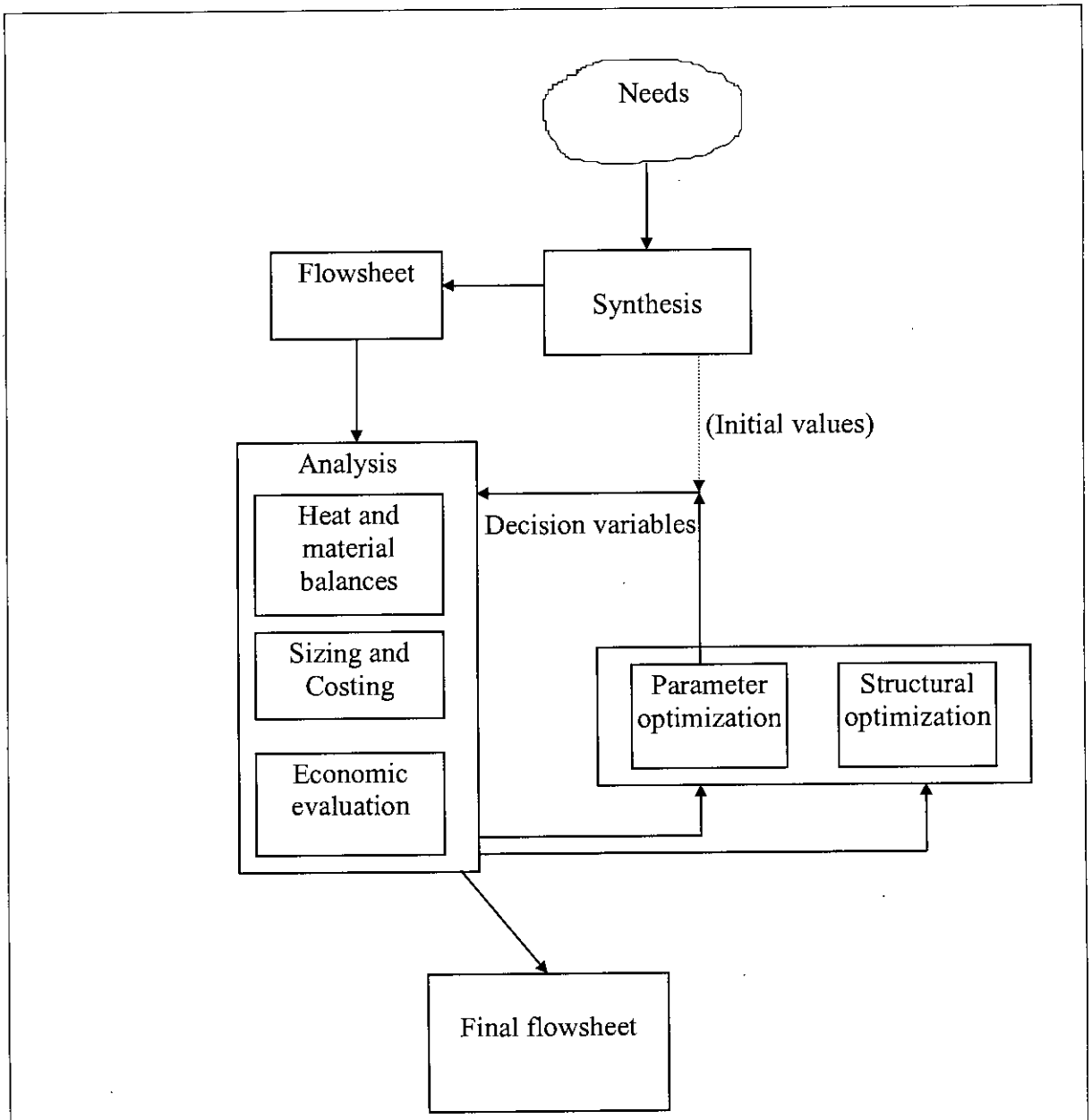


FIGURE 2.1. PARTITIONING THE PROCESS DESIGN TASK INTO INTERRELATED SUBTASKS.

2.1.1. PROCESS SYNTHESIS

Process synthesis is the step where the flowsheet structure is chosen; i.e. the particular equipment to be used and its interconnection are selected. Process synthesis by and large depends on design heuristics, more so on the intuition of process engineers. This, however, can lead only to that upperbound efficiency which is inherent to an already synthesized system.

2.1.2. PROCESS ANALYSIS

Once a process is synthesized, an analysis is required to solve material and energy balances for a steady state process, sizing and costing of the equipment and evaluating worth of the flowsheet.

2.1.3. PROCESS OPTIMIZATION

Finally, optimization is performed leading to the final flowsheet with its optimal decision variable values. It is valuable in different ways throughout the life of a project[26] which are discussed below,

2.1.3.1. PROCESS DEVELOPMENT

While evaluating process alternatives, it is important that any comparison be based on the optimum value for each alternative.

2.1.3.2. PLANT DESIGN

Once the process configuration is fixed the results of the heat and material balance calculations are used to finalize the design of the process and its equipment. For this stage detailed equipment size and cost, and operating cost are important in determining the optimum design.

2.1.3.3. PLANT OPERATIONS

Optimization studies of existing plants can be important when there are variations in the feed to the plant or when the demand on the production or product ratios change. Here capital cost is not important, and the optimization is based on production rates and operating rates.

At all three stages, optimization can now be performed in conjunction with process simulation.

In existing plants, the flowsheet exists already and process simulation is carried out to optimize the performance of the plant within the process constraints. The use of flowsheeting in design however differs from its use in operations and this should be reflected in the development of the simulation procedure [21]. For steady-state calculations the equations are naturally algebraic at least for lumped-parameter model of individual units, while dynamic problems involve mixed systems of algebraic and differential equations whose solution in turn involves repetitive solution of algebraic systems. The setting up and solving of these linear and nonlinear equations by hand is tedious and error prone, and often impossible because the problem is too large. It is here that one can visualize the usefulness of a computer programming system to aid in inputting the flowsheet, the needed data, the required flows and so forth and then to solve, giving diagnostics if a failure occurs.

2.2. HISTORICAL DEVELOPMENT

The development and acceptance of process simulation by the chemical industry is a continuous process, which started in the middle 1950's[18]. The first years of history in the development of flowsheeting programs can be broken roughly into three five-year

periods. The first developments occurred in the 1955-1959 was characterized by the development of computer programs for individual operations. The developer was required to be an expert in chemical engineering, mathematics, and computers including machine language. In that period computers were of any size and speed, and languages such as FORTRAN were unavailable. Usually the developer was the only who could use these programs for solution of actual programs. Successes were relatively few, but when there were successes, they generated huge savings. These successes encouraged the management to fund limited process simulator development projects in the periods of 1960-1964.

In the late 1950s Kelloggs began to discuss their Flexible Flowsheet Program[1]. During the next five years (1960-1964), several simulators appeared. The successful systems-where 'success' means they survived the period and are still in use. The simulators which survived this era and which enjoy wide acceptance today had the following developmental guidelines[18], coding would in a high level language (for example, FORTRAN) and would be highly modular. The physical property correlations would be as rigorous and as accurate as possible. The system would be easy to use with little or no intervention by an expert required.

The simulators developed were now put to the test of being used on a variety of industrial problems. Many failed, discouraging their users and management, which funded them. Thus the next five-year period (19965-1969) was a proving and a weeding-out time. And that period was characterized by the refinement of industrial simulation programs. Due to the problems encountered many of the innovative first users became deschanted with the concept of process simulation and would not apply it for several years after an early bad experience. However, by the end of this period the concept of process simulation was

firmly established and accepted with only a sprinkling of holdouts. The reliability of the process simulators had increased because large-scale computer power had become generally available by this time.

By 1970 most (but certainly not all) process designers were accepting that flowsheeting programs were useful and cost effective. In the 70s, $250,000 analog–based panel boards were used to represent sections of process plants and contained 15 real electronic controllers[27]. They were becoming fast enough and reliable enough to be practical for moderately large processes. Companies buying chemical plants from the contracting companies began to request that the processes be simulated, and even if the contractor did not prefer to use this tool, he had to use it to satisfy his customer.

In the early 80s, Atlantic Simulation introduced the first self-contained digital simulators for operator training[27]. These digital simulators evolved into systems that utilize two training stations in a dual operator mode. In 1984, a $7,000 hardware upgrade was introduced that upgrades an IBM PC to a PC Simulator. The real successes, where considerable engineering time is saved, belong to those, often special-purpose, programs for chemical plants which are repeatedly contracted and built, such as ammonia plants. Sometimes within a day, the calculations can be set up and run, replacing several man-weeks of hand calculations.

2.3. MOTIVATION FOR DEVELOPMENT

Figure 2.2 gives a basis for the development of a general purpose flowsheeting programs[1]. The initial programs developed for flowsheeting tended to deal with specific examples. The programs were written for a single problem and, even if they were successful, they still made it evident that they were generally too restrictive. The

flowsheet could not be readily modified, if at all. A lack of consistency for physical property calculations existed within the programs; for example, enthalpies calculated in one unit might not match those found in another.

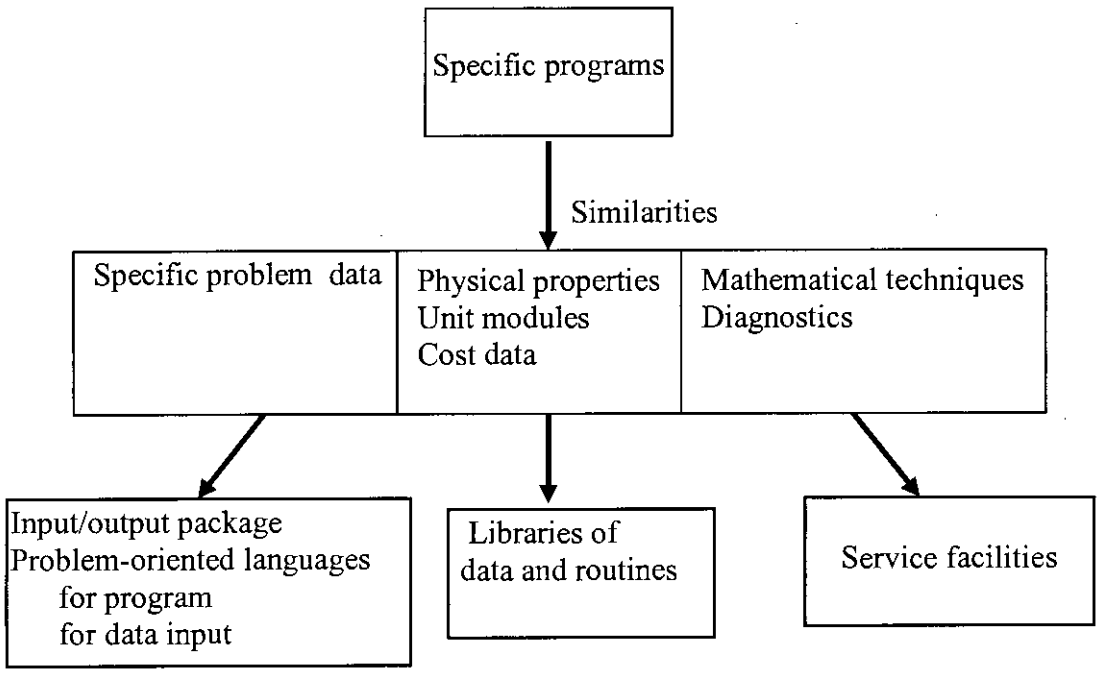


FIGURE 2.2. DEVELOPMENT OF SIMULATION SOFTWARE SYSTEM

To design a programming system which would allow performance of the calculations for an entire flowsheet rather than a single unit meant one had to make decisions about a major software system where no one else had.

In the figure 2.2, examining the special-purpose programs made it clear that the problem could be divided into three parts. Part of the problem is very specific to the particular design problem at hand. This includes at the very least the flowsheet, the components list, and the design requirements that the plant must meet. Part of the problem, and hopefully the major part, is common to all problems. The unit operations, types and their calculations should to a large extent be common. The methods to calculate physical

properties can hopefully be made common; costing information may also be common. Underlying these, a library of numerical techniques could prove very useful to stop them from being rewritten over and over again, and to centralize the approach so subsequent improvements might be very easy to incorporate.

These observations, viewing figure 2.2, provided the basis for the design of a flowsheeting system which requires a part to handle the problem-specific features, and a set of routines that enables the general purpose parts to be applied in the context of the problem.

2.4. SIMULATION MODEL

A process with its control system is simulated by programming an electronic computer so that it contains a mathematical model of the process and control system. This mathematical model responds to disturbances and adjustments or modifications in the same way as the real process. Simulation of a process and its control system is divided into two parts: the preparation of the model and the use of the model to study control of the process. Knowledge about the process developed in the course of preparation of a model, which responds to disturbances in the same manner as the process, will often lead to solutions of the control problems not readily available through other analysis techniques[3].

The use of computer aids to perform steady-state heat and mass balancing, sizing and costing calculations for a chemical process can be defined as Flowsheeting. There are particular differences between a steady-state and dynamic models. In a chemical process, of course, the process is nearly always in a dynamic mode, at some level of precision, but when the time dependent fluctuations are below some value, a steady-state model can be formulated. Steady-state simulation provides a snapshot of unit operation or plant[23,33]. It

gives the user a heat and material balance at equilibrium conditions over a specific time period – minute, hour, day, or week. It assumes equilibrium results for all unit operations. In contrast the dynamic simulation directly mimics the plant operation. It gives time-dependent results, usually on a minute by minute basis. It requires a greater amount of information. The dynamic simulations are important in the analysis of control aspects as well as for studying transient response during startup or shutdown of a plant[2,7]. Although the dynamic simulation is the most complicated and computationally expensive but it has become a valuable tool for system analysis and design in many industries - most notably aerospace [22].

2.5. STEPS IN THE PROCESS SIMULATION

The principal steps in any process simulation study are as follows[3]:

(1) Define the process and derive a mathematical model.

A precise formulation of the mathematical model of the system to be studied to the complexity needed for the study or to the limits of the available computer capability in speed of operation and available computing time. All simplifying assumptions used in developing the mathematical model detract to some degree from the faithfulness of the simulation results.

(2) Determine the model scale factors and constraints required.

Conversion of the mathematical model into a computer program for running on the available digital computer system. There is a wide choice of possibilities here including several special programming language developed especially for simulation projects.

(3) Check the validity of the model.

Validation of the model and its representation in the computer program. That is, if the simulated system can be proven to be a reasonable facsimile of the real system that it was intended to represent.

(4) Program the computer.

Exercise of the model on the computer including the design of the experimental program to be carried out (i.e. the choice of the several conditions to be tested).

(5) Check out and run the simulation.

Interpretation and use of the simulation results to achieve the ultimate purpose of the intended study such as a new process design, a new production schedule, determination of the safe limits of operation of the process, etc.

(6) Lists the findings

Documentation of the study including the recording of project activities and results as well as the documenting of the mathematical model, the computer program and their uses.

2.6. APPLICATIONS OF THE PROCESS SIMULATION

Process simulators may be used at the following stages[18]:

1. **Research and Development Stage:** A simple simulation program which requires a minimum of data may be used for testing the feasibility of different processes.

2. **Critical Examination Stage:** Once a financially attractive process has been found, different alternatives of plant size layout and operating conditions must be tested for optimality.

3. **Pilot Plant Stage:** The use of most sophisticated simulator may help to obtain good estimates of the operating conditions in the full-scale plant from relatively few results of the pilot plant.
4. **Design Stage:** The process simulator gives the engineer all of the process data required for the detailed design of different equipment. In this way the safety factors due to uncertainty in equipment design may be reduced.
5. **Simulation of Existing Plants:** Simulation of existing plant may be very useful when there is a need for changing the operating conditions. The simulation is useful to find the best strategy for raising the production, to enhance the efficiency of operation through better energy integration, to adapt the existing plant to different raw material, or a requirements for products with different compositions.

The simulation models have been used in the engineering and research division of Amoco Corporation for last 30 years for the following purposes [22]:

Dynamic material and energy balances; Vapor-liquid phase equilibrium correlations; Heat-transfer calculations; Reaction kinetics; Catalyst bed expansion correlations; Reactor hydraulics correlations; and Equation of state.

2.7. ADVANTAGES AND DISADVANTAGES OF SIMULATION

2.7.1. ADVANTAGES OF SIMULATION

There are several advantages of using the simulation. The major benefit of process simulation that it produces better process designs lower capital and operating costs in less time than hand methods alone or hand methods in combination with stand alone computer programs[18].

Simulation is an excellent teaching tool for plant operating personnel to allow them to become acquainted with a new process before they have to start up a new plant. Any problem that can be foreseen with the new plant can then be anticipated and their remedies used as plant operating practice.

Simulation affords complete control over time since a phenomenon may be speeded up or slowed down at will. Depending on the problem requirements, simulation can be operated at speeds many times faster or slower than the actual process. So restriction is imposed on the application of simulation to processes that operate at extreme speeds, either fast or slow.

The analyses of control-system by simulation are characterized by the ease with which runs are made and parameters can be varied. Simulation also has the capability of computing variables that may not be accessible as direct measurements in the real process, for example, the reaction rate in a chemical process. Simulation of a computer control system would permit experimental testing of such computed variables for control along with various control algorithms, controller configurations, and controller tunings. The course of the simulation depends on what control criteria are to be met.

Computerized process simulation allows one to study the control of the process in an online manner, that is, to conduct experiments with the process in much the same as manner as they would be conducted on the real process. Some advantages of simulation over plant experimentation are that the economic and physical risks involved in manipulating the real process are circumvented. The time scale may be reduced or increased from the actual process depending on the needs of the experimenter. Processing condition excursions outside the normal operating range may be made, and modifications

of the process by programming changes rather than modify equipment permits study the interaction of control and process design.

In the process simulation the results are much more consistent because the physical property estimation procedures and data are consistent throughout the flowsheet. Parameter variations are more likely to give meaningful trends because of this consistency when doing multiple runs and Also the chances for simple errors in arithmetic are significantly reduced, giving one a better opportunity to eliminate such errors. Once a program has made as error free as possible, it will blindly, but correctly, perform the calculations it represents from then on. Comparisons of alternative designs by different design teams are more likely to be realistic

2.7.2. DISADVANTAGES OF SIMULATION

At the same time there exists some important draw-backs or disadvantages of a simulation. Simulation model can be very expensive in terms of manpower and computer time if a proper design of experiments is not carried out. An extensive development period may be necessary in the production of the model itself, and the parameters of the model (kinetic coefficients, heat transfer coefficients, etc) may be difficult to determine thus necessitating very expensive plant tests on the real system with associated extensive data collection, reduction and interpretation time and costs to obtain this required data. Hidden critical assumptions in the development of the model may cause it to deviate from the real system thus leading to erroneous results.

The disadvantages are not to be overlooked that the system at hand may be ill-suited for the problem under consideration and may never reach an answer for it, or do so only after very considerable effort. Flowsheeting systems are man-made and as such contain 'bugs'

(errors in the program) which the user may be unaware of, or all-too-aware of, and these 'bugs' once, the user may well be unwilling to try again.

Following, or along with, the steady-state flowsheeting effort, the dynamic characteristics have to be investigated to establish controller locations and types, and to establish operability during start-up and in the face of expected upsets. Controllers are usually designed by an analysis of small fluctuations in the process, often using a linear dynamic analysis. Operability studies are usually concerned with large process fluctuations, and these studies are needed to locate and size spares, process hold-up and the like which cannot be established by a steady-state analysis.

2.8. SOLUTION APPROACHES

The goal of the process simulation is to solve equations for all units in the process, as well as connectivity equations that relate the outlet streams of a unit to the inlet streams of other units[26]. Symbolically, these equations are: $h(y)=0$, where h= collection of all the process equations and connectivity equations, and y= process variables These interconnection equations are the basic material energy balance equations.

There is another set of model equations, which represent the model of the individual unit operations or process such as mixer, reactor, heat exchanger, distillation column, etc. All these equations are generally strongly nonlinear. Moreover, in the simplest case if a process is of a sequential configuration, figure 2.3-I, it is easy to proceed from the feed streams until the products are obtained calculating sequentially for one process unit after the other. Unfortunately, most of the chemical plants are of complex configuration involving recycle of streams, mass (figure2. 3-II) or energy (figure 2.3-III) or both; they represent interlinked networks of units.

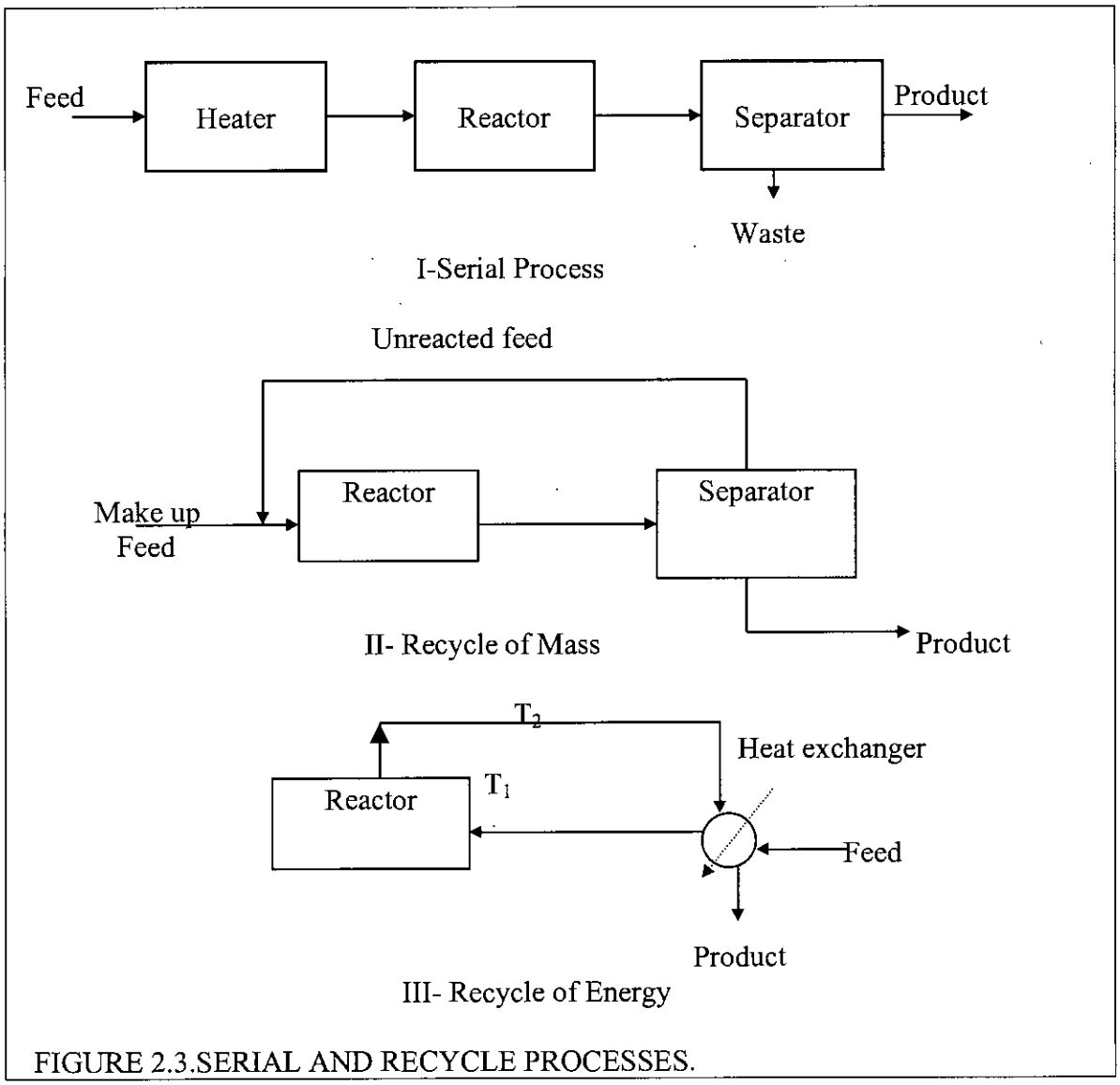


FIGURE 2.3.SERIAL AND RECYCLE PROCESSES.

Increasing attention has therefore been directed towards alternative calculation strategies, some of which actually were proposed early in the development of the field but subsequently neglected[33]. These alternative strategies include, sequential modular approaches, the simultaneous modular strategy and the equation oriented approach.

2.8.1. SEQUENTIAL MODULAR APPROACHES

The most widely used structure for flowsheeting is the sequential modular approach[9,18,26,30,31,33]. In this approach the model equations are handled using a library of modules or subroutines (procedures), each of which performs computations for one of the

models used[41]. The process unit modules are typically simulation oriented; that is given values for the variables describing the input streams and the equipment, the model equations are solved for the variables describing the output streams. The connection equations are handled implicitly, the executive routine passing output values from one unit module to other unit modules as inputs, as called for by the specified flowsheet topology. Specifications such as input stream data and equipment parameters are easily handled by passing the specified values directly to the proper unit modules. This concept is parallel to that of a unit-operation, hence termed as a " unit computation". Thus module calculates values pertaining to the output streams for the given input conditions and parameters for that process or equipment, irrespective of the source of input information or the sink of output information. A typical flowsheet network simulation program is shown in figure 2.4. Using such a concept it is thus possible to evolve a library of modules and use them to simulate variety of flowsheets in a building block approach.

The sequential modular approach has been and still is by far the most common approach to process flowsheeting, particularly in industrial use. From a computational standpoint, perhaps its most important strong points are[30]:

1. On the module level, one or more specialized algorithms can be used to solve the model equations within each module; thus the module calculations can very efficient and robust.
2. On the flowsheet level, both direct and accelerated substitution are generally very reliable solution methods, though even accelerated substitution is generally rather slow.

Major disadvantage of this approach is that it is difficult to deal with design problems efficiently and presence of multiple nested iteration loops. In order to use the sequential-

modular method, it is necessary to specify the feed conditions and the unit modules completely, by giving values for their equipment parameters.

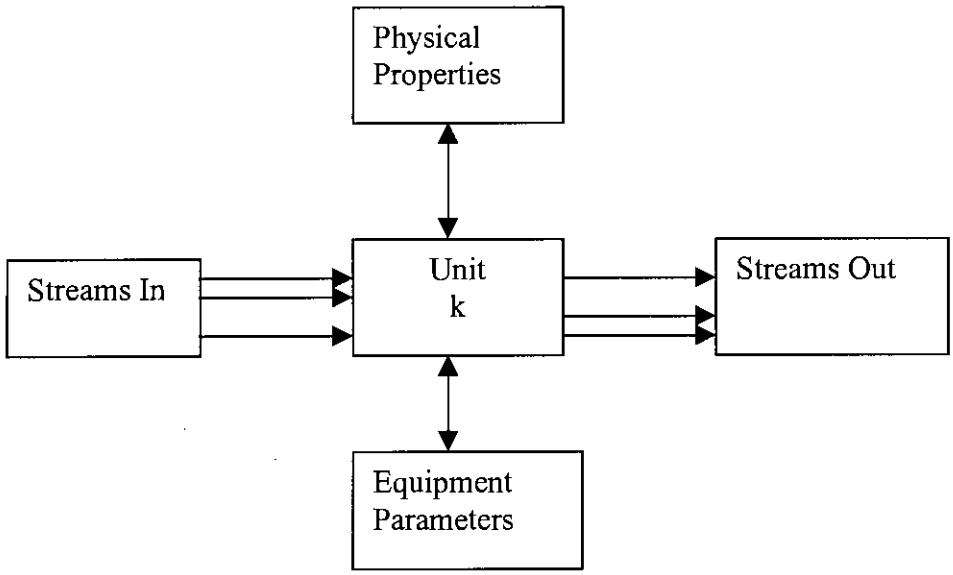


FIGURE 2.4. UNIT COMPUTATION MODULE.

For a design study, it is likely that some of these equipment parameters are unknown, and the user is interested in finding values, which meet the required product specifications. The handling of design specifications, typically equations of the form x = constant, by introducing additional iteration loops is obviously an inefficient way to handle to such simple equations[30]. The usual approach to this difficulty is via iterated simulation. Either the whole process is iterated with the iterations controlled by the user, or there are local iterations inside the simulation using control blocks, which manipulate specific design variables to meet the design requirements. The third problem of the sequential modular approach is that it is not well suited to process optimization. This is because, using the sequential modular approach, optimization is performed by adding yet another outer iteration loop, further exacerbating the numerical efficiency problems, thus accounting in

part for the great computational expense that has in general been associated with process optimization [1].

The sequential part of the approach involves carrying out calculations from module to module, starting with feed streams until products are obtained. In order to make it total sequential, it is then necessary to identify recycle loops of units in a given flowsheet and to "tear" certain streams, or in other words, assume values of the variables associated with these streams and adopt an iterative procedure which should converge on the assumed values. For instance, tearing streams (2) and (4) in the network of modules shown in figure 2.5, the whole procedure becomes sequential in the order of modules (1), (4),(3),(5), and (2).

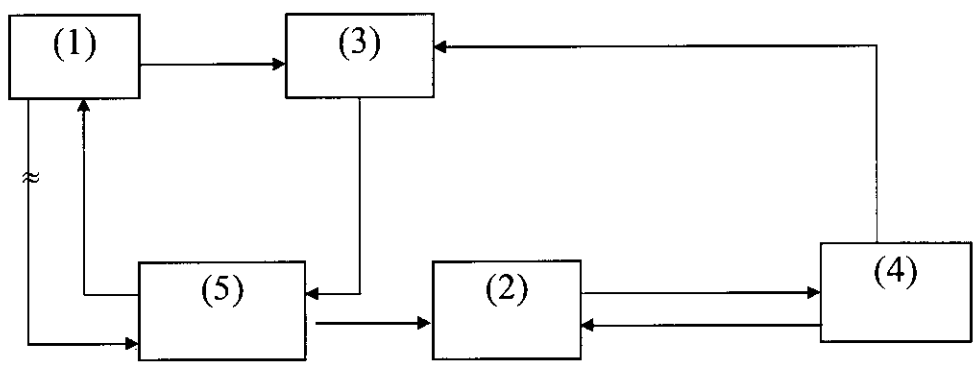


FIGURE. 2.5. NETWORK MODULES WITH TEAR STREAMS.

A general purpose sequential modular program has the following structural components:

i) A store of physical and thermodynamic properties for pure chemical species and their mixtures.

ii) A system working data derived from the data obtained from the store as well as the problem input.

iii) Individual module data base derived from the working data base.

iv) Modules or subroutines for individual process units, computational procedures including input/output for each module and internally iterated variables, if any.

v) Flow sheet topology to be used by the system executive to order computation sequence. This is usually defined by a "process matrix", which specifies standard unit modules for use in simulation of a particular process along with identification numbers, positive for input streams and negative for the output.

vi) Routines for recycle calculations and convergence analysis.

vii) Other mathematical service routines.

2.8.2. SIMUTANEOUS MODULAR APPROACH

In this type of approach, the unit modules are similar to those used in the sequential modular approach, each module calculating outputs for given inputs and specified equipment parameter values. However, the main difference is that for each unit additional module is written which approximately relates each output value by a linear combination of all input values. Thus for the given input x_{i1}, x_{i2} .....x_{in} for module I and equipment parameters u_i ;

Exact Model for module I

$$y_{ij} = f_{ij} (x_{i1}, x_{i2} .....x_{in}, ,u_i) \qquad (1.1)$$

Linear Models for module I

Connecting equations $y_{ij} = \sum_{k=1}^{n} \beta_{ijk} x_{ik}$ (1.2)

$$x_{st} = y_{pq} \qquad (1.3)$$

In the above equations, y denotes output values and β coefficients of linear equations. Let us assume that for a given system of nodes, the feed stream values are specified and the

information flow diagram as shown in figure 2.6 indicates that nodes m, (m+1),.....(m+I) comprise a recycle loop.

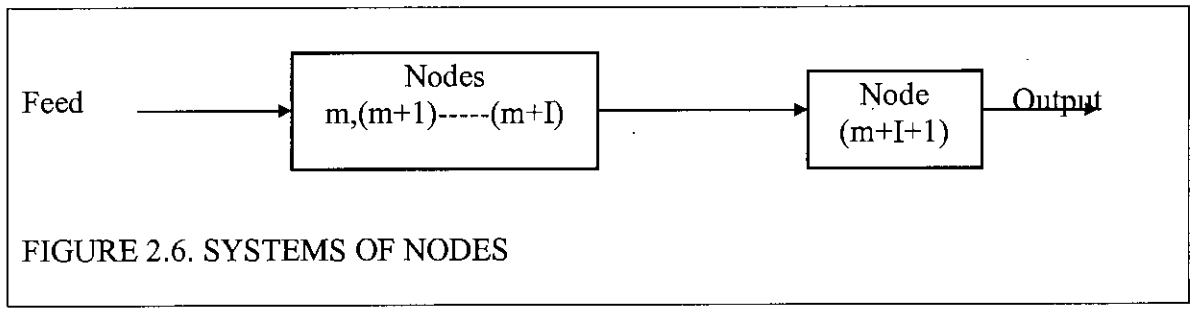


FIGURE 2.6. SYSTEMS OF NODES

A simulation system of this type has been commercially developed in Japan. Lin (1979) suggested to break the flowsheet into one or more blocks of modules[2]. Each block contains one or more modules, which are solved simultaneously. The whole flowsheet is then solved by sequential modular approach by treating each block as a module.

2.8.3. EQUATION SOLVING APPROACH

In the sequential modular approach, constraints can be accommodated by means of additional iteration loops around the module, provided these constraints involve stream quantities associated with that module. However, if the constraints involve streams not incident to the underspecified module, then iterations in the outer loops involving the entire flowsheet are needed; this type of procedure is quite cumbersome and tedious. For that reason, the modular approach could not gain popularity for simulation in the design mode[7,8].

In the equation solving approach, the mathematical model of a steady-state process is organized and handled as one large global set of equations representing the entire process[15]. This is in contrast to subsets of equations, called modules, use in a modular approach according to the process units that appear in a given process. Hence, in the

global approach of equation solving any number of constraints can be added as equations to the set defining the problem.

Because the global approach analyzes all the equations representing an entire chemical process, it takes full advantage of the specific features of the equations, which in the modular approach are ignored. It also generates a tailored computer program for each new problem, while the modular-oriented simulator is used for all the problems. The tailored computer program executes faster and uses less memory compared to the modular-approach-oriented simulator. However, the major disadvantages of the global approach is the necessity of manually preparing a new input description of all the equations for each new problem.

2.9. SIMULATION PACKAGES

The sequential modular algorithm has been used widely for steady-state simulation and design. An exhaustive list of simulation packages with programming languages and computers used in the seventies was compiled by Klemes (1977). A few typical packages, all written in FROTRAN, along with their significant features and applications made are listed in Table 2.1.

TABLE 2. 1. TYPICAL STEADY-STATE SIMULATION PROGRAMS USING THE SEQUENTIAL MODULAR APPROACH[8]

Name	Organisation	Properties data Bank	No of Modules	Typical Appplication Mode	Refernce
PACER 245	Digital systems,U.S.A.	101 components	163*	Sulfuric acid	Crowe, et al (1971)
CHESS (9)	Univ. of Houston, U.S.A.	98 components	29**	Polymerization of olefins	friedman and Pinder (1972)
FLOWTRAN	Mosanto Co., U.S.A.	180 components	42***	Chlorination of decane	Seader, et al (1974)
PROSIM	RRI, Hyderabad, India	100 components	29**	Natural gasoline	Husain and Ali (1977)
CONCEPT	CADC, Cambridge, U.K.	—	—	Propylene to 2-hexene conversion	Westerberg, et al (1979)
ASPEN	MIT, Cambridge, MA,U.S.A.	400 components	47	SNG from gasifier effluent	Gallier, et al (1980)

* On different simulation levels, including economic evaluation.

** 15 standard and 14 user-supplied.

*** Economic evaluation incorporated.

2.9.1. PROSIM

In recent years there has been a dramatic increase in the use of, and reliance on, process simulation programs, for modeling of steady-state mass and energy flow in the chemical and petroleum industries[14]. PROSIM is a simulation package designed to work in the analysis mode. Its structure is shown in figure 2.7. It is a fixed structure program which means that the program executive remains the same no matter which flowsheet is being simulated. The executive is a collection of subroutines which,

- Receive user input and problem description,
- Decide order of the calculation,
- Decompose recycle loops,
- Check data consistency at various stages of simulation,
- Do all book keeping and
- Execute the whole process of flowsheeting right through.

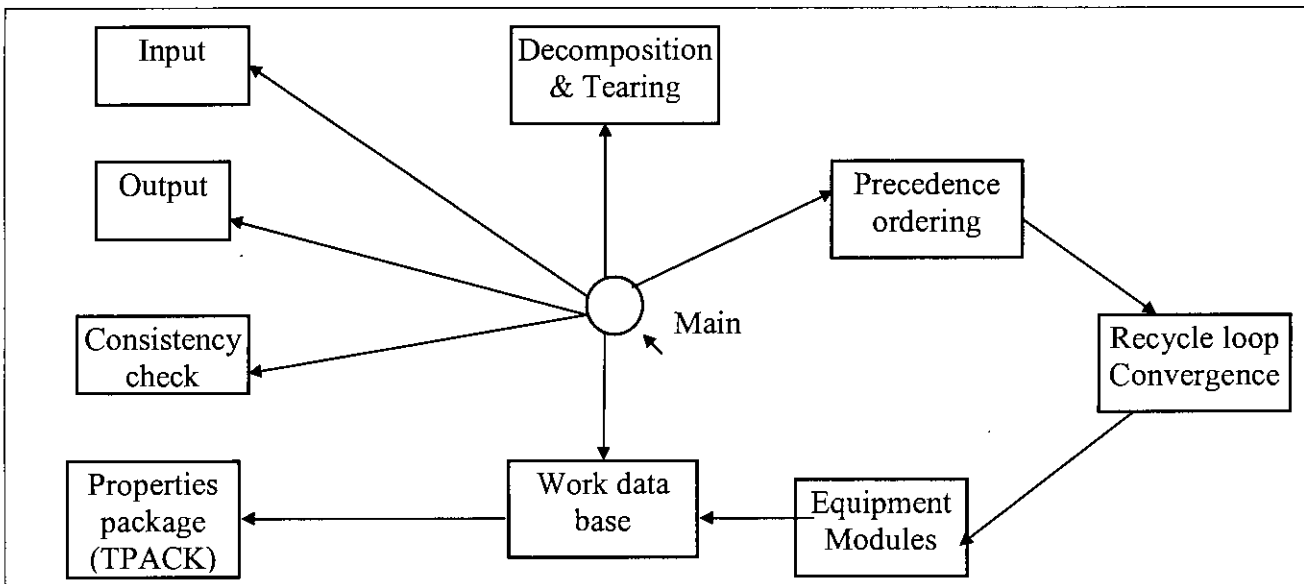


FIGURE 2.7. STRUCTURE OF PROSIM.

Four main phases in the simulation are as follows: Input Phase, Preprocessing Phase, Calculation Phase, and Output Phase[18].

2.9.1.1. INPUT PHASE

This phase is the most critical interface between the user and the simulation program and therefore has received considerable attention. The less the input data required, the easier it is to use and fewer the user mistakes.

In the input phase the following steps are executed : data input, data checking and data storage.

The data required by all process simulation programs are :

1. Process topology.
2. Feed stream information, including property data.
3. Design parameters of the units.
4. Convergence criteria.
5. Calculation order list.
6. Cost parameters.
7. Optimization criteria.

2.9.1.2. OUTPUT PHASE

There are two types output from a standard simulation program: intermediate output and final results. The form of the final results pages are usually fixed[18]. A stream table is printed containing the composition, flow rate, temperature, enthalpy, pressure, and perhaps density and other information for every stream.

2.9.1.3. PREPROCESSING PHASE

Where the input data has been introduced via a POL or user written FORTRAN main program, the precompilation (POL) and subsequent compilation and linkage editing of the target simulation program to job satisfactions is done in this phase.

2.9.1.4. CALCULATION PHASE

The calculation phase is executed by the unit module subprograms with the aid of the thermodynamic and physical property package and the supervision of the executive program. To solve a wide selection of simulation problems, there must be a large number of unit subprograms for the same item with different level of sophistication.

2.9.1.5. DESIGN CRITERIA

The design criteria used in the development of PROSIM are[14]:

(a) Highly reliable and easy to use.

(b) Completely modular for easy expansion and modification both by us and others.

(c) Data-base and file oriented to allow for manipulation of data files, transfer of results to other programs for economic studies, detailed engineering, etc. and to permit restart and case studies with maximum computing efficiency.

(d) Able to handle all varieties of applications with equal efficiency in the chemical, petroleum and synfuels industries.

(e) Capable of performing preliminary calculations as well as rigorous mass and energy calculations.

(f) Equipped with a comprehensive chemical component data bank and flexibility to accommodate the proprietary data banks of others.

(g) Portable and easily installed on all main frame computer hardware.

(h) Easy to access and cost effective for both remote batch and time-shared users via teletypewrites or CRT devices.

PROSIM is an integrated system of programmed methods and data for the calculation of steady-state mass and energy balances in chemical, petroleum and synfuels process plants. The largest flowsheet which can be handled by the standard version of PROCESS is : 75 unit operations, 150 streams and 50 components; extension to larger flowsheet is quite simple[14].

2.9.1.6. THERMODYNAMIC AND PHYSICAL PROPERTY PACKAGE

The thermodynamic and physical properties package includes 11 basic parameters for each of the 100 pure components. Based on these, it computes for a designated stream

vaporization equilibrium ratio, single phase enthalpy, compressibility factor (liquid or vapor), dew point or bubble point temperatures, and temperature at the given enthalpy.

2.9.2. ASPEN

The package ASPEN (Advanced System for Process Engineering) is designed for processes involving solids in addition to handling conventional vapor-liquid operations. It can represent multi-phase streams and complex substances, such as coal, which are not described by conventional components or pseudo compounds. The program system is comprised of about 150,000 lines of FORTRAN code, data for physical properties and cost data banks. This has allowed complete flexibility in design[2,13].

The executive system in ASPEN is a preprocessor type. Figure 8 shows the information flow in executing ASPEN. An input Translator program reads the user input and generates a FORTRAN main program. The executive programs set up the data structures and generate the computing sequence of equipment modules. The load module thus created is a tailor made simulation program for the problem at hand.

Being module in nature, the ASPEN structure allows a larger and variable number of modules to be executed, new FORTRAN statements to be inserted, and minimum amount of memory is needed for simulation. The ASPEN input language is user-oriented for process engineers familiar with chemical engineering calculations, but without extensive knowledge of computer programming. The input is made of paragraphs, sentences and words. Each paragraph begins with a primary keyword and each sentence with a secondary keyword. Tertiary keywords are used to enter data.

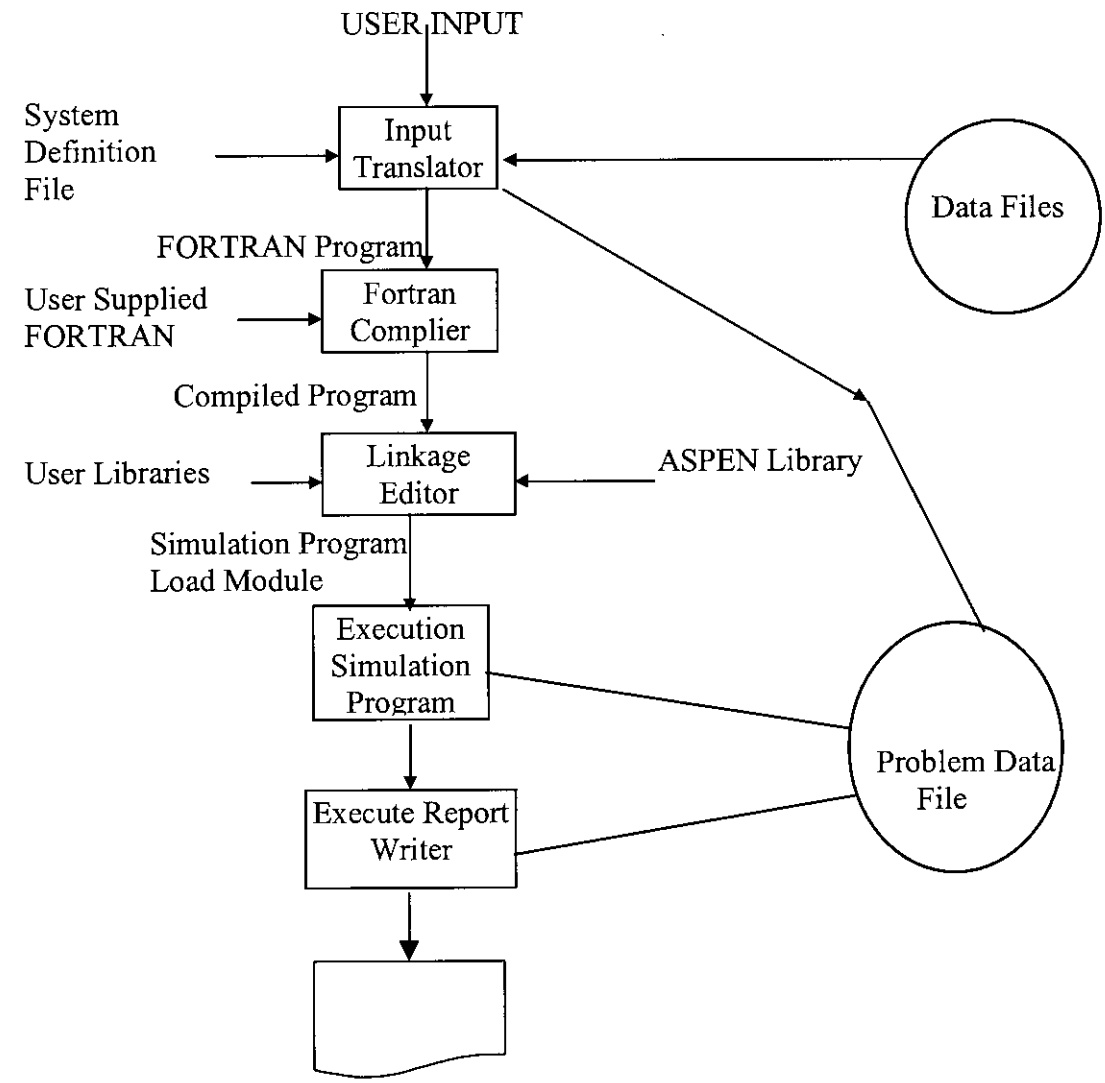


FIGURE 2.8. FLOW OF INFORMATION IN ASPEN (COURTESY: ACS SYMPOSIUM SERIES NO.124, 293(1980))

The input Translator is completely table driven which means that all the information required to process input statements, such as keywords, default values of data items, etc, are stored in tables called the System Definition File. It is thus easy to add new system parameters without changing any code in the Input Translator.

Chemical components are the most fundamental entities in a process simulation. In ASPEN there are two types of components: conventional and non-conventional.

Conventional components are pure compounds or pseudo compounds that may be characterized in terms of standard pure properties such as molecular weight, critical temperature, critical pressure, vapor pressure coefficients, and heat capacity coefficients. There are 200 pure compound properties that can be specified for each component.

In ASPEN there are four levels of complexity and sophistication in specifying physical properties. In order of increasing complexity, they are:

(1) Use of default option through-out the flowsheet.

(2) Use of one or more standard option sets provided by the system.

(3) Definition of one or more option sets, either completely or by modifying standard ones, using standard major property routes provided by the system.

Creation of a new major property route by specifying which physical models are to be used for computing the subordinate properties for a major property.

2.9.3. FLOWPACK II

FLOWPACK II is a steady-state process flowsheeting package[12]. FLOWPACK II is a system for everyday use by design engineers. It must, therefore, satisfy the basic criterion that its use should involve, the minimum total expenditure of manpower and computing resources to derive a satisfactory solution to the problem, within the time scale dictated by the project.

FLOWPACK II is,

- A simple, easy to use input language.
- Comprehensive data checking with meaningful diagnostics.
- Libraries of unit operation models and physical property correlations.
- A flexible and powerful physical property data bank.

- Meaningful runtime diagnostics and high system reliability and robustness.
- A simple frame to network to enable the easy addition of new unit operation models, physical property correlations etc.

The main facilities incorporated to maximize computational efficiency are:

- Partitioning and sorting the units. This leads to saving in space and time and ensures that we solve the minimum independent equations, thus reducing the chance of computational problems of inconsistency and equation inter-dependence.
- Powerful equation solving techniques of both first and second order types.
- Optional control over the nesting structure of the solution, by altering the data rather than the program.
- Novel techniques for calculating thermo-physical properties and unit operations.
- A flexible and compact storage structure which removes limitations on the number of units, streams, components, etc.

2.9.4. QUASILIN

The QUASILIN is a modularly organized equation-oriented process simulator[15,16] which is capable of implementation in a modular fashion. The actual equations describing the operations of the units have to be linearised and each module is composed of a set of linearised equations which depend on the current state of the solution. The executive passes the unit parameters and the current values of all the process variables to each unit module. This information is used to construct the linearised equations, which are returned to the executive. When all the linearised equations are assembled they are solved, by means of a modified form of Gaussian Elimination. This process is repeated until convergence is attained. The equations, which result, are very sparse so that only the non-zero elements need be characterized. This is done with three pieces of information: the

value of the element, the equation in which the element occurs and the variables it refers. The constituent parts of the process simulator are shown diagrammatically in figure 2.9.

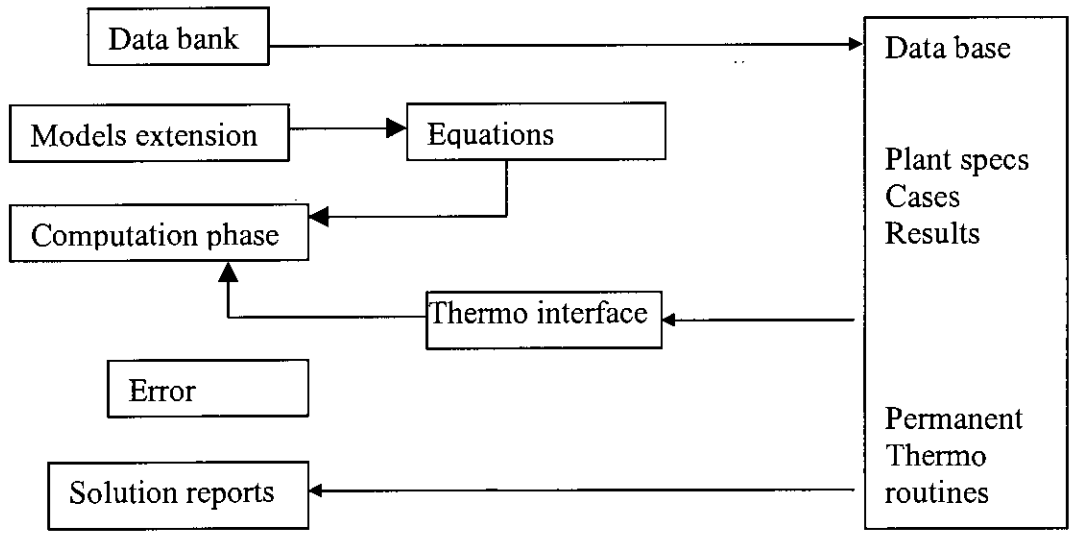


FIGURE 2. 9. THE CONSTITUENT PARTS OF QUASILIN

2.9.5. HYSYS

HYSYS performs both steady-state and dynamic simulations[40]. Steady-state simulation is used to rapidly develop, screen and optimize process designs, while dynamic simulation is used to evaluate process operability and controllability. Together, they enable engineers to optimize process designs, operating conditions, and control strategies without placing process, equipment or personnel at risk. This concurrent modeling approach ensures that trade offs between optimum steady-state designs and dynamic operability are identified. Advance features about the HYSYS includes:

- Rigorous thermodynamic and physical property models,
- Extensive component libraries,
- Built-in-EXCEL like spreadsheet,
- Built-in-Visual basic like macro language,

- Case study tool,
- Multi variable optimizer
- Industry proven oil characterization,
- PID controllers,
- Multi variable strip charts
- Transfer function blocks,
- And one click access between steady-state and dynamics.

2.10. PLEX DATA STRUCTURE

The plex data structure is proposed for use in an advanced computing system to model chemical processes[28]. All the process simulation programs except that of ASPEN, use dimensioned arrays for storing variables of a process, which usually reside in COMMON blocks for accessibility to different subprograms. Such programs, no doubt, have proved their utility in handling a limited class of problems dealing mostly with hydrocarbons in petroleum and other chemical industries. However, they have serious limitations in solving new problems required by process engineering such as in coal processing, biomass conversion, paper, cement, food and metal processing. These problems require to handle diverse types of streams, e.g. solid-liquid and solid-vapor, characterized by variables such as size distributions, particle shape parameters, porosities, etc. They also need unit-operation modules involving solids, for instance, cyclone separators, fluidized-bed heat exchangers, kilns, centrifuges, driers, crystallizers, screens, precipitators, crushing and grinding equipment, etc.

The inflexibility of the fixed data because the fact that the time of designing the system all the variables of interest should be known. Afterwards it becomes extremely difficult to change their layout in COMMON blocks without changing every routine. In order to get

better flexibility and modularity required for an advanced simulation system, an alternate data structure is warranted composed of interconnected n-component elements of a general type. Such a structure based on "plex" instead of a fixed array was first proposed by Ross, which is derived from the Greek word "plexus" meaning an interwoven combination of elements in a structure. And suggested for use in computer aided process design by Porter. Fay used such a structure in a prototype system for computer aided design of heat exchange networks[1,28].

PLEXSYS is a collection of routines to create plex data structure for access by FORTRAN programs. Neville and Seider used FLOWTRAN along with PLEXSYS to simulate process units involving solids, such as coal in the gasification process[19].

Two methods have been described for creating and operating on the plex data structure: the problem oriented language and the problem oriented calling programs. SSPS (Steady State Process Simulator) by Kaijaluoto, which claims possibility of defining stream classes separately for any specific process and for any types of streams[11]. The plex data structure is shown to permit inflexebility and modularity over dimensioned-array-based ones in the review by S. Kaijaluoto. The most important features are the possibility of defining stream classes separately for any specific process and for any types of streams, the ease with which new features can be added to the systems and its adaptability to different computing environments.

The plex provides an elegant way to represent the data describing a process model. It has many advantages over fixed array structures. It promotes modularity: the building block routines require a single argument, the pointer to the portion of the plex upon which they are to operate. It provides flexibility: for example, stream classes for new types streams

are easily represented. It allows easy modification to the process configuration by deleting beads and creating new ones. It does not waste storage for large numbers of unused entries in predimensioned arrays.

2.11. THERMODYNAMIC AND PHYSICAL PROPERTIES

A flowsheeting program almost always contains a physical property service, since the quality of process design is ultimately dependent on the way in which the laws of physics and chemistry are applied to the problem. The physical property service has to perform a number of tasks, but the most useful of these are[1,24,25]:

1. To supply estimates repetitively for a number of physical properties while the simulation is in execution.
2. To provide the user with values of properties of interest during the calculation and/or at simulation completion, for subsequent use in other calculations.
3. To allow the user to input his own special data for new components and transform it into the form required by the system during a simulation.
4. To supply the user with a means to estimate properties where little, except perhaps chemical structure, is known about a particular chemical compound. Again the system must put these estimates into the form needed by the simulation during execution.
5. To estimate any missing parameters.

2.11.1. PHYSICAL PROPERTY CALCULATIONS

Table 2.2 lists a typical set of physical properties which might be provided with a flowsheeting package and Table 2.3 lists some thermodynamic models available in simulators[25]. The four basic factors that should be considered when choosing property methods are:

- The nature of the properties of interest

- The composition of mixture
- The pressure and temperature range and
- The availability of parameters.

Many chemical process simulations include distillation, stripping, or evaporation, one improtant consideration for the choice of physical property models is vapor/liquid equilibrium (VLE). Liquid/liquid equilibrium (LLE) also becomes important in processes such as solvent extraction and extractive distillation.

TABLE 2.2 MORE-COMMON PHYSICAL PROPERTIES USED IN DESIGN FOR SINGLE-PHASE MIXTURES.

Thermodynamic	Thermodynamic	Transport
Equation of state	Entropy of formation	Viscosity
*Density	Heat of reaction	Thermal conductivity
Compressibility	Free energy of reaction	Diffusion coefficients
Thermal expansion coefficient	*K-values	
Heat capacity	Activity coefficients	
*Enthalpy	Fugacity coefficients	
Heat of mixing	Chemical potential	
*Entropy	Fugacity	
Gibbs free energy	Surface tension	
Heats of formation		

The (*) asterisks indicate those properties quite commonly available to model a special unit for a plant simulation.

Another critical consideration is pure-component and mixture enthalpy. Enthalpies and heat capacities are important for unit operations such as heat exchangers, condensers, distillation columns, and reactors.

Electrolyte mixtures include components that are charged molecules (ions) or that form salts. The most common electrolyte methods are the Pitzer model, and the modified-NRTL activity coefficient model of Chen and coworkers.

TABLE 2.3 THERMODYNAMIC PROPERTY MODELS AVAILABLE IN A SIMULATOR

Equation-of-State Models	Activity Coefficient Models
Benedict-Webb-Rubin(BWR)-Lee-Starling	Electrolyte NRTL
Hayden-O'Connell*	Flory-Huggins
Hydrogen-fluoride equation of state for hexamerization*	NRTL
Ideal gas law*	Scatchard-Hildebrand
Lee-Kesler (LK)	UNIQUAC
Lee-Kesler-Plocker	UNIFAC
Peng-Robinson (PR)	Van Laar
Perturbed-Hard-Chain	Wilson
Predictive SRK	**Special models:**
Redlich-Kwong (RK)	API sour-water method
Redlich-Kwong-Soave (RKS)	Braun K-10
RKS or PR with Wong-Sandler mixing rule	Chao-Seader
RKS or PR with modified-Huron-Videl-2 mixing rule	Grayson-Streed
Sanchez-Lacombe for polymers	Kent-Eisenberg
	Steam Table

* Not used for liquid

At simulation pressures less than 10 atm and where there are near critical components, for the best results Wilson, NRTL, or UNIQUAC binary parameters that may be available in built-in databanks can be used.

Vapor density is calculated by an equation of state or the ideal gas law. Mixture liquid densities can be calculated by an equation of state, a temperature-dependent model such as the COSTALD.

Vapor enthalpies usually is calculated via an ideal gas assumption or an equation of state. Liquid enthalpies are calculated by a variety of methods. If the simulator uses the ideal gas as the reference state, then the pure-component liquid enthalpy is calculated from the ideal gas enthalpy and a liquid enthalpy departure.

Viscosity is another important property for sizing of piping, pumps, heat exchangers, and distillation columns. There are various vapor and liquid methods for calculating viscosity and, generally, the parameter requirements for these methods are substantial. Transport properties are important when doing equipment sizing calculations.

CHAPTER-III

DESCRIPTION OF THE SIMULATOR USED

3.1. OBJECTIVES

The simulation works for an operating plant helps to evaluate the performance of the plant and to compare against design specifications in order to identify areas for improvement. In respect of this, the present works using '**HYSIM**' simulator had the following objectives:

a) To simulate the existing plant at Kailashtilla-I using the design parameters and

b) To study the performance of the plants using operating data.

During the simulation only the material and enrgy balances for the plant have been performed.

3.2. DESCRIPTION OF THE PROCESS SIMULATOR

The HYSIM developed by Hyprotech Ltd. is a powerful desktop process simulator designed for the gas processing, oil refining, petrochemical, chemicals, and synthetic fuels industries. It has built-in modules that cover the entire chemical processing industry, including separators, heat exchangers, compressors, pumps, valves, mixers, multiple reactor models, rigorous columns plus a range of helpful utilities. There are no preprogrammed limits on the numbers of components, streams, unit operations or trays. HYSIM offers a wide selection of property methods, including equations of state, semi empirical correlations, and activity models.

HYSIM is an interactive steady-state simulator incorporating the following features: rigorous thermodynamic and physical property models, extensive component libraries,

industry-proven oil characterization, a wide range of unit operations and utilities (including tower and heat exchanger design and rating). Since HYSIM is totally interactive, it provides virtually unlimited flexibility for solving any simulation problem.

3.2.1. HARDWARE REQUIRENENTS

For installation and proper use, HYSIM requires operating system DOS 3.0 or greater, a minimum conventional memory of 200 KB, a minimum extended memory of 3.5 MB for the 386 version, a minimum of 9 MB of disk space to store the executable and data files. HYSIM also requires a math co-processor [34].

CHAPTER-IV

DESCRIPTION OF THE KAILASHTILLA-I GAS PROCESSING PLANT

4.1. PRODUCTION HISTORY

Kailashtilla-I (KTL-I) field is located approximately 13 miles east of Sylhet town in the North-Eastern part of Bangladesh. The field was discovered in1962 by Pakistan Shell Oil Company Limited and went into production in July, 1983 from both upper and lower sands. Due to excessive water cut from lower sand, this sand was permanently sealed off in the first workover operation during May 1995 to August 1995 and continuous production from this field (only from the upper sand) resumed in May 1997. Production from this well was again suspended from October 1997 to February 1998. KTL-I was reopened in middle sand during second workover operation and the production from this field started from February 1998. The total gas, condensate and water production from the lower and upper sands by KTL1 is 82118.421 MMCF, 860025 STB and 166347 BBL[36] respectively. At present the well head flowing pressure is 3100 psia. The total gas, condensate and water production from middle sand upto September 1998 is 4801.397 MMCF, 44922 STB and 1281 BBL[36] respectively.

4.2. DESCRIPTION OF THE EXISTING GAS PROCESSING PLANT (KAILASHTILLA-I):

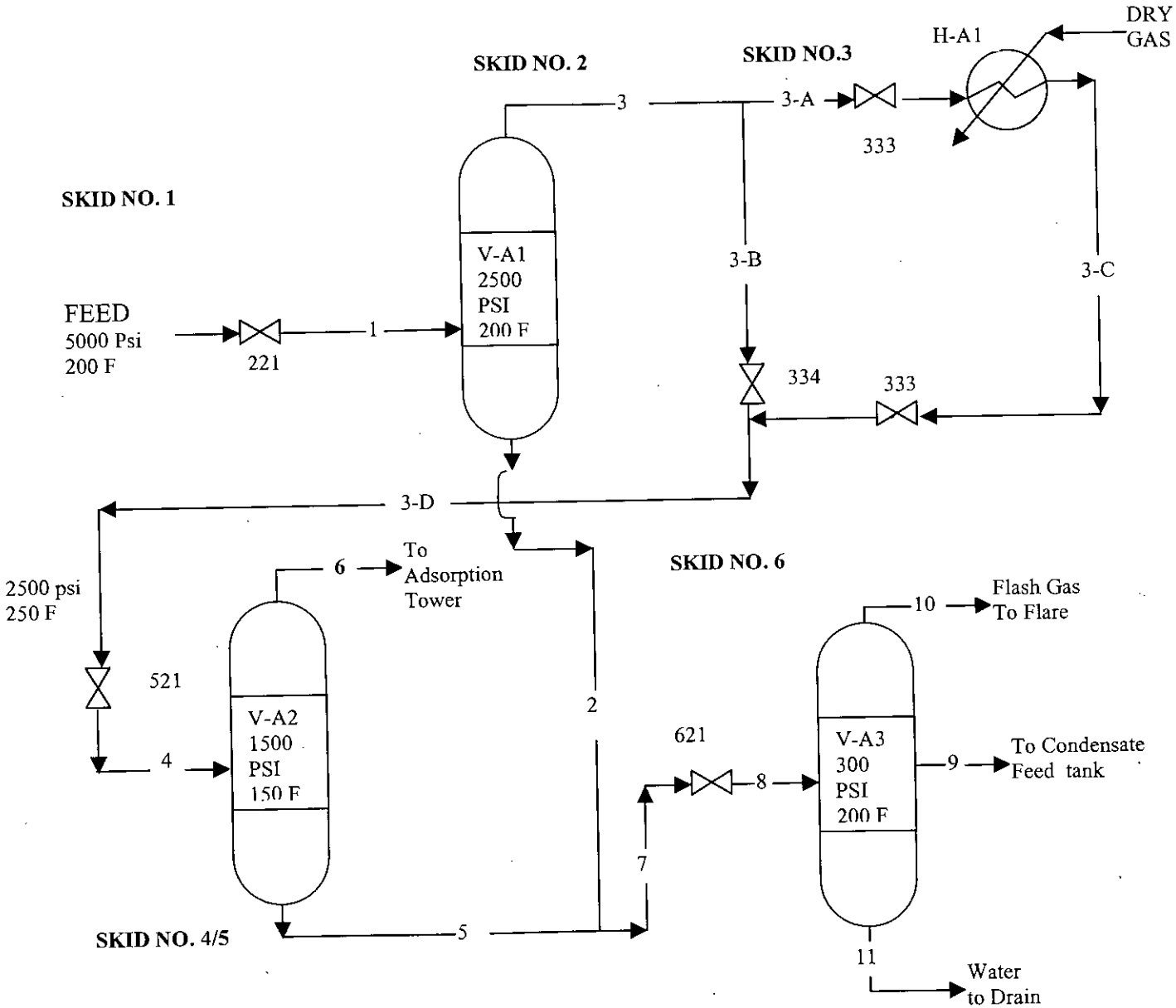
In the gas processing plant at Kailashtilla-1, the gas is drawn from a single well. The gas is a sweet gas. The whole plant is divided into three sections. The gas gathering (**Skid No. 1-6**), gas dehydration (**Skid No.7-13**), and condensate fractionation (**Skid No.14**) sections. In the gas gathering sections the wellhead pressure of the gas is reduced and the mixture of gas and condensate is separated. In the dehydration sections the gas is

dehydrated to remove water from the gas. And in the fractionation sections the marketable products are mainly separated.

4.2.1. GAS GATHERING SECTIONS (SKID NO. 1-6: Figure 4.1)

In the Kailshtilla-1 the main well stream is drawn from the middle sand stream of the reservoir which contains mixture of gas, condensate and water. The well head design pressure is 5000 psia.

The wellhead pressure is reduced (**Skid no.1**) by flowing the **FEED** through a valve (**221**). Then the raw gas (**Stream 1**) is separated into vapor (**Stream 3**) and condensate (**Stream 2**). This two phase separation is carried out in a flash separator (**V-A1**) at a pressure 2500 psia and temperature 200^0 F. One third of the vapor (**Stream 3-A**) is passed through heat exchanger (**H-A1**) and heated upto 250^0 F. The rest of the vapor (**Stream 3-B**) is now mixed with hot vapor (**Stream 3-C**). The pressure of the mixed stream (**Stream 3-D**) is 2500 psia. The second stage pressure is reduced by passing the stream (**Stream 3-D**) through a valve (**521**). The pressure is reduced from 2500 psia to 1500 psia (**Skid no.4/5**). The mixed stream (**Stream 4**) is again separated in a flash separator (**V-A2**) into vapor (**Stream 6**) and condensate (**Stream 5**). The condensate (**Stream 5**) is mixed with the condensate separated from the flash separator **V-A1** (**Stream 2**). The third stage pressure is reduced by passing the stream through a valve (**621**). Next the stream (**Stream 8**) is separated into three phase in the flash separator **V-A3**. The condensate (**Stream 9**) is stored in the condensate storage tank, which is separated into the marketable products in a fractionation column. The vapor (**Stream 10**) is sent as flare gas and residual water (**Stream 11**) is drained out.



V-A1, V-A2: FLASH SEPARATOR

H-A1: HEATER

221, 333, 334, 521, 621: VALVES

DRY GAS: HEATING SOURCE

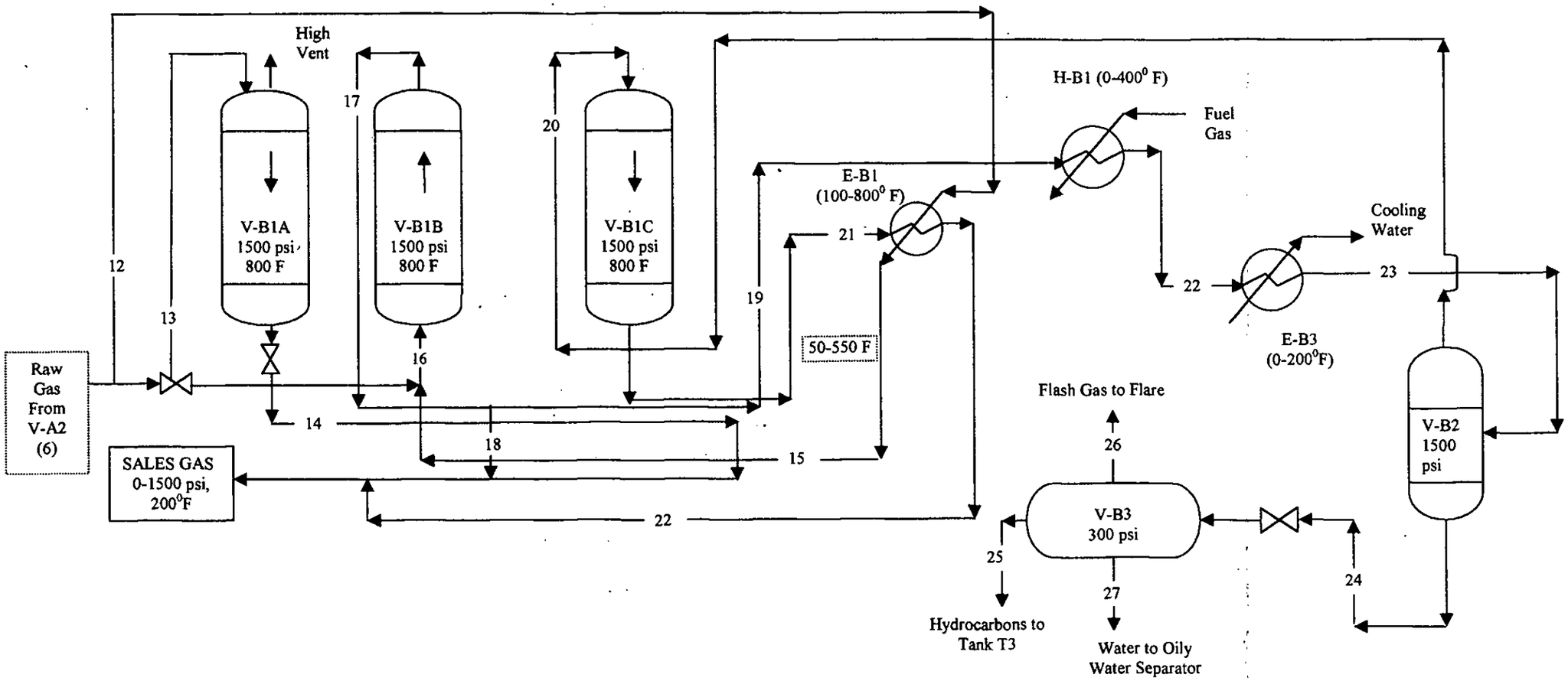
FIGURE 4.1.
GAS GATHERING SECTION
(SKID NO.1-6)

4.2.2. GAS DEHYDRATION (Skid No. 7-13: Figure 4.2.)

Raw gas from flash separator **V-A2** (**Stream 6**) is first divided into two parts. One third (**Stream 12**) is taken into the regeneration gas pre-heater (**E-B1**) and two third of the gas (**Stream 13**) is passed through the adsorption tower **V-B1A**. The design temperature and pressure of the tower are 800^0 F and 1500 psia. Two third of the adsorbed gas (**Stream 14**) is sent to the sales gas line and rest is mixed with the gas (**Stream 15**) entering the regeneration tower. The mixed stream (**Stream 16**) is passed through the regeneration tower **V-B1B** (1500 psia and 800^0F). The top product (**Stream 17**) is also divided into two portions. One portion is mixed with the sales gas line (**Stream 18**) and rest of the gas is the return regeneration gas (**Stream 19**). One third of the inlet raw gas stream is heated in the (**Stream 12**) regeneration gas pre-heater (E-B1, 100-800^0 F) and the heated gas (**Stream 15**) is sent to the regeneration tower. The temperature of this gas is between 50-550^0 F. The bottom product from the cooling tower **V-B1C** (**Stream 21**) is also passed through the regeneration gas pre-heater **E-B1** and the heated gas (**Stream 22**) is mixed with the sales gas. The top product from the regeneration tower (**Stream 17**) is passed through the regeneration gas heater **H-B1** where it is heated and again cooled (**Stream 23**) and the gas is taken to the regeneration gas scrubber **V-B2**. The lighter portion is sent to the cooling tower **V-B1C** and the heavier hydrocarbons (**Stream 24**) are sent to the flash separator **V-B3**. The separator is a three phase separator where the lighter fractions make the flare gas (**Stream 26**), heavy fractions (**Stream 27**) are sent to the oily water separator and the rest (**Stream 25**) is sent to the hydrocarbon storage Tank **T3**.

V-B1A: ADSORPTION TOWER
V-BIB: REGENERATION TOWER
V-BIC: COOLING TOWER
E-B1: REGENERATION GAS PRE-HEATER
H-B1: REGENERATION GAS HEATER
E-B3: RREGENERATION WATER COOLER
V-B2: REGENERATION GAS SCRUBBER
V-B3: FLASH SEPARATOR
FUEL GAS: HEATING SOURCE

SKID NO.7,8,9 **SKID NO. 10** **SKID NO.11/12**



SKID NO. 13

FIGURE 4.2.
GAS DEHYDRATION SECTION &HYDROCARBON RECOVERY SECTION (SKID NO.7-13)

4.2.3. CONDENSATE FRACTIONATION SECTION (Skid No.14: Figure 4.3)

The condensate (**Stream 9**) from the three phase separator (V-A3) is first heated in the heater **E-C2** from 300 to 400^0 F. The vapor from the fractionation column is used as a heating source. The pressure of the hot condensate (**Stream 29**) is reduced to 60 psia. Now the fractionation of the condensate (**Stream 29**) is carried out in the column **C-C1**. The temperature and pressure of the entering feed (**Stream 29**) is 400^0F and 60 psia respectively. The exit vapor (**Stream 30**) is cooled in the cooler **E-C1** and separated in the two phase separator **V-C1**. The temperature and pressure of the cooled vapor (**Stream 33**) is 200^0 F and 60 psia respectively. The bottom product (**Stream 34**) from the reflux gasoline pump drum is pumped (**Stream 36**) and divided into two portions (**Stream 37, and 38**) and top product (**Stream 35**) is the flare gas. **Stream37** is stored in the **Storage Tank T3** and **stream 38** is sent to 1st stage of the fractionation column **C-C1**.The liquid fraction (**Stream 31**) of the column **C-C1** is also divided into three portions (**Streams 39, 40, and 41**). **Stream 39** is cooled in the cooler **E-C3** and the cooled product (**Stream 42**) is the HS diesel product. The **stream 41** is recycled to the column **C-C1** and **stream 40** is heated in oil bath re-boiler **H-C1** and sent back to the column.

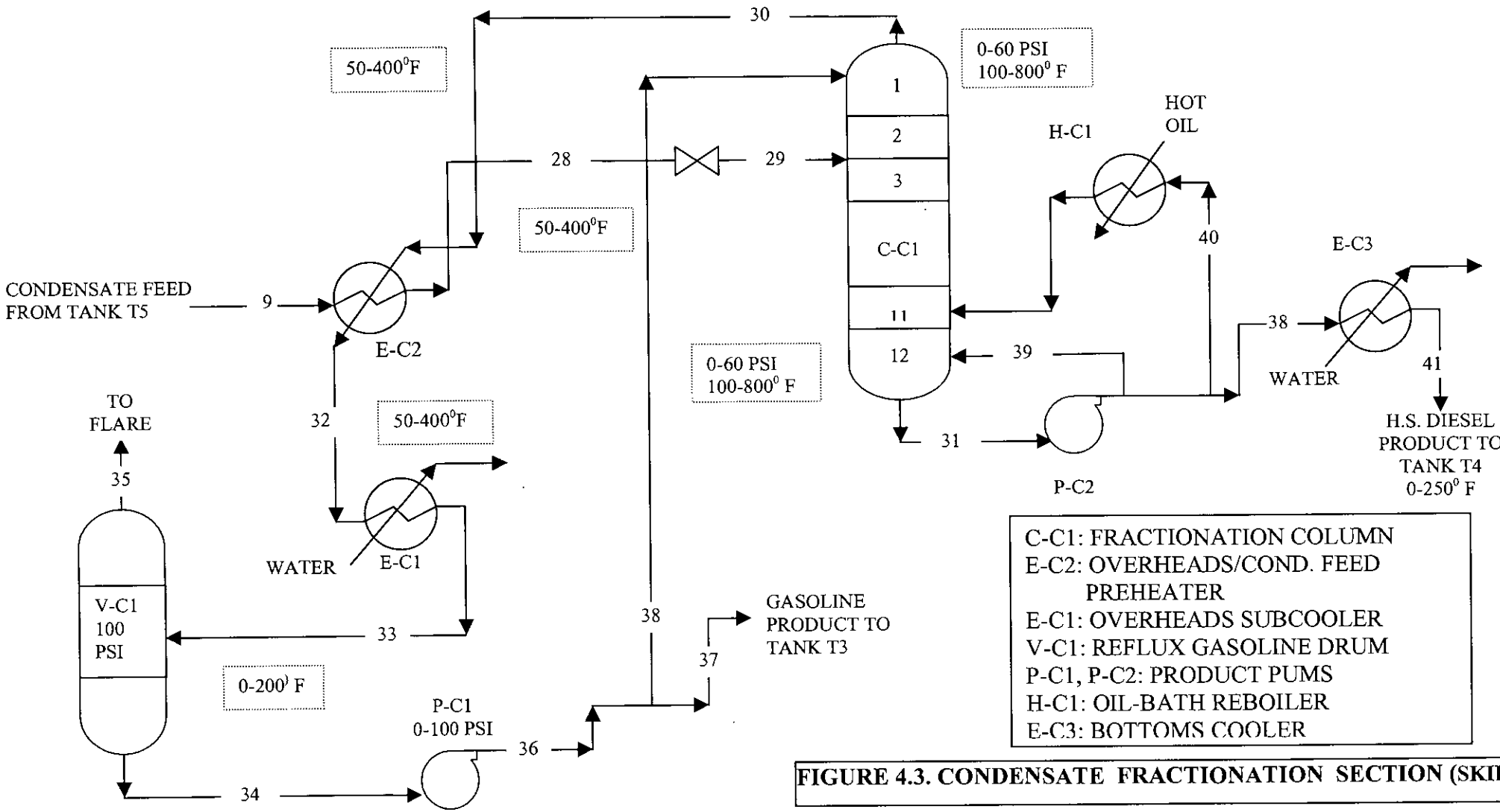


FIGURE 4.3. CONDENSATE FRACTIONATION SECTION (SKID NO.14)

4.3. DESCRIPTION OF THE SIMULATED PLANT

At first, the **FEED** pressure is reduced by passing the gas through a valve (**VA-1**) . Then the stream (**Stream 1**) is separated into vapor (**Stream 3**) and condensate (**Stream 2**) in a flash separator (**V-A1**) at a pressure 2500 psia. One third of the vapor (**Stream 3-A**) is passed through heat exchanger (**H-A1**) and heated upto 250^0 F where **Q-1** is the energy stream. The rest of the vapor (**Stream 3-B**) is now mixed in the mixer (**M-1**) with the hot gas stream (**Stream 3-C**). The pressure of the mixed stream (**Stream 3-D**) is 2490 psia. Valve **VA-2** the reduced pressure of the stream (**Stream 3-D**) from 2490 psia to 1500 psia. Then the stream (**Stream 4**) is again separated in a flash separator (**V-A2**). Most of the inlet stream (**Stream 4**) is separated into the vapor stream (**Stream 6**). The condensate (**Stream 5**) from the separator **V-A2** is mixed with the condensate in the mixer (**M-2**) separated from **V-A1** (**Stream 2**). The pressure is reduced from 1500 to 300 psia by inserting a valve **VA-3**. Next the stream (**Stream 8**) is separated into three phase in the flash separator **V-A3**. The condensate (**Stream 9**) is separated in the fractionation column **C-C1** to separate the marketable products. The vapor (**Stream 10**) is sent as flare gas and residual water (**Stream 11**) is drained. Because of the unavailability of the dehydration unit in the HYSIM the dehydration of the gas (**Stream 6**) is carried out in two different methods which are described below:

i) The vapor (**Stream 6**) is first cooled to 32^0 F in the cooler **C-1**. The cooled stream (**Stream 6-A**) is then separated into three phase in the separator **V-A4**. The water (**Stream 14**) is drained and the mixed stream (**Stream 15**) of vapor and condensate is further cooled down to 10.4^0 F in the cooler **C-2**. Finally the cooled stream (**Stream 16**) is separated and the vapor (**Stream 18**) and condensate (**Stream 17**) is again mixed and heated in the heater **H-A2.** The gas heated from 10.4 to 200^0 F. And the

gas (**Stream 21**) is separated in the two phase separator **V-A6** and the gas (**Stream 24**) is the sales gas. **The process flow dia gram (PFD-I) is shown in the Figure A-I (Page-64).**

ii) In this method instead of cooling the gas, the gas is separated from the water in a component splitter. The component splitter separates 100% water from the gas. The gas (**Stream 24**) is the sales gas. **The process flow dia gram (PFD-II) is shown in the Figure A-II (Page-78).**

The condensate (**Stream 9**) from the three phase separator is first heated in the heater **E-C2** from 129 to 320^0 F. The pressure of the hot stream (**Stream 25**) is reduced by installing a valve **VA-4**. Now the fractionation of the condensate (**Stream 26**) is carried out in the column **C-C1**. The temperature and pressure of the entering feed (**Stream 26**) is 307^0F and 60 psia respectively. The exit vapor (**Stream 27**) is cooled in the cooler **E-C1** and separated in the two phase separator **V-C1**. The temperature and pressure of the cooled vapor stream (**Stream 30**) is 150^0 F and 60 psia respectively. The condensate is the gasoline product (**Stream 31**) and the vapor (**Stream 32**) is the flare gas. The liquid fraction (**Stream 28**) of the column **C-C1** is cooled in the cooler **E-C3** and the cooled product (**Stream 29**) is the HS diesel product.

4.4. SIMULATION METHODOLOGY

HYSIM is significantly different from other process simulators because it does not rely only on the sequential modular calculation scheme. It can calculate input from known output or take advantage of partial information known in other streams to calculate properties in adjoining streams.

To simulate the existing plant from the property package lists Peng-Robinson property package was selected. For oil, gas and petrochemical applications, the Peng-Robinson Equation of State is generally recommended property package.

HYSIM can operate in any of the three modes

- From the Main Command Menu,
- In Worksheet environment or
- In the PFD.

The **Worksheet** provides a convenient format for building and modifying Flowsheet.

The **PFD** command switches **HYSIM** into a graphical working environment where it can build the entire flowsheet. Each of these interfaces are different representations of the same information. **For example**, if a change is made in the PFD, such as adding an operation, next entering the Worksheet the information related to that operation will be there.

As soon as a new value is supplied, **HYSIM** will perform any necessary calculations and re-display the results in the worksheet.

HYSIM recognizes the type of flash calculation can be performed from the concept of degrees of freedom. The known variables can either be specified by the user or calculated by a unit operation. HYSIM will display a warning if information is inconsistent or overspecified.

The Flowsheet is built by installing unit operations and specifying information about streams in any order as appropriate. Unit operations link streams together in a Flowsheet,

in a similar manner to the way real pieces of equipment connect streams together in a plant. Although this analogy is useful, it is not exact.

HYSIM will use any available information to its fullest extent. Information can be passed both forward and backward through an operation. When any new information is supplied HYSIM will automatically determine what new information can be calculated. It will then pass this information to any attached operation, which in turn repeats this process until no new information can be determined.

Since HYSIM performs all its calculations in background, so progressing through a flowsheet, an intermediate calculations on-line, on-the-spot revisions can be made for what-if studies, and different cases studies can be generated without leaving HYSIM.

CHAPTER-V

RESULTS AND DISCUSSIONS

5.1 RESULTS AND DISCUSSIONS

During the simulation works some changes have been made due to the limitations of the HYSIM simulator.

The **FEED** temperature was not known. So at first a temperature is guessed and all other calculations continue on a unit by unit basis until all unit operations in the flowsheet have been calculated. Next deleting the guessed temperature of the feed, the temperature of the **stream1** (given) is inserted. That is, the design temperature (200^0 **F**) of the flash separator **V-A1** is applied for **stream 1**. It gives the amount of the condensate (**Stream 2**) is zero. To keep an optimum value of the condensate the temperature has been set to 150^0 F.

There is no dehydration unit present in the HYSIM, so the removal of water from the gas is performed by two different methods,

a) By Cooling

b) By Component Splitter

Two process flow diagrams are shown (**Figure A-I and A-II, p.66 & 81**) and the plant is simulated using these two alternate ways. The worksheets and results are also shown based on these techniques (**Page. 65-76 & 79-87**). Due to these changes the simulated pressures and temperatures are slightly different from the design pressure and temperature which have been shown in **Table 5.2**.

The sales gas compositions obtained from these two different processes have been compared in **Table 5.4** with design gas compositions of the plant. It is found from the worksheet that the sales gas obtained by cooling method contained some water.

Therefore, the simulation of the plant using operating data for three different times (8:00 hrs, 20:00 hrs and 6:00 hrs) have carried out by component splitter method.

The condensate from gas gathering and dehydration sections are stored in six storage tanks. The feed for the condensate fractionation sections is supplied from these storage tanks subsequently. In the HYSIM, the supply of any feed in the middle of operation from the storage tank cannot be performed. And HYSIM is also a steady-state simulator. The level of these tanks with time cannot be measured. Therefore, it was very difficult to simulate the fractionation column with the gas gathering section. The simulation of the condensate fractionation column have been carried out after selecting the condensate (**Stream 9**) from the flash separator V-A3 as feed. Thus the calculations procedure have been made sequential modular.

The plant is very old and there are not enough data available as per the requirement to simulate the plant. The study of the performance could not be performed as per the objectives of this study. Only the operating data for gas gathering and gas dehydration sections are available in the log-sheet. However the operating data for dehydration section is not useful due to the following reasons,

1. There is no dehydration unit present in any available simulator at present.
2. Silica-gel dehydration unit consists of adsorption, regeneration, cooling and other important sections required for the adsorption plant **(Figure 4.2, p.44)**. Neither the design data for these sections could be simulated nor the operating data could be studied.

The performance of the plants has also been studied using three sets of operating data from the log sheet of the plant dated on 31-10-98. **Table 5.2** shows some of the comparison between the operating data (8:00 hours) and simulated data of different

streams (**PFD I**). All the worksheets for three sets of operating times have been given in the **Appendix-III (Page-89-128)**. Some differences have appeared in the different stages of the result **(Table 5.3)** which may be due to,

1. Only the material and energy balances can be performed using the HYSIM. The length of the pipe (pressure due to friction and other heat losses) or piping heat loss during simulation is not considered.
2. The operability of the plant might have reduced due to the operation of the plant for a long time.
3. Hidden critical assumptions on the development of the simulation model may be responsible for the deviation of pressures and temperatures from the actual pressure and temperature.

TABLE 5.1. FEED GAS COMPOSITION (Sylhet Gas Field Limited)

Components	Mole Fraction	Components	Mole Fraction
Methane	0.9457	n-Octane	0.0014
Ethane	0.0255	n-Nonane	0.0008
Propane	0.0086	n-Decane	0.0004
i-Butane	0.0022	$n\text{-}C_{11}$	0.0003
n-Butane	0.0023	$n\text{-}C_{12}$	0.0003
i-Pentane	0.0014	$n\text{-}C_{13}$	0.0003
n-Pentane	0.0009	$n\text{-}C_{14}$	0.0007
n-Hexane	0.0018	H_2O	0.0005
n-Heptane	0.0035	CO_2	0.0015

TABLE 5.2. COMPARISON BETWEEN OPERATING DATA (8.00 hrs) AND SIMULATED RESULTS (PFD II)

STREAM NO.		OPERATING DATA		SIMULATED DATA	
		T in ^{0}F	P in psia	T in ^{0}F	P in psia
1		90	1360	104	1360*
3-C		136	-	136*	2490
3-D		-	1490	106	1350
4		66	670	74	670*
8		66	110	88	110*
21		116	540	116*	670
22		116	540	109	540*
Column	Stage 1	296	60	296	60
	Stage 13	380	60	380	60

TABLE 5.3. COMPARISON BETWEEN THE DESIGN AND THE SIMULATED DATA OF DIFFERENT STREAMS (PFD-I)

STREAM NO.		DESIGN DATA		SIMULATED DATA	
		T in ^{0}F	P in psia	T in ^{0}F	P in psia
1		200	2500	150*	2500
3-D		250	2500	250*	2490
4		150	1500	127	1500*
8		200	300	129	300*
28/25		50-400	-	320*	300
30/27		50-400	-	271	60
38/28		100-800	-	484	60
41/29		250	-	250*	60
33/30		200	-	150*	60
Column	Stage 1	800	60	500*	60
	Stage 13	800*	60	800*	60

*These values had been specified

(-) Values are not known

LHS/RHS: (LHS) data from the original PFD and (RHS) data from the simulated PFD

SOURCE (Design data): SYLHET GAS FIELD LIMITED

TABLE 5.4 COMPOSITION OF THE SALES GAS

Composition	Mole Farction (Design)	Mole Fraction (Simulated) **(Appendix I, Stream 24)**	Mole Fraction (Simulated) **(Appendix II, Stream 24)**
Methane	0.95408	0.9528	0.9494
Ethane	0.027	0.0255	0.0255
Propane	0.0094	0.0085	0.0085
i-Butane	0.0021	0.0021	0.0021
n-Butane	0.0020	0.0022	0.0023
i-Pentane	0.0012	0.0012	0.0013
n-Pentane	0.00001	0.0008	0.0009
n-Hexane	0.0002	0.0013	0.0016
n-Heptane	0.0035	0.0017	0.0029
n-Octane	0000	0.0003	0.0010
n-Nonane	0000	0.0001	0.0002
n-Decane	0000	0000	0000
n-C11	0000	0000	0000
N_2	0.0020	0.0020	0.0020
CO_2	0.0015	0.0015	0.0015

SOURCE (Design data): SYLHET GAS FIELD LIMITED

CHAPTER-VI

CONCLUSIONS

The following conclusions are drawn based on the the simulation of the Kailshtilla-1gas processing plant:

1. The simulation of the plant has been carried out by two different methods after some modifications of the existing dehydration system of the gas. The compositions of the gas obtained from both methods are very close to the specified composition.
2. HYSIM only calculates material and energy balances for a process, where the heat losses due to piping are not included automatically. The simulated results are therefore different from the operating data.

CHAPTER-VII

SUGGESTIONS FOR FUTURE WORKS

For future the following works are recommended:

1. Modeling for an adsorption unit may be carried out for making the simulation more realistic.
2. Performance of the plant may be studied unitwise with the collection of necessary parameters and stream analysis.

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APPENDIX-I

SIMULATED PROCESS FLOW DIAGRAM (PFD-I) AND

WORKSHEET-I

REMOVAL OF WATER BY COOLING

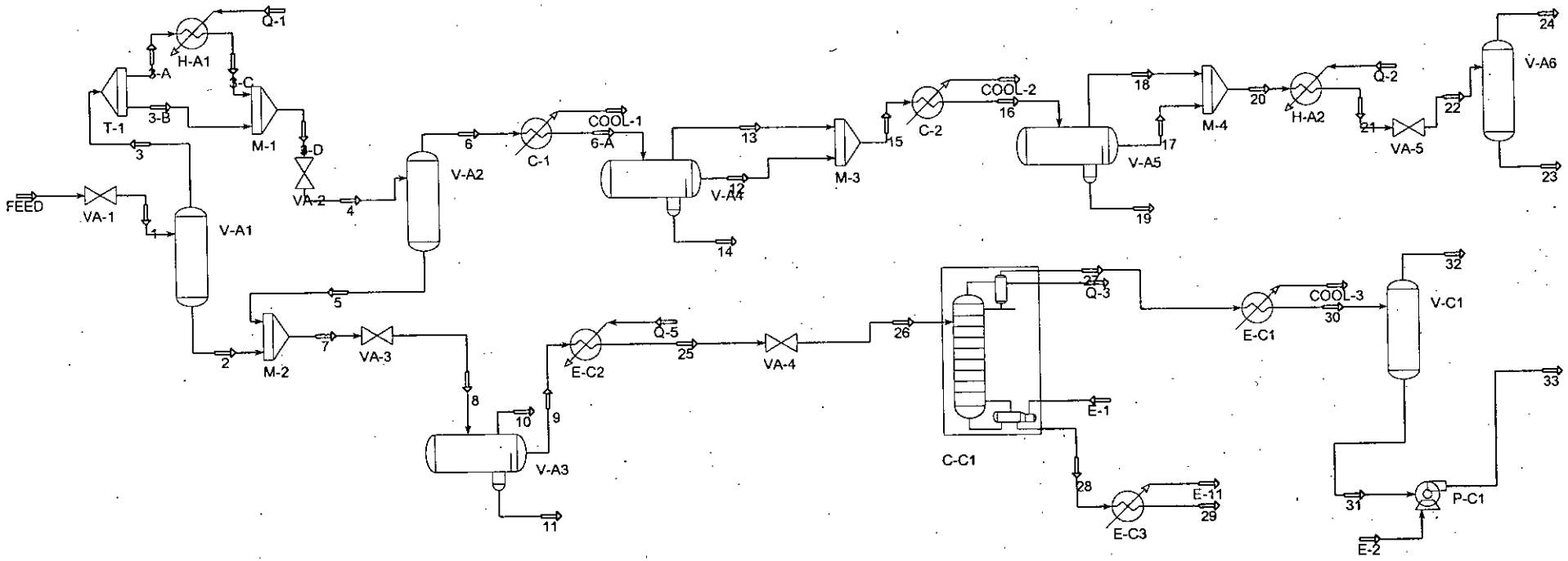

Fig. A-I: SIMULATED PROCESS FLOW DIAGRAM (PFD-I)
REMOVAL OF WATER BY COOLING

WORKSHEET-I (REMOVAL OF WATER BY COOLING)

Stream		FEED	1	2	3
Description					
Vapour frac.		1	0.9984	0	1
Temperature	F	182.2161	150.0000*	150	150
Pressure	psia	5000.0002*	2500.0001*	2500.0001	2500.0001
Molar Flow	lbmole/hr	34999.9992*	34999.9992	55.9279	34944.0704
Mass Flow	lb/hr	629655.8749	629655.8749	4803.6415	624852.2582
LiqVol Flow	barrel/day	134281.017	134281.017	506.9938	133774.0216
Enthalpy	Btu/hr	1.42E+08	1.42E+08	141285.0277	1.42E+08
Density	lb/ft3	13.4518	8.1052	39.0479	8.0561
Mole Wt.		17.9902	17.9902	85.8898	17.8815
Spec. Heat	Btu/lb-F	0.7626	0.7472	0.5681	0.7485
Therm Cond	Btu/hr-ft-F	0.0476	---	0.0654	0.0335
Viscosity	cP	0.0276	---	0.3408	0.0188
Z Factor		0.9707	---	0.8405	0.8481
Sur Tension	dyne/cm	---	---	9.5943	---
Std Density	lb/ft3	---	---	41.5275	---
Methane	mole frac.	0.9457*	0.9457	0.4663	0.9465
Ethane	mole frac.	0.0255*	0.0255	0.0272	0.0255
Propane	mole frac.	0.0086*	0.0086	0.0161	0.0086
i-Butane	mole frac.	0.0022*	0.0022	0.0062	0.0022
n-Butane	mole frac.	0.0023*	0.0023	0.0076	0.0023
i-Pentane	mole frac.	0.0014*	0.0014	0.0069	0.0014
n-Pentane	mole frac.	0.0009*	0.0009	0.0051	0.0009
n-Hexane	mole frac.	0.0018*	0.0018	0.017	0.0018
n-Heptane	mole frac.	0.0035*	0.0035	0.0539	0.0034
n-Octane	mole frac.	0.0014*	0.0014	0.0348	0.0013
n-Nonane	mole frac.	0.0008*	0.0008	0.031	0.0007
n-Decane	mole frac.	0.0004*	0.0004	0.0237	0.0004
n-C11	mole frac.	0.0003*	0.0003	0.0267	0.0003
n-C12	mole frac.	0.0003*	0.0003	0.0371	0.0002
n-C13	mole frac.	0.0003*	0.0003	0.0551	0.0002
n-C14	mole frac.	0.0007*	0.0007	0.1829	0.0004
H2O	mole frac.	0.0005*	0.0005	0.0004	0.0005
Nitrogen	mole frac.	0.0020*	0.002	0.0006	0.002
CO2	mole frac.	0.0015*	0.0015	0.0013	0.0015

Stream		3-B	3-A	3-C	Q-1
Description					
Vapour frac.		1	1	1	2.0000*
Temperatur	F	150	150	250*	0.0000*
Pressure	psia	2500.0001	2500.0001	2490.0002	0.0000*
Molar Flow	lbmole/hr	32944.0698	2000.0000*	2000	0.0000*
Mass Flow	lb/hr	589089.237	35762.9911	35762.9911	0.0000*
LiqVol Flo	barrel/day	126117.56	7656.4646	7656.4646	0.0000*
Enthalpy	Btu/hr	1.34E+08	8.11E+06	1.07E+07	2.60E+06
Density	lb/ft3	8.0561	8.0561	6.3064	0
Mole Wt.		17.8815	17.8815	17.8815	0
Spec. Heat	Btu/lb-F	0.7485	0.7485	0.7131	---
Therm Con	Btu/hr-ft-	0.0335	0.0335	0.0351	---
Viscosity	cP	0.0188	0.0188	0.0187	---
Z Factor		0.8481	0.8481	0.9271	---
Sur Tension	dyne/cm	---	---	---	---
Std Density	lb/ft3	---	---	---	---
Methane	mole frac.	0.9465	0.9465	0.9465	0.0000*
Ethane	mole frac.	0.0255	0.0255	0.0255	0.0000*
Propane	mole frac.	0.0086	0.0086	0.0086	0.0000*
i-Butane	mole frac.	0.0022	0.0022	0.0022	0.0000*
n-Butane	mole frac.	0.0023	0.0023	0.0023	0.0000*
i-Pentane	mole frac.	0.0014	0.0014	0.0014	0.0000*
n-Pentane	mole frac.	0.0009	0.0009	0.0009	0.0000*
n-Hexane	mole frac.	0.0018	0.0018	0.0018	0.0000*
n-Heptane	mole frac.	0.0034	0.0034	0.0034	0.0000*
n-Octane	mole frac.	0.0013	0.0013	0.0013	0.0000*
n-Nonane	mole frac.	0.0007	0.0007	0.0007	0.0000*
n-Decane	mole frac.	0.0004	0.0004	0.0004	0.0000*
n-C11	mole frac.	0.0003	0.0003	0.0003	0.0000*
n-C12	mole frac.	0.0002	0.0002	0.0002	0.0000*
n-C13	mole frac.	0.0002	0.0002	0.0002	0.0000*
n-C14	mole frac.	0.0004	0.0004	0.0004	0.0000*
H2O	mole frac.	0.0005	0.0005	0.0005	0.0000*
Nitrogen	mole frac.	0.002	0.002	0.002	0.0000*
CO2	mole frac.	0.0015	0.0015	0.0015	0.0000*

Stream		**3-D**	**4**	**5**	**6**
Description					
Vapour frac.		1	0.9958	0	1
Temperatur	F	155.3463	127.6861	127.6861	127.6861
Pressure	psia	2490.0002	1500.0000*	1500	1500
Molar Flow	lbmole/hr	34944.0704	34944.0704	146.0396	34798.0307
Mass Flow	lb/hr	624852.258	624852.258	13121.635	611730.548
LiqVol Flo	barrel/day	133774.022	133774.022	1363.1529	132410.864
Enthalpy	Btu/hr	1.44E+08	1.44E+08	165880.559	1.44E+08
Density	lb/ft3	7.9036	5.0036	39.9844	4.9114
Mole Wt.		17.8815	17.8815	89.8498	17.5795
Spec. Heat	Btu/lb-F	0.7444	0.6876	0.5534	0.6904
Therm Con	Btu/hr-ft-	0.0334	---	0.0663	0.027
Viscosity	cP	0.0187	---	0.3504	0.0152
Z Factor		0.8536	---	0.5348	0.8518
Sur Tension	dyne/cm	---	---	11.8345	---
Std Density	lb/ft3	---	---	42.1642	---
Methane	mole frac.	0.9465	0.9465	0.3429	0.949
Ethane	mole frac.	0.0255	0.0255	0.0262	0.0255
Propane	mole frac.	0.0086	0.0086	0.019	0.0085
i-Butane	mole frac.	0.0022	0.0022	0.0084	0.0022
n-Butane	mole frac.	0.0023	0.0023	0.0109	0.0023
i-Pentane	mole frac.	0.0014	0.0014	0.0113	0.0013
n-Pentane	mole frac.	0.0009	0.0009	0.0086	0.0009
n-Hexane	mole frac.	0.0018	0.0018	0.0333	0.0016
n-Heptane	mole frac.	0.0034	0.0034	0.1177	0.0029
n-Octane	mole frac.	0.0013	0.0013	0.0798	0.001
n-Nonane	mole frac.	0.0007	0.0007	0.069	0.0005
n-Decane	mole frac.	0.0004	0.0004	0.0469	0.0002
n-C11	mole frac.	0.0003	0.0003	0.0422	0.0001
n-C12	mole frac.	0.0002	0.0002	0.0454	0
n-C13	mole frac.	0.0002	0.0002	0.0446	0
n-C14	mole frac.	0.0004	0.0004	0.092	0
H2O	mole frac.	0.0005	0.0005	0.0004	0.0005
Nitrogen	mole frac.	0.002	0.002	0.0003	0.002
CO2	mole frac.	0.0015	0.0015	0.001	0.0015

Stream		**7**	**8**	**9**	**10**
Description					
Vapour frac.		0.0667	0.3578	0	1
Temperatur	F	133.973	129.5448	129.5448	129.5448
Pressure	psia	1500	300.0000*	300	300
Molar Flow	lbmole/hr	201.9676	201.9676	129.7021	72.2655
Mass Flow	lb/hr	17925.2764	17925.2764	16596.485	1328.7905
LiqVol Flo	barrel/day	1870.1467	1870.1467	1589.0922	281.0544
Enthalpy	Btu/hr	307165.593	307165.593	-41896.018	349059.939
Density	lb/ft3	36.745	9.7281	43.2554	0.9108
Mole Wt.		88.7532	88.7532	127.9585	18.3876
Spec. Heat	Btu/lb-F	0.5561	0.5363	0.5348	0.5558
Therm Con	Btu/hr-ft-	---	---	0.0685	0.0218
Viscosity	cP	---	---	0.5372	0.0126
Z Factor		---	---	0.1404	0.9578
Sur Tension	dyne/cm	---	---	17.4198	---
Std Density	lb/ft3	---	---	45.2678	---
Methane	mole frac.	0.3771	0.3771	0.0786	0.9128
Ethane	mole frac.	0.0265	0.0265	0.0158	0.0457
Propane	mole frac.	0.0182	0.0182	0.0182	0.0183
i-Butane	mole frac.	0.0078	0.0078	0.0096	0.0045
n-Butane	mole frac.	0.01	0.01	0.013	0.0046
i-Pentane	mole frac.	0.0101	0.0101	0.0144	0.0023
n-Pentane	mole frac.	0.0077	0.0077	0.0111	0.0014
n-Hexane	mole frac.	0.0288	0.0288	0.0436	0.0021
n-Heptane	mole frac.	0.1	0.1	0.1541	0.0029
n-Octane	mole frac.	0.0673	0.0673	0.1044	0.0008
n-Nonane	mole frac.	0.0585	0.0585	0.091	0.0003
n-Decane	mole frac.	0.0405	0.0405	0.063	0.0001
n-C11	mole frac.	0.0379	0.0379	0.059	0
n-C12	mole frac.	0.0431	0.0431	0.0671	0
n-C13	mole frac.	0.0475	0.0475	0.074	0
n-C14	mole frac.	0.1172	0.1172	0.1825	0
H2O	mole frac.	0.0004	0.0004	0.0002	0.0008
Nitrogen	mole frac.	0.0004	0.0004	0	0.0011
CO2	mole frac.	0.0011	0.0011	0.0004	0.0023

Stream		11	6-A	COOL-1	12
Description					
Vapour frac.		0	0.9921	2*	0
Temperature	F	129.5448	32.0000*	0*	32
Pressure	psia	300	1500	0*	1500
Molar Flow	lbmole/hr	0	34798.031	0*	262.0315
Mass Flow	lb/hr	0	611730.55	0*	15286.282
LiqVol Flow	barrel/day	0	132410.86	0*	1810.7511
Enthalpy	Btu/hr	0	9.97E+07	4.44E+07	-262070.79
Density	lb/ft3	51.9644	6.9896	0	37.1374
Mole Wt.		18.0182	17.5795	0	58.3376
Spec. Heat	Btu/lb-F	1.032	0.827	---	0.5339
Therm Cond	Btu/hr-ft-F	0.3742	---	---	0.07
Viscosity	cP	0.5075	---	---	0.2576
Z Factor		0.0165	---	---	0.4466
Sur Tension	dyne/cm	66.985	---	---	10.6417
Std Density	lb/ft3	63.3323	---	---	35.8135
Methane	mole frac.	0	0.949	0*	0.4585
Ethane	mole frac.	0	0.0255	0*	0.0413
Propane	mole frac.	0	0.0085	0*	0.0327
i-Butane	mole frac.	0	0.0022	0*	0.0148
n-Butane	mole frac.	0	0.0023	0*	0.0198
i-Pentane	mole frac.	0	0.0013	0*	0.0203
n-Pentane	mole frac.	0	0.0009	0*	0.0159
n-Hexane	mole frac.	0	0.0016	0*	0.0567
n-Heptane	mole frac.	0	0.0029	0*	0.1668
n-Octane	mole frac.	0	0.001	0*	0.0825
n-Nonane	mole frac.	0	0.0005	0*	0.0467
n-Decane	mole frac.	0	0.0002	0*	0.0193
n-C11	mole frac.	0	0.0001	0*	0.0098
n-C12	mole frac.	0	0	0*	0.0063
n-C13	mole frac.	0	0	0*	0.0031
n-C14	mole frac.	0	0	0*	0.0031
H2O	mole frac.	0.9999	0.0005	0*	0.0001
Nitrogen	mole frac.	0	0.002	0*	0.0004
CO2	mole frac.	0.0001	0.0015	0*	0.0016

Stream		13	14	15	16
Description					
Vapour frac.		1	0	0.9925	0.9897
Temperature	F	32	32	32.0002	10.4000*
Pressure	psia	1500	1500	1500	1500
Molar Flow	lbmole/hr	34523.466	12.534	34785.496	34785.496
Mass Flow	lb/hr	596218.5	225.8252	611504.78	611504.78
LiqVol Flow	barrel/day	130584.62	15.4947	132395.38	132395.38
Enthalpy	Btu/hr	1.00E+08	-195449.63	9.99E+07	8.83E+07
Density	lb/ft3	6.8448	64.2249	6.9873	7.8586
Mole Wt.		17.2699	18.017	17.5793	17.5793
Spec. Heat	Btu/lb-F	0.8344	1.0309	0.8269	0.909
Therm Cond	Btu/hr-ft-F	0.0261	0.3287	---	---
Viscosity	cP	0.0151	1.7448	---	---
Z Factor		0.7173	0.0798	---	---
Sur Tension	dyne/cm	---	76.3906	---	---
Std Density	lb/ft3	---	63.3309	---	---
Methane	mole frac.	0.9531	0	0.9493	0.9493
Ethane	mole frac.	0.0254	0	0.0255	0.0255
Propane	mole frac.	0.0084	0	0.0085	0.0085
i-Butane	mole frac.	0.0021	0	0.0022	0.0022
n-Butane	mole frac.	0.0021	0	0.0023	0.0023
i-Pentane	mole frac.	0.0012	0	0.0013	0.0013
n-Pentane	mole frac.	0.0007	0	0.0009	0.0009
n-Hexane	mole frac.	0.0012	0	0.0016	0.0016
n-Heptane	mole frac.	0.0017	0	0.0029	0.0029
n-Octane	mole frac.	0.0004	0	0.001	0.001
n-Nonane	mole frac.	0.0001	0	0.0005	0.0005
n-Decane	mole frac.	0	0	0.0002	0.0002
n-C11	mole frac.	0	0	0.0001	0.0001
n-C12	mole frac.	0	0	0	0
n-C13	mole frac.	0	0	0	0
n-C14	mole frac.	0	0	0	0
H2O	mole frac.	0.0001	0.9999	0.0001	0.0001
Nitrogen	mole frac.	0.002	0	0.002	0.002
CO2	mole frac.	0.0015	0.0001	0.0015	0.0015

Stream		COOL-2	17	18	19
Description					
Vapour frac.		2.0000*	0	1	0
Temperature	F	0.0000*	10.4	10.4	10.4
Pressure	psia	0.0000*	1500	1500	1500
Molar Flow	lbmole/hr	0.0000*	356.4019	34427.1046	1.9891
Mass Flow	lb/hr	0.0000*	19039.2873	592429.619	35.84
LiqVol Flow	barrel/day	0.0000*	2331.6205	130061.292	2.4591
Enthalpy	Btu/hr	1.16E+07	-462320.047	8.88E+07	-31816.3028
Density	lb/ft3	0	36.56	7.6648	64.7684
Mole Wt.		0	53.4208	17.2082	18.0178
Spec. Heat	Btu/lb-F	---	0.5323	0.921	1.0342
Therm Cond	Btu/hr-ft-F	---	0.0715	0.0268	0.3176
Viscosity	cP	---	0.2491	0.0154	1.1197
Z Factor		---	0.4345	0.6676	0.0827
Sur Tension	dyne/cm	---	10.1878	---	78.4435
Std Density	lb/ft3	---	34.0517	---	63.3319
Methane	mole frac.	0.0000*	0.4982	0.9541	0
Ethane	mole frac.	0.0000*	0.0452	0.0253	0
Propane	mole frac.	0.0000*	0.0355	0.0083	0
i-Butane	mole frac.	0.0000*	0.0158	0.002	0
n-Butane	mole frac.	0.0000*	0.0211	0.0021	0
i-Pentane	mole frac.	0.0000*	0.021	0.0011	0
n-Pentane	mole frac.	0.0000*	0.0163	0.0007	0
n-Hexane	mole frac.	0.0000*	0.0552	0.0011	0
n-Heptane	mole frac.	0.0000*	0.1511	0.0014	0
n-Octane	mole frac.	0.0000*	0.0695	0.0003	0
n-Nonane	mole frac.	0.0000*	0.0372	0.0001	0
n-Decane	mole frac.	0.0000*	0.0149	0	0
n-C11	mole frac.	0.0000*	0.0074	0	0
n-C12	mole frac.	0.0000*	0.0047	0	0
n-C13	mole frac.	0.0000*	0.0023	0	0
n-C14	mole frac.	0.0000*	0.0023	0	0
H2O	mole frac.	0.0000*	0.0001	0	0.9999
Nitrogen	mole frac.	0.0000*	0.0004	0.002	0
CO2	mole frac.	0.0000*	0.0017	0.0015	0.0001

Stream		20	Q-2	21	22
Description					
Vapour frac.		0.9898	2.0000*	1	1
Temperature	F	10.4008	0.0000*	200*	200
Pressure	psia	1500	0.0000*	1500	1500.0000*
Molar Flow	lbmole/hr	34783.5071	0.0000*	34783.5071	34783.5071
Mass Flow	lb/hr	611468.889	0.0000*	611468.889	611468.889
LiqVol Flow	barrel/day	132392.916	0.0000*	132392.916	132392.916
Enthalpy	Btu/hr	8.83E+07	8.56E+07	1.74E+08	1.74E+08
Density	lb/ft3	7.8582	0	4.0981	4.0981
Mole Wt.		17.5793	0	17.5793	17.5793
Spec. Heat	Btu/lb-F	0.9089	---	0.6692	0.6692
Therm Cond	Btu/hr-ft-F	---	---	0.0295	0.0295
Viscosity	cP	---	---	0.0159	0.0159
Z Factor		---	---	0.9089	0.9089
Sur Tension	dyne/cm	---	---	---	---
Std Density	lb/ft3	---	---	---	---
Methane	mole frac.	0.9494	0.0000*	0.9494	0.9494
Ethane	mole frac.	0.0255	0.0000*	0.0255	0.0255
Propane	mole frac.	0.0085	0.0000*	0.0085	0.0085
i-Butane	mole frac.	0.0022	0.0000*	0.0022	0.0022
n-Butane	mole frac.	0.0023	0.0000*	0.0023	0.0023
i-Pentane	mole frac.	0.0013	0.0000*	0.0013	0.0013
n-Pentane	mole frac.	0.0009	0.0000*	0.0009	0.0009
n-Hexane	mole frac.	0.0016	0.0000*	0.0016	0.0016
n-Heptane	mole frac.	0.0029	0.0000*	0.0029	0.0029
n-Octane	mole frac.	0.001	0.0000*	0.001	0.001
n-Nonane	mole frac.	0.0005	0.0000*	0.0005	0.0005
n-Decane	mole frac.	0.0002	0.0000*	0.0002	0.0002
n-C11	mole frac.	0.0001	0.0000*	0.0001	0.0001
n-C12	mole frac.	0	0.0000*	0	0
n-C13	mole frac.	0	0.0000*	0	0
n-C14	mole frac.	0	0.0000*	0	0
H2O	mole frac.	0	0.0000*	0	0
Nitrogen	mole frac.	0.002	0.0000*	0.002	0.002
CO2	mole frac.	0.0015	0.0000*	0.0015	0.0015

Stream		23	24	25	Q-5
Description					
Vapour frac.		0	1	0.0407	2.0000*
Temperature	F	200	200	320*	0.0000*
Pressure	psia	1500	1500	300	0.0000*
Molar Flow	lbmole/hr	0	34783.5071	129.7021	0.0000*
Mass Flow	lb/hr	0	611468.821	16596.485	0.0000*
LiqVol Flow	barrel/day	0	132392.898	1589.0922	0.0000*
Enthalpy	Btu/hr	0	1.74E+08	1.85E+06	1.89E+06
Density	lb/ft3	4.0981	4.0981	28.6545	0
Mole Wt.		17.5793	17.5793	127.9585	0
Spec. Heat	Btu/lb-F	0.6692	0.6692	0.6526	---
Therm Cond	Btu/hr-ft-F	0.0178	0.0295	---	---
Viscosity	cP	0.0121	0.0159	---	---
Z Factor		0.9089	0.9089	---	---
Sur Tension	dyne/cm	0.1235	---	---	---
Std Density	lb/ft3	---	---	---	---
Methane	mole frac.	0.9494	0.9494	0.0786	0.0000*
Ethane	mole frac.	0.0255	0.0255	0.0158	0.0000*
Propane	mole frac.	0.0085	0.0085	0.0182	0.0000*
i-Butane	mole frac.	0.0022	0.0022	0.0096	0.0000*
n-Butane	mole frac.	0.0023	0.0023	0.013	0.0000*
i-Pentane	mole frac.	0.0013	0.0013	0.0144	0.0000*
n-Pentane	mole frac.	0.0009	0.0009	0.0111	0.0000*
n-Hexane	mole frac.	0.0016	0.0016	0.0436	0.0000*
n-Heptane	mole frac.	0.0029	0.0029	0.1541	0.0000*
n-Octane	mole frac.	0.001	0.001	0.1044	0.0000*
n-Nonane	mole frac.	0.0005	0.0005	0.091	0.0000*
n-Decane	mole frac.	0.0002	0.0002	0.063	0.0000*
n-C11	mole frac.	0.0001	0.0001	0.059	0.0000*
n-C12	mole frac.	0	0	0.0671	0.0000*
n-C13	mole frac.	0	0	0.074	0.0000*
n-C14	mole frac.	0	0	0.1825	0.0000*
H2O	mole frac.	0	0	0.0002	0.0000*
Nitrogen	mole frac.	0.002	0.002	0	0.0000*
CO2	mole frac.	0.0015	0.0015	0.0004	0.0000*

Stream		26	27	Q-3	28
Description					
Vapour frac.		0.1945	1	2*	0
Temperature	F	307.9169	271.1567	0*	484.5496
Pressure	psia	60.0000*	60	0*	60
Molar Flow	lbmole/hr	129.7021	49.9995	0*	79.7026
Mass Flow	lb/hr	16596.485	3635.0999	0*	12961.3849
LiqVol Flow	barrel/day	1589.0922	398.9951	0*	1190.0972
Enthalpy	Btu/hr	1.85E+06	835588.6093	1.18E+06	2.77E+06
Density	lb/ft3	4.4575	0.6013	0	34.0922
Mole Wt.		127.9585	72.7027	0	162.6219
Spec. Heat	Btu/lb-F	0.6318	0.5263	---	0.7472
Therm Cond	Btu/hr-ft-F	---	---	---	---
Viscosity	cP	---	---	---	---
Z Factor		---	---	---	---
Sur Tension	dyne/cm	---	---	---	---
Std Density	lb/ft3	---	---	---	---
Methane	mole frac.	0.0786	0.2038	0*	0
Ethane	mole frac.	0.0158	0.041	0*	0
Propane	mole frac.	0.0182	0.0471	0*	0
i-Butane	mole frac.	0.0096	0.025	0*	0
n-Butane	mole frac.	0.013	0.0337	0*	0
i-Pentane	mole frac.	0.0144	0.0375	0*	0
n-Pentane	mole frac.	0.0111	0.0289	0*	0
n-Hexane	mole frac.	0.0436	0.1132	0*	0
n-Heptane	mole frac.	0.1541	0.3908	0*	0.0056
n-Octane	mole frac.	0.1044	0.0699	0*	0.126
n-Nonane	mole frac.	0.091	0.0064	0*	0.144
n-Decane	mole frac.	0.063	0.0007	0*	0.102
n-C11	mole frac.	0.059	0.0001	0*	0.0959
n-C12	mole frac.	0.0671	0	0*	0.1091
n-C13	mole frac.	0.074	0	0*	0.1204
n-C14	mole frac.	0.1825	0	0*	0.2969
H2O	mole frac.	0.0002	0.0004	0*	0
Nitrogen	mole frac.	0	0.0001	0*	0
CO2	mole frac.	0.0004	0.0012	0*	0

Stream		E-1	29	E-11	30
Description					
Vapour frac.		2.0000*	0	2*	0.3504
Temperature	F	0.0000*	250.0000*	0*	150.0000*
Pressure	psia	0.0000*	60	0*	60
Molar Flow	lbmole/hr	0.0000*	79.7026	0*	49.9995
Mass Flow	lb/hr	0.0000*	12961.3849	0*	3635.0999
LiqVol Flow	barrel/day	0.0000*	1190.0972	0*	398.9951
Enthalpy	Btu/hr	2.94E+06	740316.8257	2.03E+06	197389.9605
Density	lb/ft3	0	41.6596	0	1.8792
Mole Wt.		0	162.6219	0	72.7027
Spec. Heat	Btu/lb-F	---	0.5975	---	0.5524
Therm Cond	Btu/hr-ft-F	---	0.065	---	---
Viscosity	cP	---	0.3961	---	---
Z Factor		---	0.0308	---	---
Sur Tension	dyne/cm	---	15.9318	---	---
Std Density	lb/ft3	---	46.7208	---	---
Methane	mole frac.	0.0000*	0	0*	0.2038
Ethane	mole frac.	0.0000*	0	0*	0.041
Propane	mole frac.	0.0000*	0	0*	0.0471
i-Butane	mole frac.	0.0000*	0	0*	0.025
n-Butane	mole frac.	0.0000*	0	0*	0.0337
i-Pentane	mole frac.	0.0000*	0	0*	0.0375
n-Pentane	mole frac.	0.0000*	0	0*	0.0289
n-Hexane	mole frac.	0.0000*	0	0*	0.1132
n-Heptane	mole frac.	0.0000*	0.0056	0*	0.3908
n-Octane	mole frac.	0.0000*	0.126	0*	0.0699
n-Nonane	mole frac.	0.0000*	0.144	0*	0.0064
n-Decane	mole frac.	0.0000*	0.102	0*	0.0007
n-C11	mole frac.	0.0000*	0.0959	0*	0.0001
n-C12	mole frac.	0.0000*	0.1091	0*	0
n-C13	mole frac.	0.0000*	0.1204	0*	0
n-C14	mole frac.	0.0000*	0.2969	0*	0
H2O	mole frac.	0.0000*	0	0*	0.0004
Nitrogen	mole frac.	0.0000*	0	0*	0.0001
CO2	mole frac.	0.0000*	0	0*	0.0012

Stream		COOL-3	31	32	33
Description					
Vapour frac.		2.0000*	0	1	0
Temperature	F	0.0000*	150	150	150.2732
Pressure	psia	0.0000*	60	60	100.0000*
Molar Flow	lbmole/hr	0.0000*	32.481	17.5185	32.481
Mass Flow	lb/hr	0.0000*	3031.8743	603.2261	3031.8743
LiqVol Flow	barrel/day	0.0000*	308.3061	90.6891	308.3061
Enthalpy	Btu/hr	638198.6478	72711.9689	124677.9973	73472.0918
Density	lb/ft3	0	39.3658	0.3248	39.3885
Mole Wt.		0	93.3429	34.4337	93.3429
Spec. Heat	Btu/lb-F	---	0.5664	0.4817	0.5662
Therm Cond	Btu/hr-ft-F	---	0.0606	0.017	0.0605
Viscosity	cP	---	0.2396	0.0116	0.2394
Z Factor		---	0.0217	0.9723	0.0362
Sur Tension	dyne/cm	---	14.2882	---	14.2739
Std Density	lb/ft3	---	42.2578	---	42.2578
Methane	mole frac.	0.0000*	0.0103	0.5625	0.0103
Ethane	mole frac.	0.0000*	0.0076	0.103	0.0076
Propane	mole frac.	0.0000*	0.0204	0.0967	0.0204
i-Butane	mole frac.	0.0000*	0.0176	0.0388	0.0176
n-Butane	mole frac.	0.0000*	0.0272	0.0458	0.0272
i-Pentane	mole frac.	0.0000*	0.0406	0.0316	0.0406
n-Pentane	mole frac.	0.0000*	0.0332	0.0208	0.0332
n-Hexane	mole frac.	0.0000*	0.1542	0.0371	0.1542
n-Heptane	mole frac.	0.0000*	0.5721	0.0549	0.5721
n-Octane	mole frac.	0.0000*	0.1055	0.0041	0.1055
n-Nonane	mole frac.	0.0000*	0.0098	0.0002	0.0098
n-Decane	mole frac.	0.0000*	0.0011	0	0.0011
n-C11	mole frac.	0.0000*	0.0002	0	0.0002
n-C12	mole frac.	0.0000*	0	0	0
n-C13	mole frac.	0.0000*	0	0	0
n-C14	mole frac.	0.0000*	0	0	0
H2O	mole frac.	0.0000*	0.0001	0.0012	0.0001
Nitrogen	mole frac.	0.0000*	0	0.0003	0
CO2	mole frac.	0.0000*	0.0001	0.0031	0.0001

Stream		**E-2**
Description		
Vapour frac.		2.0000*
Temperature	F	0.0000*
Pressure	psia	0.0000*
Molar Flow	lbmole/hr	0.0000*
Mass Flow	lb/hr	0.0000*
LiqVol Flow	barrel/day	0.0000*
Enthalpy	Btu/hr	760.1229
Density	lb/ft3	0
Mole Wt.		0
Spec. Heat	Btu/lb-F	---
Therm Cond	Btu/hr-ft-F	---
Viscosity	cP	---
Z Factor		---
Sur Tension	dyne/cm	---
Std Density	lb/ft3	---
Methane	mole frac.	0.0000*
Ethane	mole frac.	0.0000*
Propane	mole frac.	0.0000*
i-Butane	mole frac.	0.0000*
n-Butane	mole frac.	0.0000*
i-Pentane	mole frac.	0.0000*
n-Pentane	mole frac.	0.0000*
n-Hexane	mole frac.	0.0000*
n-Heptane	mole frac.	0.0000*
n-Octane	mole frac.	0.0000*
n-Nonane	mole frac.	0.0000*
n-Decane	mole frac.	0.0000*
n-C11	mole frac.	0.0000*
n-C12	mole frac.	0.0000*
n-C13	mole frac.	0.0000*
n-C14	mole frac.	0.0000*
H2O	mole frac.	0.0000*
Nitrogen	mole frac.	0.0000*
CO2	mole frac.	0.0000*

APPENDIX-II

SIMULATED PROCESS FLOW DIAGRAM (PFD-II) AND

WORKSHEET-II

REMOVAL OF WATER BY COMPONENT SPLITTER

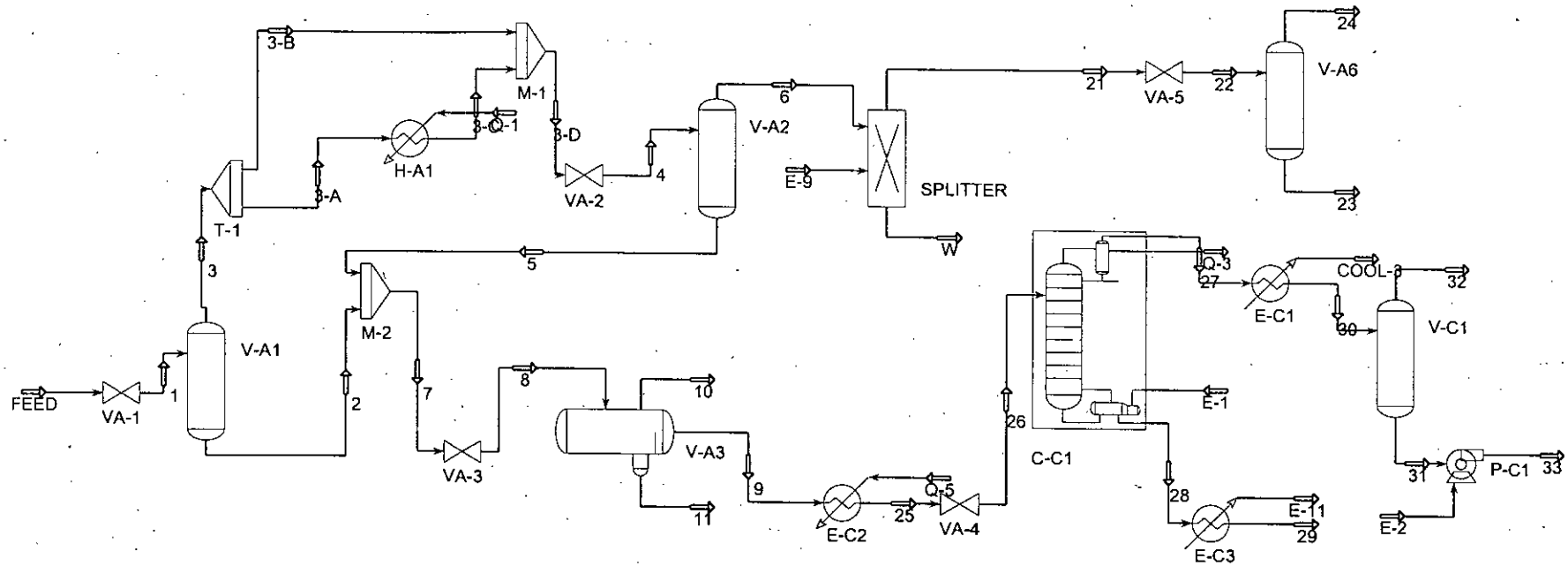

Fig. A-II: SIMULATED PROCESS FLOW DIAGRAM (PFD-II)
REMOVAL OF WATER BY SPLITTER

WORKSHEET-II (REMOVAL OF WATER BY COMPONENT SPLITTER)

Stream		FEED	1	2	3
Description					
Vapour frac.		1	0.9984	0	1
Temperature	F	182.2161	150.0000*	150	150
Pressure	psia	5000.0002*	2500.0001*	2500	2500
Molar Flow	lbmole/hr	34999.9992*	35000	55.9279	34944.07
Mass Flow	lb/hr	629655.9	629655.9	4803.642	624852.3
LiqVol Flow	barrel/day	134281	134281	506.9938	133774
Enthalpy	Btu/hr	1.42E+08	1.42E+08	141285	1.42E+08
Density	lb/ft3	13.4518	8.1052	39.0479	8.0561
Mole Wt.		17.9902	17.9902	85.8898	17.8815
Spec. Heat	Btu/lb-F	0.7626	0.7472	0.5681	0.7485
Therm Cond	Btu/hr-ft-F	0.0476	---	0.0654	0.0335
Viscosity	cP	0.0276	---	0.3408	0.0188
Z Factor		0.9707	---	0.8405	0.8481
Sur Tension	dyne/cm	---	---	9.5943	---
Std Density	lb/ft3	---	---	41.5275	---
Methane	mole frac.	0.9457*	0.9457	0.4663	0.9465
Ethane	mole frac.	0.0255*	0.0255	0.0272	0.0255
Propane	mole frac.	0.0086*	0.0086	0.0161	0.0086
i-Butane	mole frac.	0.0022*	0.0022	0.0062	0.0022
n-Butane	mole frac.	0.0023*	0.0023	0.0076	0.0023
i-Pentane	mole frac.	0.0014*	0.0014	0.0069	0.0014
n-Pentane	mole frac.	0.0009*	0.0009	0.0051	0.0009
n-Hexane	mole frac.	0.0018*	0.0018	0.017	0.0018
n-Heptane	mole frac.	0.0035*	0.0035	0.0539	0.0034
n-Octane	mole frac.	0.0014*	0.0014	0.0348	0.0013
n-Nonane	mole frac.	0.0008*	0.0008	0.031	0.0007
n-Decane	mole frac.	0.0004*	0.0004	0.0237	0.0004
n-C11	mole frac.	0.0003*	0.0003	0.0267	0.0003
n-C12	mole frac.	0.0003*	0.0003	0.0371	0.0002
n-C13	mole frac.	0.0003*	0.0003	0.0551	0.0002
n-C14	mole frac.	0.0007*	0.0007	0.1829	0.0004
H2O	mole frac.	0.0005*	0.0005	0.0004	0.0005
Nitrogen	mole frac.	0.0020*	0.002	0.0006	0.002
CO2	mole frac.	0.0015*	0.0015	0.0013	0.0015

Stream		3-B	3-A	3-C		Q-1
Description						
Vapour frac.		1	1	1		2.0000*
Temperature	F	150	150	250	*	0.0000*
Pressure	psia	2500	2500	2490		0.0000*
Molar Flow	lbmole/hr	32944.07	2000.0000*	2000		0.0000*
Mass Flow	lb/hr	589089.2	35762.99	35762.99		0.0000*
LiqVol Flow	barrel/day	126117.6	7656.465	7656.465		0.0000*
Enthalpy	Btu/hr	1.34E+08	8.11E+06	1.07E+07		2.60E+06
Density	lb/ft3	8.0561	8.0561	6.3064		0
Mole Wt.		17.8815	17.8815	17.8815		0
Spec. Heat	Btu/lb-F	0.7485	0.7485	0.7131		---
Therm Cond	Btu/hr-ft-F	0.0335	0.0335	0.0351		---
Viscosity	cP	0.0188	0.0188	0.0187		---
Z Factor		0.8481	0.8481	0.9271		---
Sur Tension	dyne/cm	---	---	---		---
Std Density	lb/ft3	---	---	---		---
Methane	mole frac.	0.9465	0.9465	0.9465		0.0000*
Ethane	mole frac.	0.0255	0.0255	0.0255		0.0000*
Propane	mole frac.	0.0086	0.0086	0.0086		0.0000*
i-Butane	mole frac.	0.0022	0.0022	0.0022		0.0000*
n-Butane	mole frac.	0.0023	0.0023	0.0023		0.0000*
i-Pentane	mole frac.	0.0014	0.0014	0.0014		0.0000*
n-Pentane	mole frac.	0.0009	0.0009	0.0009		0.0000*
n-Hexane	mole frac.	0.0018	0.0018	0.0018		0.0000*
n-Heptane	mole frac.	0.0034	0.0034	0.0034		0.0000*
n-Octane	mole frac.	0.0013	0.0013	0.0013		0.0000*
n-Nonane	mole frac.	0.0007	0.0007	0.0007		0.0000*
n-Decane	mole frac.	0.0004	0.0004	0.0004		0.0000*
n-C11	mole frac.	0.0003	0.0003	0.0003		0.0000*
n-C12	mole frac.	0.0002	0.0002	0.0002		0.0000*
n-C13	mole frac.	0.0002	0.0002	0.0002		0.0000*
n-C14	mole frac.	0.0004	0.0004	0.0004		0.0000*
H2O	mole frac.	0.0005	0.0005	0.0005		0.0000*
Nitrogen	mole frac.	0.002	0.002	0.002		0.0000*
CO2	mole frac.	0.0015	0.0015	0.0015		0.0000*

Stream		**3-D**	**4**	**5**	**6**
Description					
Vapour frac.		1	0.9958	0	1
Temperature	F	155.3463	127.6861	127.6861	127.6861
Pressure	psia	2490	1500.0000*	1500	1500
Molar Flow	lbmole/hr	34944.07	34944.07	146.0396	34798.03
Mass Flow	lb/hr	624852.3	624852.3	13121.64	611730.5
LiqVol Flow	barrel/day	133774	133774	1363.153	132410.9
Enthalpy	Btu/hr	1.44E+08	1.44E+08	165880.6	1.44E+08
Density	lb/ft3	7.9036	5.0036	39.9844	4.9114
Mole Wt.		17.8815	17.8815	89.8498	17.5795
Spec. Heat	Btu/lb-F	0.7444	0.6876	0.5534	0.6904
Therm Cond	Btu/hr-ft-F	0.0334	---	0.0663	0.027
Viscosity	cP	0.0187	---	0.3504	0.0152
Z Factor		0.8536	---	0.5348	0.8518
Sur Tension	dyne/cm	---	---	11.8345	---
Std Density	lb/ft3	---	---	42.1642	---
Methane	mole frac.	0.9465	0.9465	0.3429	0.949
Ethane	mole frac.	0.0255	0.0255	0.0262	0.0255
Propane	mole frac.	0.0086	0.0086	0.019	0.0085
i-Butane	mole frac.	0.0022	0.0022	0.0084	0.0022
n-Butane	mole frac.	0.0023	0.0023	0.0109	0.0023
i-Pentane	mole frac.	0.0014	0.0014	0.0113	0.0013
n-Pentane	mole frac.	0.0009	0.0009	0.0086	0.0009
n-Hexane	mole frac.	0.0018	0.0018	0.0333	0.0016
n-Heptane	mole frac.	0.0034	0.0034	0.1177	0.0029
n-Octane	mole frac.	0.0013	0.0013	0.0798	0.001
n-Nonane	mole frac.	0.0007	0.0007	0.069	0.0005
n-Decane	mole frac.	0.0004	0.0004	0.0469	0.0002
n-C11	mole frac.	0.0003	0.0003	0.0422	0.0001
n-C12	mole frac.	0.0002	0.0002	0.0454	0
n-C13	mole frac.	0.0002	0.0002	0.0446	0
n-C14	mole frac.	0.0004	0.0004	0.092	0
H2O	mole frac.	0.0005	0.0005	0.0004	0.0005
Nitrogen	mole frac.	0.002	0.002	0.0003	0.002
CO2	mole frac.	0.0015	0.0015	0.001	0.0015

Stream		**7**	**8**	**9**	**10**
Description					
Vapour frac.		0.0667	0.3578	0	1
Temperature	F	133.973	129.5448	129.5448	129.5448
Pressure	psia	1500	300.0000*	300	300
Molar Flow	lbmole/hr	201.9676	201.9676	129.7021	72.2655
Mass Flow	lb/hr	17925.28	17925.28	16596.49	1328.791
LiqVol Flow	barrel/day	1870.147	1870.147	1589.092	281.0544
Enthalpy	Btu/hr	307165.6	307165.6	-41896	349059.9
Density	lb/ft3	36.745	9.7281	43.2554	0.9108
Mole Wt.		88.7532	88.7532	127.9585	18.3876
Spec. Heat	Btu/lb-F	0.5561	0.5363	0.5348	0.5558
Therm Cond	Btu/hr-ft-F	---	---	0.0685	0.0218
Viscosity	cP	---	---	0.5372	0.0126
Z Factor		---	---	0.1404	0.9578
Sur Tension	dyne/cm	---	---	17.4198	---
Std Density	lb/ft3	---	---	45.2678	---
Methane	mole frac.	0.3771	0.3771	0.0786	0.9128
Ethane	mole frac.	0.0265	0.0265	0.0158	0.0457
Propane	mole frac.	0.0182	0.0182	0.0182	0.0183
i-Butane	mole frac.	0.0078	0.0078	0.0096	0.0045
n-Butane	mole frac.	0.01	0.01	0.013	0.0046
i-Pentane	mole frac.	0.0101	0.0101	0.0144	0.0023
n-Pentane	mole frac.	0.0077	0.0077	0.0111	0.0014
n-Hexane	mole frac.	0.0288	0.0288	0.0436	0.0021
n-Heptane	mole frac.	0.1	0.1	0.1541	0.0029
n-Octane	mole frac.	0.0673	0.0673	0.1044	0.0008
n-Nonane	mole frac.	0.0585	0.0585	0.091	0.0003
n-Decane	mole frac.	0.0405	0.0405	0.063	0.0001
n-C11	mole frac.	0.0379	0.0379	0.059	0
n-C12	mole frac.	0.0431	0.0431	0.0671	0
n-C13	mole frac.	0.0475	0.0475	0.074	0
n-C14	mole frac.	0.1172	0.1172	0.1825	0
H2O	mole frac.	0.0004	0.0004	0.0002	0.0008
Nitrogen	mole frac.	0.0004	0.0004	0	0.0011
CO2	mole frac.	0.0011	0.0011	0.0004	0.0023

Stream		11	W	21	22
Description					
Vapour frac.		0	0	1	1
Temperature	F	129.5448	199.9994*	199.9994*	199.9994
Pressure	psia	300	1100.0000*	1500*	1500.0000*
Molar Flow	lbmole/hr	0	16.0274	34782	34782
Mass Flow	lb/hr	0	288.7357	611441.8	611441.8
LiqVol Flow	barrel/day	0	19.8105	132391.1	132391.1
Enthalpy	Btu/hr	0	-200227	1.74E+08	1.74E+08
Density	lb/ft3	51.9644	59.7225	4.0981	4.0981
Mole Wt.		18.0182	18.0151	17.5793	17.5793
Spec. Heat	Btu/lb-F	1.032	1.0428	0.6692	0.6692
Therm Cond	Btu/hr-ft-F	0.3742	0.3915	0.0295	0.0295
Viscosity	cP	0.5075	0.2998	0.0158	0.0158
Z Factor		0.0165	0.0469	0.9089	0.9089
Sur Tension	dyne/cm	66.985	59.863	---	---
Std Density	lb/ft3	63.3323	63.3284	---	---
Methane	mole frac.	0	0	0.9494	0.9494
Ethane	mole frac.	0	0	0.0255	0.0255
Propane	mole frac.	0	0	0.0085	0.0085
i-Butane	mole frac.	0	0	0.0022	0.0022
n-Butane	mole frac.	0	0	0.0023	0.0023
i-Pentane	mole frac.	0	0	0.0013	0.0013
n-Pentane	mole frac.	0	0	0.0009	0.0009
n-Hexane	mole frac.	0	0	0.0016	0.0016
n-Heptane	mole frac.	0	0	0.0029	0.0029
n-Octane	mole frac.	0	0	0.001	0.001
n-Nonane	mole frac.	0	0	0.0005	0.0005
n-Decane	mole frac.	0	0	0.0002	0.0002
n-C11	mole frac.	0	0	0.0001	0.0001
n-C12	mole frac.	0	0	0	0
n-C13	mole frac.	0	0	0	0
n-C14	mole frac.	0	0	0	0
H2O	mole frac.	0.9999	1	0	0
Nitrogen	mole frac.	0	0	0.002	0.002
CO2	mole frac.	0.0001	0	0.0015	0.0015

Stream		11	W	21	22
Description					
Vapour frac.		0	0	1	1
Temperature	F	129.5448	199.9994*	199.9994*	199.9994
Pressure	psia	300	1100.0000*	1500*	1500.0000*
Molar Flow	lbmole/hr	0	16.0274	34782	34782
Mass Flow	lb/hr	0	288.7357	611441.8	611441.8
LiqVol Flow	barrel/day	0	19.8105	132391.1	132391.1
Enthalpy	Btu/hr	0	-200227	1.74E+08	1.74E+08
Density	lb/ft3	51.9644	59.7225	4.0981	4.0981
Mole Wt.		18.0182	18.0151	17.5793	17.5793
Spec. Heat	Btu/lb-F	1.032	1.0428	0.6692	0.6692
Therm Cond	Btu/hr-ft-F	0.3742	0.3915	0.0295	0.0295
Viscosity	cP	0.5075	0.2998	0.0158	0.0158
Z Factor		0.0165	0.0469	0.9089	0.9089
Sur Tension	dyne/cm	66.985	59.863	---	---
Std Density	lb/ft3	63.3323	63.3284	---	---
Methane	mole frac.	0	0	0.9494	0.9494
Ethane	mole frac.	0	0	0.0255	0.0255
Propane	mole frac.	0	0	0.0085	0.0085
i-Butane	mole frac.	0	0	0.0022	0.0022
n-Butane	mole frac.	0	0	0.0023	0.0023
i-Pentane	mole frac.	0	0	0.0013	0.0013
n-Pentane	mole frac.	0	0	0.0009	0.0009
n-Hexane	mole frac.	0	0	0.0016	0.0016
n-Heptane	mole frac.	0	0	0.0029	0.0029
n-Octane	mole frac.	0	0	0.001	0.001
n-Nonane	mole frac.	0	0	0.0005	0.0005
n-Decane	mole frac.	0	0	0.0002	0.0002
n-C11	mole frac.	0	0	0.0001	0.0001
n-C12	mole frac.	0	0	0	0
n-C13	mole frac.	0	0	0	0
n-C14	mole frac.	0	0	0	0
H2O	mole frac.	0.9999	1	0	0
Nitrogen	mole frac.	0	0	0.002	0.002
CO2	mole frac.	0.0001	0	0.0015	0.0015

Stream		23	24	25	Q-3
Description					
Vapour frac.		0	1	0.0405	2.0000*
Temperature	F	199.9994	199.9994	319.19*	0.0000*
Pressure	psia	1500	1500	300	0.0000*
Molar Flow	lbmole/hr	0	34782	129.7021	0.0000*
Mass Flow	lb/hr	0	611441.8	16596.49	0.0000*
LiqVol Flow	barrel/day	0	132391	1589.092	0.0000*
Enthalpy	Btu/hr	0	1.74E+08	1.84E+06	1.18E+06
Density	lb/ft3	4.0981	4.0981	28.7093	0
Mole Wt.		17.5793	17.5793	127.9585	0
Spec. Heat	Btu/lb-F	0.6692	0.6692	0.6521	---
Therm Cond	Btu/hr-ft-F	0.0177	0.0295	---	---
Viscosity	cP	0.0121	0.0158	---	---
Z Factor		0.9089	0.9089	---	---
Sur Tension	dyne/cm	0.1209	---	---	---
Std Density	lb/ft3	---	---	---	---
Methane	mole frac.	0.9494	0.9494	0.0786	0.0000*
Ethane	mole frac.	0.0255	0.0255	0.0158	0.0000*
Propane	mole frac.	0.0085	0.0085	0.0182	0.0000*
i-Butane	mole frac.	0.0022	0.0022	0.0096	0.0000*
n-Butane	mole frac.	0.0023	0.0023	0.013	0.0000*
i-Pentane	mole frac.	0.0013	0.0013	0.0144	0.0000*
n-Pentane	mole frac.	0.0009	0.0009	0.0111	0.0000*
n-Hexane	mole frac.	0.0016	0.0016	0.0436	0.0000*
n-Heptane	mole frac.	0.0029	0.0029	0.1541	0.0000*
n-Octane	mole frac.	0.001	0.001	0.1044	0.0000*
n-Nonane	mole frac.	0.0005	0.0005	0.091	0.0000*
n-Decane	mole frac.	0.0002	0.0002	0.063	0.0000*
n-C11	mole frac.	0.0001	0.0001	0.059	0.0000*
n-C12	mole frac.	0	0	0.0671	0.0000*
n-C13	mole frac.	0	0	0.074	0.0000*
n-C14	mole frac.	0	0	0.1825	0.0000*
H2O	mole frac.	0	0	0.0002	0.0000*
Nitrogen	mole frac.	0.002	0.002	0	0.0000*
CO2	mole frac.	0.0015	0.0015	0.0004	0.0000*

Stream		26	27	28	E-1
Description					
Vapour frac.		0.1935	1	0	2.0000*
Temperature	F	307.2155	271.1453	484.5623	0.0000*
Pressure	psia	60.0000*	60	60	0.0000*
Molar Flow	lbmole/hr	129.7021	50.001	79.7011	0.0000*
Mass Flow	lb/hr	16596.49	3635.203	12961.28	0.0000*
LiqVol Flow	barrel/day	1589.092	399.0064	1190.086	0.0000*
Enthalpy	Btu/hr	1.84E+06	835595.9	2.77E+06	2.95E+06
Density	lb/ft3	4.4807	0.6013	34.0787	0
Mole Wt.		127.9585	72.7026	162.6236	0
Spec. Heat	Btu/lb-F	0.6314	0.5263	0.7472	---
Therm Cond	Btu/hr-ft-F	---	---	---	---
Viscosity	cP	---	---	---	---
Z Factor		---	---	---	---
Sur Tension	dyne/cm	---	---	---	---
Std Density	lb/ft3	---	---	---	---
Methane	mole frac.	0.0786	0.2038	0	0.0000*
Ethane	mole frac.	0.0158	0.041	0	0.0000*
Propane	mole frac.	0.0182	0.0471	0	0.0000*
i-Butane	mole frac.	0.0096	0.025	0	0.0000*
n-Butane	mole frac.	0.013	0.0337	0	0.0000*
i-Pentane	mole frac.	0.0144	0.0375	0	0.0000*
n-Pentane	mole frac.	0.0111	0.0289	0	0.0000*
n-Hexane	mole frac.	0.0436	0.1132	0	0.0000*
n-Heptane	mole frac.	0.1541	0.3909	0.0056	0.0000*
n-Octane	mole frac.	0.1044	0.0699	0.126	0.0000*
n-Nonane	mole frac.	0.091	0.0064	0.144	0.0000*
n-Decane	mole frac.	0.063	0.0007	0.102	0.0000*
n-C11	mole frac.	0.059	0.0001	0.0959	0.0000*
n-C12	mole frac.	0.0671	0	0.1091	0.0000*
n-C13	mole frac.	0.074	0	0.1204	0.0000*
n-C14	mole frac.	0.1825	0	0.2969	0.0000*
H2O	mole frac.	0.0002	0.0004	0	0.0000*
Nitrogen	mole frac.	0	0.0001	0	0.0000*
CO2	mole frac.	0.0004	0.0012	0	0.0000*

Stream		29	E-11	30	COOL-3
Description					
Vapour frac.		0	2.0000*	0.3504	2.0000*
Temperature	F	250.0000*	0.0000*	150*	0.0000*
Pressure	psia	60	0.0000*	60	0.0000*
Molar Flow	lbmole/hr	79.7011	0.0000*	50.001	0.0000*
Mass Flow	lb/hr	12961.28	0.0000*	3635.203	0.0000*
LiqVol Flow	barrel/day	1190.086	0.0000*	399.0064	0.0000*
Enthalpy	Btu/hr	740302.2	2.03E+06	197397.6	638198.2
Density	lb/ft3	41.6597	0	1.8792	0
Mole Wt.		162.6236	0	72.7026	0
Spec. Heat	Btu/lb-F	0.5975	---	0.5524	---
Therm Cond	Btu/hr-ft-F	0.065	---	---	---
Viscosity	cP	0.3962	---	---	---
Z Factor		0.0308	---	---	---
Sur Tension	dyne/cm	15.9319	---	---	---
Std Density	lb/ft3	46.7208	---	---	---
Methane	mole frac.	0	0.0000*	0.2038	0.0000*
Ethane	mole frac.	0	0.0000*	0.041	0.0000*
Propane	mole frac.	0	0.0000*	0.0471	0.0000*
i-Butane	mole frac.	0	0.0000*	0.025	0.0000*
n-Butane	mole frac.	0	0.0000*	0.0337	0.0000*
i-Pentane	mole frac.	0	0.0000*	0.0375	0.0000*
n-Pentane	mole frac.	0	0.0000*	0.0289	0.0000*
n-Hexane	mole frac.	0	0.0000*	0.1132	0.0000*
n-Heptane	mole frac.	0.0056	0.0000*	0.3909	0.0000*
n-Octane	mole frac.	0.126	0.0000*	0.0699	0.0000*
n-Nonane	mole frac.	0.144	0.0000*	0.0064	0.0000*
n-Decane	mole frac.	0.102	0.0000*	0.0007	0.0000*
n-C11	mole frac.	0.0959	0.0000*	0.0001	0.0000*
n-C12	mole frac.	0.1091	0.0000*	0	0.0000*
n-C13	mole frac.	0.1204	0.0000*	0	0.0000*
n-C14	mole frac.	0.2969	0.0000*	0	0.0000*
H2O	mole frac.	0	0.0000*	0.0004	0.0000*
Nitrogen	mole frac.	0	0.0000*	0.0001	0.0000*
CO2	mole frac.	0	0.0000*	0.0012	0.0000*

Stream		31	32	33	E-2
Description					
Vapour frac.		0	1	0	2.0000*
Temperature	F	150	150	150.2732	0.0000*
Pressure	psia	60	60	100*	0.0000*
Molar Flow	lbmole/hr	32.4826	17.5184	32.4826	0.0000*
Mass Flow	lb/hr	3031.98	603.2247	3031.98	0.0000*
LiqVol Flow	barrel/day	308.3177	90.6887	308.3177	0.0000*
Enthalpy	Btu/hr	72719.94	124677.7	73480.09	760.1529
Density	lb/ft3	39.3656	0.3248	39.3883	0
Mole Wt.		93.3416	34.4338	93.3416	0
Spec. Heat	Btu/lb-F	0.5664	0.4817	0.5662	---
Therm Cond	Btu/hr-ft-F	0.0606	0.017	0.0605	---
Viscosity	cP	0.2396	0.0116	0.2394	---
Z Factor		0.0217	0.9723	0.0362	---
Sur Tension	dyne/cm	14.2881	---	14.2737	---
Std Density	lb/ft3	42.2576	---	42.2576	---
Methane	mole frac.	0.0103	0.5625	0.0103	0.0000*
Ethane	mole frac.	0.0076	0.103	0.0076	0.0000*
Propane	mole frac.	0.0204	0.0967	0.0204	0.0000*
i-Butane	mole frac.	0.0176	0.0388	0.0176	0.0000*
n-Butane	mole frac.	0.0272	0.0458	0.0272	0.0000*
i-Pentane	mole frac.	0.0406	0.0316	0.0406	0.0000*
n-Pentane	mole frac.	0.0332	0.0208	0.0332	0.0000*
n-Hexane	mole frac.	0.1542	0.0371	0.1542	0.0000*
n-Heptane	mole frac.	0.5721	0.0549	0.5721	0.0000*
n-Octane	mole frac.	0.1055	0.0041	0.1055	0.0000*
n-Nonane	mole frac.	0.0097	0.0002	0.0097	0.0000*
n-Decane	mole frac.	0.0011	0	0.0011	0.0000*
n-C11	mole frac.	0.0002	0	0.0002	0.0000*
n-C12	mole frac.	0	0	0	0.0000*
n-C13	mole frac.	0	0	0	0.0000*
n-C14	mole frac.	0	0	0	0.0000*
H2O	mole frac.	0.0001	0.0012	0.0001	0.0000*
Nitrogen	mole frac.	0	0.0003	0	0.0000*
CO2	mole frac.	0.0001	0.0031	0.0001	0.0000*

Stream		E-9	Q-5
Description			
Vapour frac.		2.0000*	2.0000*
Temperature	F	0.0000*	0.0000*
Pressure	psia	0.0000*	0.0000*
Molar Flow	lbmole/hr	0.0000*	0.0000*
Mass Flow	lb/hr	0.0000*	0.0000*
LiqVol Flow	barrel/day	0.0000*	0.0000*
Enthalpy	Btu/hr	2.97E+07	1.88E+06
Density	lb/ft3	0	0
Mole Wt.		0	0
Spec. Heat	Btu/lb-F	---	---
Therm Cond	Btu/hr-ft-F	---	---
Viscosity	cP	---	---
Z Factor		---	---
Sur Tension	dyne/cm	---	---
Std Density	lb/ft3	---	---
Methane	mole frac.	0.0000*	0.0000*
Ethane	mole frac.	0.0000*	0.0000*
Propane	mole frac.	0.0000*	0.0000*
i-Butane	mole frac.	0.0000*	0.0000*
n-Butane	mole frac.	0.0000*	0.0000*
i-Pentane	mole frac.	0.0000*	0.0000*
n-Pentane	mole frac.	0.0000*	0.0000*
n-Hexane	mole frac.	0.0000*	0.0000*
n-Heptane	mole frac.	0.0000*	0.0000*
n-Octane	mole frac.	0.0000*	0.0000*
n-Nonane	mole frac.	0.0000*	0.0000*
n-Decane	mole frac.	0.0000*	0.0000*
n-C11	mole frac.	0.0000*	0.0000*
n-C12	mole frac.	0.0000*	0.0000*
n-C13	mole frac.	0.0000*	0.0000*
n-C14	mole frac.	0.0000*	0.0000*
H2O	mole frac.	0.0000*	0.0000*
Nitrogen	mole frac.	0.0000*	0.0000*
CO2	mole frac.	0.0000*	0.0000*

APPENDIX-III

WORKSHEETS USING OPERATING DATA FROM THE

LOG SHEET FOR

THREE DIFFERENT TIMES (8:00, 20:00, 6:00 hrs) DATED ON 31/10/98

(SOURCE: KAILASHTILLA-I GAS FIELD)

WORKSHEET USING OPERATING DATA (8:00 hrs)

Stream		FEED	1	2	3
Description					
Vapour frac.		1	0.992	0	1
Temperature	F	150.0000*	104.5856	104.5856	104.5856
Pressure	psia	3100.0001*	1360.0000*	1360	1360
Molar Flow	lbmole/hr	25000.0004*	25000	199.8916	24800.11
Mass Flow	lb/hr	449754.2	449754.2	17422.18	432332
LiqVol Flow	barrel/day	95915.01	95915.01	1823.722	94091.3
Enthalpy	Btu/hr	9.73E+07	9.73E+07	23522.77	9.73E+07
Density	lb/ft3	9.9413	4.8315	40.3485	4.666
Mole Wt.		17.9902	17.9902	87.1581	17.4327
Spec. Heat	Btu/lb-F	0.7675	0.6836	0.5413	0.6893
Therm Cond	Btu/hr-ft-F	0.0373	---	0.0675	0.0257
Viscosity	cP	0.0212	---	0.3671	0.0146
Z Factor		0.8574	---	0.4852	0.8391
Sur Tension	dyne/cm	---	---	12.3973	---
Std Density	lb/ft3	---	---	41.7974	---
Methane	mole frac.	0.9457*	0.9457	0.3337	0.9506
Ethane	mole frac.	0.0255*	0.0255	0.028	0.0255
Propane	mole frac.	0.0086*	0.0086	0.0216	0.0085
i-Butane	mole frac.	0.0022*	0.0022	0.01	0.0021
n-Butane	mole frac.	0.0023*	0.0023	0.0131	0.0022
i-Pentane	mole frac.	0.0014*	0.0014	0.014	0.0013
n-Pentane	mole frac.	0.0009*	0.0009	0.0108	0.0008
n-Hexane	mole frac.	0.0018*	0.0018	0.0417	0.0015
n-Heptane	mole frac.	0.0035*	0.0035	0.1413	0.0024
n-Octane	mole frac.	0.0014*	0.0014	0.0872	0.0007
n-Nonane	mole frac.	0.0008*	0.0008	0.0665	0.0003
n-Decane	mole frac.	0.0004*	0.0004	0.04	0.0001
n-C11	mole frac.	0.0003*	0.0003	0.0331	0
n-C12	mole frac.	0.0003*	0.0003	0.0348	0
n-C13	mole frac.	0.0003*	0.0003	0.0361	0
n-C14	mole frac.	0.0007*	0.0007	0.0863	0
H2O	mole frac.	0.0005*	0.0005	0.0004	0.0005
Nitrogen	mole frac.	0.0020*	0.002	0.0003	0.002
CO2	mole frac.	0.0015*	0.0015	0.0011	0.0015

Stream		3-B	3-A	3-C	Q-1
Description					
Vapour frac.		1	1	1	2.0000*
Temperature	F	104.5856	104.5856	136*	0.0000*
Pressure	psia	1360	1360	1350	0.0000*
Molar Flow	lbmole/hr	22800.11	2000.0000*	2000	0.0000*
Mass Flow	lb/hr	397466.7	34865.33	34865.33	0.0000*
LiqVol Flow	barrel/day	86503.32	7587.974	7587.974	0.0000*
Enthalpy	Btu/hr	8.94E+07	7.85E+06	8.60E+06	753517.5
Density	lb/ft3	4.666	4.666	4.2288	0
Mole Wt.		17.4327	17.4327	17.4327	0
Spec. Heat	Btu/lb-F	0.6893	0.6893	0.6709	---
Therm Cond	Btu/hr-ft-F	0.0257	0.0257	0.0266	---
Viscosity	cP	0.0146	0.0146	0.0148	---
Z Factor		0.8391	0.8391	0.8706	---
Sur Tension	dyne/cm	---	---	---	---
Std Density	lb/ft3	---	---	---	---
Methane	mole frac.	0.9506	0.9506	0.9506	0.0000*
Ethane	mole frac.	0.0255	0.0255	0.0255	0.0000*
Propane	mole frac.	0.0085	0.0085	0.0085	0.0000*
i-Butane	mole frac.	0.0021	0.0021	0.0021	0.0000*
n-Butane	mole frac.	0.0022	0.0022	0.0022	0.0000*
i-Pentane	mole frac.	0.0013	0.0013	0.0013	0.0000*
n-Pentane	mole frac.	0.0008	0.0008	0.0008	0.0000*
n-Hexane	mole frac.	0.0015	0.0015	0.0015	0.0000*
n-Heptane	mole frac.	0.0024	0.0024	0.0024	0.0000*
n-Octane	mole frac.	0.0007	0.0007	0.0007	0.0000*
n-Nonane	mole frac.	0.0003	0.0003	0.0003	0.0000*
n-Decane	mole frac.	0.0001	0.0001	0.0001	0.0000*
n-C11	mole frac.	0	0	0	0.0000*
n-C12	mole frac.	0	0	0	0.0000*
n-C13	mole frac.	0	0	0	0.0000*
n-C14	mole frac.	0	0	0	0.0000*
H2O	mole frac.	0.0005	0.0005	0.0005	0.0000*
Nitrogen	mole frac.	0.002	0.002	0.002	0.0000*
CO2	mole frac.	0.0015	0.0015	0.0015	0.0000*

Stream		3-D	4	5	6
Description					
Vapour frac.		1	0.9974	0	1
Temperature	F	106.6923	74.0136	74.0136	74.0136
Pressure	psia	1350	670.0000*	670	670
Molar Flow	lbmole/hr	24800.11	24800.11	65.4474	24734.66
Mass Flow	lb/hr	432332	432332	5439.717	426892.3
LiqVol Flow	barrel/day	94091.3	94091.3	573.4051	93517.9
Enthalpy	Btu/hr	9.80E+07	9.80E+07	-64404.6	9.81E+07
Density	lb/ft3	4.5978	2.2972	40.7364	2.2699
Mole Wt.		17.4327	17.4327	83.1159	17.2589
Spec. Heat	Btu/lb-F	0.6865	0.6033	0.5235	0.6043
Therm Cond	Btu/hr-ft-F	0.0257	---	0.0682	0.0213
Viscosity	cP	0.0146	---	0.3257	0.0123
Z Factor		0.8422	---	0.2387	0.8895
Sur Tension	dyne/cm	---	---	14.9514	---
Std Density	lb/ft3	---	---	41.2281	---
Methane	mole frac.	0.9506	0.9506	0.2062	0.9526
Ethane	mole frac.	0.0255	0.0255	0.0248	0.0255
Propane	mole frac.	0.0085	0.0085	0.0249	0.0084
i-Butane	mole frac.	0.0021	0.0021	0.0137	0.0021
n-Butane	mole frac.	0.0022	0.0022	0.0193	0.0022
i-Pentane	mole frac.	0.0013	0.0013	0.0242	0.0012
n-Pentane	mole frac.	0.0008	0.0008	0.0196	0.0008
n-Hexane	mole frac.	0.0015	0.0015	0.0869	0.0012
n-Heptane	mole frac.	0.0024	0.0024	0.2967	0.0016
n-Octane	mole frac.	0.0007	0.0007	0.1506	0.0003
n-Nonane	mole frac.	0.0003	0.0003	0.0774	0.0001
n-Decane	mole frac.	0.0001	0.0001	0.0277	0
n-C11	mole frac.	0	0	0.0122	0
n-C12	mole frac.	0	0	0.0073	0
n-C13	mole frac.	0	0	0.0035	0
n-C14	mole frac.	0	0	0.0038	0
H2O	mole frac.	0.0005	0.0005	0.0003	0.0005
Nitrogen	mole frac.	0.002	0.002	0.0002	0.002
CO2	mole frac.	0.0015	0.0015	0.0008	0.0015

Stream		**7**	**8**	**9**	**10**
Description					
Vapour frac.		0.1512	0.3201	0	1
Temperature	F	95.4215	88.0076	88.0076	88.0076
Pressure	psia	670	110.0000*	110	110
Molar Flow	lbmole/hr	265.339	265.339	180.3995	84.9395
Mass Flow	lb/hr	22861.9	22861.9	21209.15	1652.743
LiqVol Flow	barrel/day	2397.127	2397.127	2058.415	338.7117
Enthalpy	Btu/hr	-40881.8	-40881.8	-433502	392620.6
Density	lb/ft3	26.8928	4.6458	43.6698	0.3726
Mole Wt.		86.1611	86.1611	117.5677	19.4579
Spec. Heat	Btu/lb-F	0.529	0.5115	0.5113	0.5147
Therm Cond	Btu/hr-ft-F	---	---	0.0701	0.0189
Viscosity	cP	---	---	0.5606	0.0115
Z Factor		---	---	0.0504	0.9773
Sur Tension	dyne/cm	---	---	19.2402	---
Std Density	lb/ft3	---	---	44.4835	---
Methane	mole frac.	0.3023	0.3023	0.0323	0.8758
Ethane	mole frac.	0.0272	0.0272	0.0115	0.0605
Propane	mole frac.	0.0224	0.0224	0.0192	0.0293
i-Butane	mole frac.	0.0109	0.0109	0.0124	0.0076
n-Butane	mole frac.	0.0146	0.0146	0.0178	0.0079
i-Pentane	mole frac.	0.0165	0.0165	0.0224	0.004
n-Pentane	mole frac.	0.0129	0.0129	0.0179	0.0024
n-Hexane	mole frac.	0.0528	0.0528	0.0762	0.0033
n-Heptane	mole frac.	0.1796	0.1796	0.2624	0.0038
n-Octane	mole frac.	0.1028	0.1028	0.1509	0.0007
n-Nonane	mole frac.	0.0692	0.0692	0.1016	0.0002
n-Decane	mole frac.	0.037	0.037	0.0544	0
n-C11	mole frac.	0.0279	0.0279	0.0411	0
n-C12	mole frac.	0.028	0.028	0.0413	0
n-C13	mole frac.	0.0281	0.0281	0.0413	0
n-C14	mole frac.	0.0659	0.0659	0.097	0
H2O	mole frac.	0.0004	0.0004	0.0001	0.0009
Nitrogen	mole frac.	0.0003	0.0003	0	0.0008
CO2	mole frac.	0.001	0.001	0.0003	0.0026

Stream		11	6-A	COOL-1	12
Description					
Vapour frac.		0	0.9967	2*	0
Temperature	F	88.0076	32.0000*	0*	32
Pressure	psia	110	670	0*	670
Molar Flow	lbmole/hr	0	24734.66	0*	74.3126
Mass Flow	lb/hr	0	426892.3	0*	5233.2301
LiqVol Flow	barrel/day	0	93517.9	0*	579.8537
Enthalpy	Btu/hr	0	8.64E+07	1.17E+07	-145428
Density	lb/ft3	52.8017	2.5697	0	40.1267
Mole Wt.		18.0165	17.2589	0	70.4218
Spec. Heat	Btu/lb-F	1.03	0.6185	---	0.509
Therm Cond	Btu/hr-ft-F	0.3581	---	---	0.0693
Viscosity	cP	0.7785	---	---	0.3029
Z Factor		0.0064	---	---	0.2229
Sur Tension	dyne/cm	71.0365	---	---	14.7444
Std Density	lb/ft3	63.3299	---	---	39.0687
Methane	mole frac.	0	0.9526	0*	0.2444
Ethane	mole frac.	0	0.0255	0*	0.035
Propane	mole frac.	0	0.0084	0*	0.0393
i-Butane	mole frac.	0	0.0021	0*	0.023
n-Butane	mole frac.	0	0.0022	0*	0.0331
i-Pentane	mole frac.	0	0.0012	0*	0.042
n-Pentane	mole frac.	0	0.0008	0*	0.0342
n-Hexane	mole frac.	0	0.0012	0*	0.1323
n-Heptane	mole frac.	0	0.0016	0*	0.3094
n-Octane	mole frac.	0	0.0003	0*	0.0828
n-Nonane	mole frac.	0	0.0001	0*	0.0195
n-Decane	mole frac.	0	0	0*	0.003
n-C11	mole frac.	0	0	0*	0.0005
n-C12	mole frac.	0	0	0*	0.0001
n-C13	mole frac.	0	0	0*	0
n-C14	mole frac.	0	0	0*	0
H2O	mole frac.	0.9999	0.0005	0*	0.0001
Nitrogen	mole frac.	0	0.002	0*	0.0002
CO2	mole frac.	0.0001	0.0015	0*	0.001

Stream		**13**	**14**	**15**	**16**
Description					
Vapour frac.		1	0	0.997	0.9949
Temperature	F	32	32	32.0003	10.4000*
Pressure	psia	670	670	670	670
Molar Flow	lbmole/hr	24652.97	7.3832	24727.28	24727.28
Mass Flow	lb/hr	421526.1	133.0192	426759.3	426759.3
LiqVol Flow	barrel/day	92928.91	9.1268	93508.77	93508.77
Enthalpy	Btu/hr	8.67E+07	-115453	8.66E+07	8.04E+07
Density	lb/ft3	2.5394	64.1246	2.5689	2.7665
Mole Wt.		17.0984	18.0164	17.2586	17.2586
Spec. Heat	Btu/lb-F	0.6198	1.0321	0.6184	0.6327
Therm Cond	Btu/hr-ft-F	0.0198	0.3287	---	---
Viscosity	cP	0.0117	1.7477	---	---
Z Factor		0.855	0.0357	---	---
Sur Tension	dyne/cm	---	76.3925	---	---
Std Density	lb/ft3	---	63.33	---	---
Methane	mole frac.	0.955	0	0.9529	0.9529
Ethane	mole frac.	0.0254	0	0.0255	0.0255
Propane	mole frac.	0.0084	0	0.0084	0.0084
i-Butane	mole frac.	0.002	0	0.0021	0.0021
n-Butane	mole frac.	0.0021	0	0.0022	0.0022
i-Pentane	mole frac.	0.0011	0	0.0012	0.0012
n-Pentane	mole frac.	0.0007	0	0.0008	0.0008
n-Hexane	mole frac.	0.0009	0	0.0012	0.0012
n-Heptane	mole frac.	0.0007	0	0.0016	0.0016
n-Octane	mole frac.	0.0001	0	0.0003	0.0003
n-Nonane	mole frac.	0	0	0.0001	0.0001
n-Decane	mole frac.	0	0	0	0
n-C11	mole frac.	0	0	0	0
n-C12	mole frac.	0	0	0	0
n-C13	mole frac.	0	0	0	0
n-C14	mole frac.	0	0	0	0
H2O	mole frac.	0.0002	0.9999	0.0002	0.0002
Nitrogen	mole frac.	0.002	0	0.002	0.002
CO2	mole frac.	0.0015	0	0.0015	0.0015

Stream		COOL-2	17	18	19
Description					
Vapour frac.		2.0000*	0	1	0
Temperature	F	0.0000*	10.4	10.4	10.4
Pressure	psia	0.0000*	670	670	670
Molar Flow	lbmole/hr	0.0000*	123.4984	24601.4	2.3827
Mass Flow	lb/hr	0.0000*	8023.691	418692.7	42.9293
LiqVol Flow	barrel/day	0.0000*	914.2752	92591.55	2.9455
Enthalpy	Btu/hr	6.12E+06	-297810	8.08E+07	-38216.4
Density	lb/ft3	0	39.8325	2.7178	64.6686
Mole Wt.		0	64.97	17.0191	18.017
Spec. Heat	Btu/lb-F	---	0.5027	0.6352	1.0352
Therm Cond	Btu/hr-ft-F	---	0.0701	0.0191	0.3176
Viscosity	cP	---	0.2983	0.0113	1.0993
Z Factor		---	0.2166	0.8317	0.037
Sur Tension	dyne/cm	---	14.4949	---	78.4456
Std Density	lb/ft3	---	37.8741	---	63.3307
Methane	mole frac.	0.0000*	0.2718	0.9564	0
Ethane	mole frac.	0.0000*	0.0426	0.0254	0
Propane	mole frac.	0.0000*	0.0506	0.0082	0
i-Butane	mole frac.	0.0000*	0.0301	0.002	0
n-Butane	mole frac.	0.0000*	0.0436	0.002	0
i-Pentane	mole frac.	0.0000*	0.0532	0.001	0
n-Pentane	mole frac.	0.0000*	0.0424	0.0006	0
n-Hexane	mole frac.	0.0000*	0.1373	0.0006	0
n-Heptane	mole frac.	0.0000*	0.2548	0.0003	0
n-Octane	mole frac.	0.0000*	0.0574	0	0
n-Nonane	mole frac.	0.0000*	0.0124	0	0
n-Decane	mole frac.	0.0000*	0.0019	0	0
n-C11	mole frac.	0.0000*	0.0003	0	0
n-C12	mole frac.	0.0000*	0.0001	0	0
n-C13	mole frac.	0.0000*	0	0	0
n-C14	mole frac.	0.0000*	0	0	0
H2O	mole frac.	0.0000*	0.0001	0.0001	0.9999
Nitrogen	mole frac.	0.0000*	0.0002	0.002	0
CO2	mole frac.	0.0000*	0.0012	0.0015	0.0001

Stream		20	E10	21	22
Description					
Vapour frac.		0.995	2.0000*	1	1
Temperature	F	10.4002	0.0000*	116*	109.1575
Pressure	psia	670	0.0000*	670	540.0000*
Molar Flow	lbmole/hr	24724.9	0.0000*	24724.9	24724.9
Mass Flow	lb/hr	426716.4	0.0000*	426716.4	426716.4
LiqVol Flow	barrel/day	93505.83	0.0000*	93505.83	93505.83
Enthalpy	Btu/hr	8.05E+07	2.84E+07	1.09E+08	1.09E+08
Density	lb/ft3	2.7662	0	2.0432	1.6456
Mole Wt.		17.2586	0	17.2586	17.2586
Spec. Heat	Btu/lb-F	0.6327	---	0.6009	0.5858
Therm Cond	Btu/hr-ft-F	---	---	0.023	0.0222
Viscosity	cP	---	---	0.013	0.0126
Z Factor		---	---	0.9161	0.9277
Sur Tension	dyne/cm	---	---	---	---
Std Density	lb/ft3	---	---	---	---
Methane	mole frac.	0.953	0.0000*	0.953	0.953
Ethane	mole frac.	0.0255	0.0000*	0.0255	0.0255
Propane	mole frac.	0.0084	0.0000*	0.0084	0.0084
i-Butane	mole frac.	0.0021	0.0000*	0.0021	0.0021
n-Butane	mole frac.	0.0022	0.0000*	0.0022	0.0022
i-Pentane	mole frac.	0.0012	0.0000*	0.0012	0.0012
n-Pentane	mole frac.	0.0008	0.0000*	0.0008	0.0008
n-Hexane	mole frac.	0.0012	0.0000*	0.0012	0.0012
n-Heptane	mole frac.	0.0016	0.0000*	0.0016	0.0016
n-Octane	mole frac.	0.0003	0.0000*	0.0003	0.0003
n-Nonane	mole frac.	0.0001	0.0000*	0.0001	0.0001
n-Decane	mole frac.	0	0.0000*	0	0
n-C11	mole frac.	0	0.0000*	0	0
n-C12	mole frac.	0	0.0000*	0	0
n-C13	mole frac.	0	0.0000*	0	0
n-C14	mole frac.	0	0.0000*	0	0
H2O	mole frac.	0.0001	0.0000*	0.0001	0.0001
Nitrogen	mole frac.	0.002	0.0000*	0.002	0.002
CO2	mole frac.	0.0015	0.0000*	0.0015	0.0015

Stream		23	24	25	Q-5
Description					
Vapour frac.		0	1	0.3305	2.0000*
Temperature	F	109.1575	109.1575	400*	0.0000*
Pressure	psia	540	540	110	0.0000*
Molar Flow	lbmole/hr	0	24724.9	180.3995	0.0000*
Mass Flow	lb/hr	0	426716.4	21209.15	0.0000*
LiqVol Flow	barrel/day	0	93505.82	2058.415	0.0000*
Enthalpy	Btu/hr	0	1.09E+08	4.15E+06	4.58E+06
Density	lb/ft3	1.6456	1.6456	4.3999	0
Mole Wt.		17.2586	17.2586	117.5677	0
Spec. Heat	Btu/lb-F	0.5858	0.5858	0.6863	---
Therm Cond	Btu/hr-ft-F	0.0376	0.0222	---	---
Viscosity	cP	0.0061	0.0126	---	---
Z Factor		0.9277	0.9277	---	---
Sur Tension	dyne/cm	0.1661	---	---	---
Std Density	lb/ft3	---	---	---	---
Methane	mole frac.	0.953	0.953	0.0323	0.0000*
Ethane	mole frac.	0.0255	0.0255	0.0115	0.0000*
Propane	mole frac.	0.0084	0.0084	0.0192	0.0000*
i-Butane	mole frac.	0.0021	0.0021	0.0124	0.0000*
n-Butane	mole frac.	0.0022	0.0022	0.0178	0.0000*
i-Pentane	mole frac.	0.0012	0.0012	0.0224	0.0000*
n-Pentane	mole frac.	0.0008	0.0008	0.0179	0.0000*
n-Hexane	mole frac.	0.0012	0.0012	0.0762	0.0000*
n-Heptane	mole frac.	0.0016	0.0016	0.2624	0.0000*
n-Octane	mole frac.	0.0003	0.0003	0.1509	0.0000*
n-Nonane	mole frac.	0.0001	0.0001	0.1016	0.0000*
n-Decane	mole frac.	0	0	0.0544	0.0000*
n-C11	mole frac.	0	0	0.0411	0.0000*
n-C12	mole frac.	0	0	0.0413	0.0000*
n-C13	mole frac.	0	0	0.0413	0.0000*
n-C14	mole frac.	0	0	0.097	0.0000*
H2O	mole frac.	0.0001	0.0001	0.0001	0.0000*
Nitrogen	mole frac.	0.002	0.002	0	0.0000*
CO2	mole frac.	0.0015	0.0015	0.0003	0.0000*

Stream		26	27	Q-3		28
Description						
Vapour frac.		0.5123	1	2*		0
Temperature	F	371.6998	335.5331	0.0000*		542.4245
Pressure	psia	60.0000*	60	0.0000*		60
Molar Flow	lbmole/hr	180.3995	132.0001	0.0000*		48.3995
Mass Flow	lb/hr	21209.15	12732.64	0.0000*	*	8476.5099
LiqVol Flow	barrel/day	2058.415	1287.657	0.0000*	*	770.7587
Enthalpy	Btu/hr	4.15E+06	3.23E+06	3.23E+06		2.14E+06
Density	lb/ft3	1.6477	0.7589	0		32.8486
Mole Wt.		117.5677	96.4594	0		175.1364
Spec. Heat	Btu/lb-F	0.6399	0.5599	---		0.779
Therm Cond	Btu/hr-ft-F	---	0.0146	---		0.0447
Viscosity	cP	---	0.0091	---		0.1346
Z Factor		---	0.8936	---		0.0297
Sur Tension	dyne/cm	---	---	---		5.3924
Std Density	lb/ft3	---	---	---		47.1535
Methane	mole frac.	0.0323	0.0441	0.0000*		0
Ethane	mole frac.	0.0115	0.0157	0.0000*		0
Propane	mole frac.	0.0192	0.0263	0.0000*		0
i-Butane	mole frac.	0.0124	0.017	0.0000*		0
n-Butane	mole frac.	0.0178	0.0243	0.0000*		0
i-Pentane	mole frac.	0.0224	0.0306	0.0000*		0
n-Pentane	mole frac.	0.0179	0.0244	0.0000*		0
n-Hexane	mole frac.	0.0762	0.1041	0.0000*		0
n-Heptane	mole frac.	0.2624	0.3587	0.0000*		0
n-Octane	mole frac.	0.1509	0.2062	0.0000*		0.0003
n-Nonane	mole frac.	0.1016	0.1316	0.0000*		0.02
n-Decane	mole frac.	0.0544	0.015	0.0000*		0.1618
n-C11	mole frac.	0.0411	0.0013	0.0000*		0.1496
n-C12	mole frac.	0.0413	0.0003	0.0000*		0.153
n-C13	mole frac.	0.0413	0.0001	0.0000*		0.1538
n-C14	mole frac.	0.097	0	0.0000*		0.3615
H2O	mole frac.	0.0001	0.0001	0.0000*		0
Nitrogen	mole frac.	0	0	0.0000*		0
CO2	mole frac.	0.0003	0.0003	0.0000*		0

Stream		E-1	29	E-11	30
Description					
Vapour frac.		2.0000*	0	2*	0.059
Temperature	F	0.0000*	250.0000*	0.0000*	150.0000*
Pressure	psia	0.0000*	60	0.0000*	60
Molar Flow	lbmole/hr	0.0000*	48.3995	0.0000*	132.0001
Mass Flow	lb/hr	0.0000*	8476.51	0.0000*	12732.6425
LiqVol Flow	barrel/day	0.0000*	770.7587	0.0000*	1287.6567
Enthalpy	Btu/hr	4.45E+06	451386.1	1.69E+06	314256
Density	lb/ft3	0	42.2156	0	11.1844
Mole Wt.		0	175.1364	0	96.4594
Spec. Heat	Btu/lb-F	---	0.5939	---	0.5596
Therm Cond	Btu/hr-ft-F	---	0.0666	---	---
Viscosity	cP	---	0.4484	---	---
Z Factor		---	0.0327	---	---
Sur Tension	dyne/cm	---	16.8261	---	---
Std Density	lb/ft3	---	47.1535	---	---
Methane	mole frac.	0.0000*	0	0.0000*	0.0441
Ethane	mole frac.	0.0000*	0	0.0000*	0.0157
Propane	mole frac.	0.0000*	0	0.0000*	0.0263
i-Butane	mole frac.	0.0000*	0	0.0000*	0.017
n-Butane	mole frac.	0.0000*	0	0.0000*	0.0243
i-Pentane	mole frac.	0.0000*	0	0.0000*	0.0306
n-Pentane	mole frac.	0.0000*	0	0.0000*	0.0244
n-Hexane	mole frac.	0.0000*	0	0.0000*	0.1041
n-Heptane	mole frac.	0.0000*	0	0.0000*	0.3587
n-Octane	mole frac.	0.0000*	0.0003	0.0000*	0.2062
n-Nonane	mole frac.	0.0000*	0.02	0.0000*	0.1316
n-Decane	mole frac.	0.0000*	0.1618	0.0000*	0.015
n-C11	mole frac.	0.0000*	0.1496	0.0000*	0.0013
n-C12	mole frac.	0.0000*	0.153	0.0000*	0.0003
n-C13	mole frac.	0.0000*	0.1538	0.0000*	0.0001
n-C14	mole frac.	0.0000*	0.3615	0.0000*	0
H2O	mole frac.	0.0000*	0	0.0000*	0.0001
Nitrogen	mole frac.	0.0000*	0	0.0000*	0
CO2	mole frac.	0.0000*	0	0.0000*	0.0003

Stream		COOL-3	31	32	33
Description					
Vapour frac.		2.0000*	0	1	0
Temperature	F	0.0000*	150	150	150.2514
Pressure	psia	0.0000*	60	60	100.0000*
Molar Flow	lbmole/hr	0.0000*	124.2167	7.7833	124.2167
Mass Flow	lb/hr	0.0000*	12482.65	249.9937	12482.65
LiqVol Flow	barrel/day	0.0000*	1248.551	39.1057	1248.551
Enthalpy	Btu/hr	2.91E+06	261283.6	52972.39	264345
Density	lb/ft3	0	40.2419	0.3018	40.2636
Mole Wt.		0	100.4909	32.1191	100.4909
Spec. Heat	Btu/lb-F	---	0.5611	0.485	0.5609
Therm Cond	Btu/hr-ft-F	---	0.0622	0.0174	0.0622
Viscosity	cP	---	0.2758	0.0118	0.2756
Z Factor		---	0.0229	0.9759	0.0381
Sur Tension	dyne/cm	---	15.1126	---	15.0996
Std Density	lb/ft3	---	43.0466	---	43.0466
Methane	mole frac.	0.0000*	0.0105	0.5805	0.0105
Ethane	mole frac.	0.0000*	0.009	0.1235	0.009
Propane	mole frac.	0.0000*	0.0214	0.1032	0.0214
i-Butane	mole frac.	0.0000*	0.0158	0.0353	0.0158
n-Butane	mole frac.	0.0000*	0.0233	0.0396	0.0233
i-Pentane	mole frac.	0.0000*	0.031	0.0242	0.031
n-Pentane	mole frac.	0.0000*	0.025	0.0157	0.025
n-Hexane	mole frac.	0.0000*	0.109	0.0262	0.109
n-Heptane	mole frac.	0.0000*	0.3789	0.0361	0.3789
n-Octane	mole frac.	0.0000*	0.2186	0.0083	0.2186
n-Nonane	mole frac.	0.0000*	0.1397	0.0022	0.1397
n-Decane	mole frac.	0.0000*	0.0159	0.0001	0.0159
n-C11	mole frac.	0.0000*	0.0014	0	0.0014
n-C12	mole frac.	0.0000*	0.0003	0	0.0003
n-C13	mole frac.	0.0000*	0.0001	0	0.0001
n-C14	mole frac.	0.0000*	0	0	0
H2O	mole frac.	0.0000*	0.0001	0.0013	0.0001
Nitrogen	mole frac.	0.0000*	0	0.0002	0
CO2	mole frac.	0.0000*	0.0001	0.0036	0.0001

Stream		E-2
Description		
Vapour frac.		2.0000*
Temperature	F	0.0000*
Pressure	psia	0.0000*
Molar Flow	lbmole/hr	0.0000*
Mass Flow	lb/hr	0.0000*
LiqVol Flow	barrel/day	0.0000*
Enthalpy	Btu/hr	3061.401
Density	lb/ft3	0
Mole Wt.		0
Spec. Heat	Btu/lb-F	---
Therm Cond	Btu/hr-ft-F	---
Viscosity	cP	---
Z Factor		---
Sur Tension	dyne/cm	---
Std Density	lb/ft3	---
Methane	mole frac.	0.0000*
Ethane	mole frac.	0.0000*
Propane	mole frac.	0.0000*
i-Butane	mole frac.	0.0000*
n-Butane	mole frac.	0.0000*
i-Pentane	mole frac.	0.0000*
n-Pentane	mole frac.	0.0000*
n-Hexane	mole frac.	0.0000*
n-Heptane	mole frac.	0.0000*
n-Octane	mole frac.	0.0000*
n-Nonane	mole frac.	0.0000*
n-Decane	mole frac.	0.0000*
n-C11	mole frac.	0.0000*
n-C12	mole frac.	0.0000*
n-C13	mole frac.	0.0000*
n-C14	mole frac.	0.0000*
H2O	mole frac.	0.0000*
Nitrogen	mole frac.	0.0000*
CO2	mole frac.	0.0000*

WORKSHEET USING OPERATING DATA (20:00 hrs)

Stream		FEED	1	2	3
Description					
Vapour frac.		1	0.9923	0	1
Temperature	F	150.0000*	107.0455	107.0455	107.0455
Pressure	psia	3050.0001*	1400.0001*	1400	1400
Molar Flow	lbmole/hr	25000.0004*	25000	192.748	24807.25
Mass Flow	lb/hr	449754.2	449754.2	16815.03	432939.2
LiqVol Flow	barrel/day	95915.01	95915.01	1760.04	94154.98
Enthalpy	Btu/hr	9.76E+07	9.76E+07	45053.25	9.76E+07
Density	lb/ft3	9.7972	4.9541	40.2864	4.7909
Mole Wt.		17.9902	17.9902	87.2384	17.4521
Spec. Heat	Btu/lb-F	0.7665	0.6869	0.5428	0.6925
Therm Cond	Btu/hr-ft-F	0.037	---	0.0674	0.0259
Viscosity	cP	0.021	---	0.3656	0.0147
Z Factor		0.856	---	0.4985	0.8386
Sur Tension	dyne/cm	---	---	12.2643	---
Std Density	lb/ft3	---	---	41.808	---
Methane	mole frac.	0.9457*	0.9457	0.3392	0.9504
Ethane	mole frac.	0.0255*	0.0255	0.0279	0.0255
Propane	mole frac.	0.0086*	0.0086	0.0213	0.0085
i-Butane	mole frac.	0.0022*	0.0022	0.0097	0.0021
n-Butane	mole frac.	0.0023*	0.0023	0.0127	0.0022
i-Pentane	mole frac.	0.0014*	0.0014	0.0135	0.0013
n-Pentane	mole frac.	0.0009*	0.0009	0.0104	0.0008
n-Hexane	mole frac.	0.0018*	0.0018	0.04	0.0015
n-Heptane	mole frac.	0.0035*	0.0035	0.1363	0.0025
n-Octane	mole frac.	0.0014*	0.0014	0.0851	0.0007
n-Nonane	mole frac.	0.0008*	0.0008	0.0659	0.0003
n-Decane	mole frac.	0.0004*	0.0004	0.0403	0.0001
n-C11	mole frac.	0.0003*	0.0003	0.0337	0
n-C12	mole frac.	0.0003*	0.0003	0.0357	0
n-C13	mole frac.	0.0003*	0.0003	0.0372	0
n-C14	mole frac.	0.0007*	0.0007	0.0892	0
H2O	mole frac.	0.0005*	0.0005	0.0004	0.0005
Nitrogen	mole frac.	0.0020*	0.002	0.0003	0.002
CO2	mole frac.	0.0015*	0.0015	0.0011	0.0015

Stream		3-B	3-A	3-C	Q-1
Description					
Vapour frac.		1	1	1	2.0000*
Temperature	F	107.0455	107.0455	136*	0.0000*
Pressure	psia	1400	1400	1390	0.0000*
Molar Flow	lbmole/hr	22807.25	2000.0000*	2000	0.0000*
Mass Flow	lb/hr	398034.9	34904.24	34904.24	0.0000*
LiqVol Flow	barrel/day	86564.05	7590.923	7590.923	0.0000*
Enthalpy	Btu/hr	8.97E+07	7.87E+06	8.57E+06	699691.8
Density	lb/ft3	4.7909	4.7909	4.3723	0
Mole Wt.		17.4521	17.4521	17.4521	0
Spec. Heat	Btu/lb-F	0.6925	0.6925	0.6749	---
Therm Cond	Btu/hr-ft-F	0.0259	0.0259	0.0268	---
Viscosity	cP	0.0147	0.0147	0.0149	---
Z Factor		0.8386	0.8386	0.8679	---
Sur Tension	dyne/cm	---	---	---	---
Std Density	lb/ft3	---	---	---	---
Methane	mole frac.	0.9504	0.9504	0.9504	0.0000*
Ethane	mole frac.	0.0255	0.0255	0.0255	0.0000*
Propane	mole frac.	0.0085	0.0085	0.0085	0.0000*
i-Butane	mole frac.	0.0021	0.0021	0.0021	0.0000*
n-Butane	mole frac.	0.0022	0.0022	0.0022	0.0000*
i-Pentane	mole frac.	0.0013	0.0013	0.0013	0.0000*
n-Pentane	mole frac.	0.0008	0.0008	0.0008	0.0000*
n-Hexane	mole frac.	0.0015	0.0015	0.0015	0.0000*
n-Heptane	mole frac.	0.0025	0.0025	0.0025	0.0000*
n-Octane	mole frac.	0.0007	0.0007	0.0007	0.0000*
n-Nonane	mole frac.	0.0003	0.0003	0.0003	0.0000*
n-Decane	mole frac.	0.0001	0.0001	0.0001	0.0000*
n-C11	mole frac.	0	0	0	0.0000*
n-C12	mole frac.	0	0	0	0.0000*
n-C13	mole frac.	0	0	0	0.0000*
n-C14	mole frac.	0	0	0	0.0000*
H2O	mole frac.	0.0005	0.0005	0.0005	0.0000*
Nitrogen	mole frac.	0.002	0.002	0.002	0.0000*
CO2	mole frac.	0.0015	0.0015	0.0015	0.0000*

Stream		3-B	3-A	3-C	Q-1
Description					
Vapour frac.		1	1	1	2.0000*
Temperature	F	107.0455	107.0455	136*	0.0000*
Pressure	psia	1400	1400	1390	0.0000*
Molar Flow	lbmole/hr	22807.25	2000.0000*	2000	0.0000*
Mass Flow	lb/hr	398034.9	34904.24	34904.24	0.0000*
LiqVol Flow	barrel/day	86564.05	7590.923	7590.923	0.0000*
Enthalpy	Btu/hr	8.97E+07	7.87E+06	8.57E+06	699691.8
Density	lb/ft3	4.7909	4.7909	4.3723	0
Mole Wt.		17.4521	17.4521	17.4521	0
Spec. Heat	Btu/lb-F	0.6925	0.6925	0.6749	---
Therm Cond	Btu/hr-ft-F	0.0259	0.0259	0.0268	---
Viscosity	cP	0.0147	0.0147	0.0149	---
Z Factor		0.8386	0.8386	0.8679	---
Sur Tension	dyne/cm	---	---	---	---
Std Density	lb/ft3	---	---	---	---
Methane	mole frac.	0.9504	0.9504	0.9504	0.0000*
Ethane	mole frac.	0.0255	0.0255	0.0255	0.0000*
Propane	mole frac.	0.0085	0.0085	0.0085	0.0000*
i-Butane	mole frac.	0.0021	0.0021	0.0021	0.0000*
n-Butane	mole frac.	0.0022	0.0022	0.0022	0.0000*
i-Pentane	mole frac.	0.0013	0.0013	0.0013	0.0000*
n-Pentane	mole frac.	0.0008	0.0008	0.0008	0.0000*
n-Hexane	mole frac.	0.0015	0.0015	0.0015	0.0000*
n-Heptane	mole frac.	0.0025	0.0025	0.0025	0.0000*
n-Octane	mole frac.	0.0007	0.0007	0.0007	0.0000*
n-Nonane	mole frac.	0.0003	0.0003	0.0003	0.0000*
n-Decane	mole frac.	0.0001	0.0001	0.0001	0.0000*
n-C11	mole frac.	0	0	0	0.0000*
n-C12	mole frac.	0	0	0	0.0000*
n-C13	mole frac.	0	0	0	0.0000*
n-C14	mole frac.	0	0	0	0.0000*
H2O	mole frac.	0.0005	0.0005	0.0005	0.0000*
Nitrogen	mole frac.	0.002	0.002	0.002	0.0000*
CO2	mole frac.	0.0015	0.0015	0.0015	0.0000*

Stream		3-D	4	5	6
Description					
Vapour frac.		1	0.9972	0	1
Temperature	F	108.9665	75.9423	75.9423	75.9423
Pressure	psia	1390	690.0000*	690	690
Molar Flow	lbmole/hr	24807.25	24807.25	69.0667	24738.19
Mass Flow	lb/hr	432939.2	432939.2	5744.803	427194.4
LiqVol Flow	barrel/day	94154.98	94154.98	605.5204	93549.46
Enthalpy	Btu/hr	9.83E+07	9.83E+07	-62602.2	9.83E+07
Density	lb/ft3	4.7248	2.3644	40.6789	2.3348
Mole Wt.		17.4521	17.4521	83.1776	17.2686
Spec. Heat	Btu/lb-F	0.6899	0.6058	0.5248	0.6069
Therm Cond	Btu/hr-ft-F	0.0259	---	0.0681	0.0215
Viscosity	cP	0.0147	---	0.3249	0.0124
Z Factor		0.8414	---	0.2455	0.8879
Sur Tension	dyne/cm	---	---	14.8247	---
Std Density	lb/ft3	---	---	41.2397	---
Methane	mole frac.	0.9504	0.9504	0.2103	0.9525
Ethane	mole frac.	0.0255	0.0255	0.0248	0.0255
Propane	mole frac.	0.0085	0.0085	0.0247	0.0085
i-Butane	mole frac.	0.0021	0.0021	0.0135	0.0021
n-Butane	mole frac.	0.0022	0.0022	0.0189	0.0022
i-Pentane	mole frac.	0.0013	0.0013	0.0236	0.0012
n-Pentane	mole frac.	0.0008	0.0008	0.0191	0.0008
n-Hexane	mole frac.	0.0015	0.0015	0.0845	0.0013
n-Heptane	mole frac.	0.0025	0.0025	0.2906	0.0017
n-Octane	mole frac.	0.0007	0.0007	0.1504	0.0003
n-Nonane	mole frac.	0.0003	0.0003	0.0794	0.0001
n-Decane	mole frac.	0.0001	0.0001	0.0292	0
n-C11	mole frac.	0	0	0.0132	0
n-C12	mole frac.	0	0	0.008	0
n-C13	mole frac.	0	0	0.004	0
n-C14	mole frac.	0	0	0.0044	0
H2O	mole frac.	0.0005	0.0005	0.0003	0.0005
Nitrogen	mole frac.	0.002	0.002	0.0002	0.002
CO2	mole frac.	0.0015	0.0015	0.0008	0.0015

Stream		**7**	**8**	**9**	**10**
Description					
Vapour frac.		0.1505	0.3237	0	1
Temperature	F	97.3514	89.8478	89.8478	89.8478
Pressure	psia	690	110.0000*	110	110
Molar Flow	lbmole/hr	261.8147	261.8147	177.0537	84.761
Mass Flow	lb/hr	22559.83	22559.83	20908.2	1651.629
LiqVol Flow	barrel/day	2365.56	2365.56	2027.409	338.1508
Enthalpy	Btu/hr	-17549	-17549	-411175	393625.8
Density	lb/ft3	27.1909	4.5847	43.6535	0.3718
Mole Wt.		86.1672	86.1672	118.0896	19.4857
Spec. Heat	Btu/lb-F	0.5304	0.5125	0.5123	0.5152
Therm Cond	Btu/hr-ft-F	---	---	0.07	0.0189
Viscosity	cP	---	---	0.5583	0.0116
Z Factor		---	---	0.0505	0.9775
Sur Tension	dyne/cm	---	---	19.1994	---
Std Density	lb/ft3	---	---	44.5197	---
Methane	mole frac.	0.3052	0.3052	0.0321	0.8757
Ethane	mole frac.	0.0271	0.0271	0.0113	0.0602
Propane	mole frac.	0.0222	0.0222	0.0188	0.0293
i-Butane	mole frac.	0.0107	0.0107	0.0122	0.0077
n-Butane	mole frac.	0.0144	0.0144	0.0174	0.008
i-Pentane	mole frac.	0.0162	0.0162	0.022	0.0041
n-Pentane	mole frac.	0.0127	0.0127	0.0176	0.0025
n-Hexane	mole frac.	0.0518	0.0518	0.075	0.0034
n-Heptane	mole frac.	0.177	0.177	0.2599	0.0039
n-Octane	mole frac.	0.1023	0.1023	0.151	0.0008
n-Nonane	mole frac.	0.0695	0.0695	0.1026	0.0002
n-Decane	mole frac.	0.0374	0.0374	0.0552	0
n-C11	mole frac.	0.0283	0.0283	0.0418	0
n-C12	mole frac.	0.0284	0.0284	0.042	0
n-C13	mole frac.	0.0285	0.0285	0.0421	0
n-C14	mole frac.	0.0668	0.0668	0.0988	0
H2O	mole frac.	0.0004	0.0004	0.0001	0.0009
Nitrogen	mole frac.	0.0003	0.0003	0	0.0008
CO2	mole frac.	0.001	0.001	0.0002	0.0026

Stream		11	6-A	COOL-1	12
Description					
Vapour frac.		0	0.9965	2*	0
Temperature	F	89.8478	32.0000*	0*	32
Pressure	psia	110	690	0*	690
Molar Flow	lbmole/hr	0	24738.19	0*	79.2681
Mass Flow	lb/hr	0	427194.4	0*	5543.9947
LiqVol Flow	barrel/day	0	93549.46	0*	615.71
Enthalpy	Btu/hr	0	8.61E+07	1.23E+07	-152207
Density	lb/ft3	52.7655	2.6608	0	40.0344
Mole Wt.		18.0165	17.2686	0	69.9398
Spec. Heat	Btu/lb-F	1.03	0.6228	---	0.5098
Therm Cond	Btu/hr-ft-F	0.3589	---	---	0.0693
Viscosity	cP	0.762	---	---	0.3012
Z Factor		0.0064	---	---	0.2285
Sur Tension	dyne/cm	70.8588	---	---	14.6025
Std Density	lb/ft3	63.33	---	---	38.9697
Methane	mole frac.	0	0.9525	0*	0.2508
Ethane	mole frac.	0	0.0255	0*	0.0355
Propane	mole frac.	0	0.0085	0*	0.0395
i-Butane	mole frac.	0	0.0021	0*	0.0229
n-Butane	mole frac.	0	0.0022	0*	0.033
i-Pentane	mole frac.	0	0.0012	0*	0.0415
n-Pentane	mole frac.	0	0.0008	0*	0.0338
n-Hexane	mole frac.	0	0.0013	0*	0.1298
n-Heptane	mole frac.	0	0.0017	0*	0.3044
n-Octane	mole frac.	0	0.0003	0*	0.0831
n-Nonane	mole frac.	0	0.0001	0*	0.0202
n-Decane	mole frac.	0	0	0*	0.0033
n-C11	mole frac.	0	0	0*	0.0006
n-C12	mole frac.	0	0	0*	0.0002
n-C13	mole frac.	0	0	0*	0
n-C14	mole frac.	0	0	0*	0
H2O	mole frac.	0.9999	0.0005	0*	0.0001
Nitrogen	mole frac.	0	0.002	0*	0.0002
CO2	mole frac.	0.0001	0.0015	0*	0.001

Stream		**13**	**14**	**15**	**16**
Description					
Vapour frac.		1	0	0.9968	0.9947
Temperature	F	32	32	32.0002	10.4000*
Pressure	psia	690	690	690	690
Molar Flow	lbmole/hr	24651.45	7.471	24730.72	24730.72
Mass Flow	lb/hr	421515.8	134.6014	427059.9	427059.9
LiqVol Flow	barrel/day	92924.52	9.2354	93540.23	93540.23
Enthalpy	Btu/hr	8.63E+07	-116818	8.62E+07	8.00E+07
Density	lb/ft3	2.6277	64.1271	2.66	2.8676
Mole Wt.		17.099	18.0164	17.2684	17.2684
Spec. Heat	Btu/lb-F	0.6242	1.0321	0.6227	0.6382
Therm Cond	Btu/hr-ft-F	0.0199	0.3287	---	---
Viscosity	cP	0.0117	1.7476	---	---
Z Factor		0.851	0.0367	---	---
Sur Tension	dyne/cm	---	76.3924	---	---
Std Density	lb/ft3	---	63.33	---	---
Methane	mole frac.	0.955	0	0.9528	0.9528
Ethane	mole frac.	0.0254	0	0.0255	0.0255
Propane	mole frac.	0.0084	0	0.0085	0.0085
i-Butane	mole frac.	0.002	0	0.0021	0.0021
n-Butane	mole frac.	0.0021	0	0.0022	0.0022
i-Pentane	mole frac.	0.0011	0	0.0012	0.0012
n-Pentane	mole frac.	0.0007	0	0.0008	0.0008
n-Hexane	mole frac.	0.0009	0	0.0013	0.0013
n-Heptane	mole frac.	0.0007	0	0.0017	0.0017
n-Octane	mole frac.	0.0001	0	0.0003	0.0003
n-Nonane	mole frac.	0	0	0.0001	0.0001
n-Decane	mole frac.	0	0	0	0
n-C11	mole frac.	0	0	0	0
n-C12	mole frac.	0	0	0	0
n-C13	mole frac.	0	0	0	0
n-C14	mole frac.	0	0	0	0
H2O	mole frac.	0.0002	0.9999	0.0002	0.0002
Nitrogen	mole frac.	0.002	0	0.002	0.002
CO2	mole frac.	0.0015	0	0.0015	0.0015

Stream		COOL-2	17	18	19
Description					
Vapour frac.		2.0000*	0	1	0
Temperature	F	0.0000*	10.4	10.4	10.4
Pressure	psia	0.0000*	690	690	690
Molar Flow	lbmole/hr	0.0000*	129.7299	24598.66	2.3296
Mass Flow	lb/hr	0.0000*	8368.073	418649.8	41.9723
LiqVol Flow	barrel/day	0.0000*	955.9557	92581.39	2.8799
Enthalpy	Btu/hr	6.16E+06	-307252	8.04E+07	-37361.9
Density	lb/ft3	0	39.7316	2.8151	64.671
Mole Wt.		0	64.5038	17.0192	18.017
Spec. Heat	Btu/lb-F	---	0.5037	0.6408	1.0352
Therm Cond	Btu/hr-ft-F	---	0.0701	0.0192	0.3176
Viscosity	cP	---	0.2966	0.0114	1.0993
Z Factor		---	0.2221	0.8269	0.0381
Sur Tension	dyne/cm	---	14.3424	---	78.4455
Std Density	lb/ft3	---	37.7594	---	63.3307
Methane	mole frac.	0.0000*	0.2787	0.9564	0
Ethane	mole frac.	0.0000*	0.0432	0.0254	0
Propane	mole frac.	0.0000*	0.0507	0.0082	0
i-Butane	mole frac.	0.0000*	0.0298	0.002	0
n-Butane	mole frac.	0.0000*	0.0432	0.002	0
i-Pentane	mole frac.	0.0000*	0.0522	0.001	0
n-Pentane	mole frac.	0.0000*	0.0416	0.0006	0
n-Hexane	mole frac.	0.0000*	0.134	0.0006	0
n-Heptane	mole frac.	0.0000*	0.2513	0.0003	0
n-Octane	mole frac.	0.0000*	0.0582	0	0
n-Nonane	mole frac.	0.0000*	0.0131	0	0
n-Decane	mole frac.	0.0000*	0.002	0	0
n-C11	mole frac.	0.0000*	0.0004	0	0
n-C12	mole frac.	0.0000*	0.0001	0	0
n-C13	mole frac.	0.0000*	0	0	0
n-C14	mole frac.	0.0000*	0	0	0
H2O	mole frac.	0.0000*	0.0001	0.0001	0.9999
Nitrogen	mole frac.	0.0000*	0.0002	0.002	0
CO2	mole frac.	0.0000*	0.0012	0.0015	0.0001

Stream		20	Q-2	21		22
Description						
Vapour frac.		0.9948	2.0000*	1		1
Temperature	F	10.4002	0.0000*	126	*	118.3957
Pressure	psia	690	0.0000*	690		540.0000*
Molar Flow	lbmole/hr	24728.39	0.0000*	24728.39		24728.39
Mass Flow	lb/hr	427017.9	0.0000*	427017.9		427017.9
LiqVol Flow	barrel/day	93537.35	0.0000*	93537.35		93537.35
Enthalpy	Btu/hr	8.00E+07	3.12E+07	1.11E+08		1.11E+08
Density	lb/ft3	2.8673	0	2.0625		1.6132
Mole Wt.		17.2683	0	17.2683		17.2683
Spec. Heat	Btu/lb-F	0.6381	---	0.6033		0.5867
Therm Cond	Btu/hr-ft-F	---	---	0.0235		0.0226
Viscosity	cP	---	---	0.0132		0.0128
Z Factor		---	---	0.9192		0.9318
Sur Tension	dyne/cm	---	---	---		---
Std Density	lb/ft3	---	---	---		---
Methane	mole frac.	0.9528	0.0000*	0.9528		0.9528
Ethane	mole frac.	0.0255	0.0000*	0.0255		0.0255
Propane	mole frac.	0.0085	0.0000*	0.0085		0.0085
i-Butane	mole frac.	0.0021	0.0000*	0.0021		0.0021
n-Butane	mole frac.	0.0022	0.0000*	0.0022		0.0022
i-Pentane	mole frac.	0.0012	0.0000*	0.0012		0.0012
n-Pentane	mole frac.	0.0008	0.0000*	0.0008		0.0008
n-Hexane	mole frac.	0.0013	0.0000*	0.0013		0.0013
n-Heptane	mole frac.	0.0017	0.0000*	0.0017		0.0017
n-Octane	mole frac.	0.0003	0.0000*	0.0003		0.0003
n-Nonane	mole frac.	0.0001	0.0000*	0.0001		0.0001
n-Decane	mole frac.	0	0.0000*	0		0
n-C11	mole frac.	0	0.0000*	0		0
n-C12	mole frac.	0	0.0000*	0		0
n-C13	mole frac.	0	0.0000*	0		0
n-C14	mole frac.	0	0.0000*	0		0
H2O	mole frac.	0.0001	0.0000*	0.0001		0.0001
Nitrogen	mole frac.	0.002	0.0000*	0.002		0.002
CO2	mole frac.	0.0015	0.0000*	0.0015		0.0015

Stream		23	24	25	Q-5
Description					
Vapour frac.		0	1	0.0816	2.0000*
Temperature	F	118.3957	118.3957	319.19	0.0000*
Pressure	psia	540	540	110	0.0000*
Molar Flow	lbmole/hr	0	24728.39	177.0537	0.0000*
Mass Flow	lb/hr	0	427017.9	20908.2	0.0000*
LiqVol Flow	barrel/day	0	93537.35	2027.409	0.0000*
Enthalpy	Btu/hr	0	1.11E+08	2.49E+06	2.91E+06
Density	lb/ft3	1.6132	1.6132	13.3787	0
Mole Wt.		17.2683	17.2683	118.0896	0
Spec. Heat	Btu/lb-F	0.5867	0.5867	0.6582	---
Therm Cond	Btu/hr-ft-F	0.0358	0.0226	---	---
Viscosity	cP	0.006	0.0128	---	---
Z Factor		0.9318	0.9318	---	---
Sur Tension	dyne/cm	0.1581	---	---	---
Std Density	lb/ft3	---	---	---	---
Methane	mole frac.	0.9528	0.9528	0.0321	0.0000*
Ethane	mole frac.	0.0255	0.0255	0.0113	0.0000*
Propane	mole frac.	0.0085	0.0085	0.0188	0.0000*
i-Butane	mole frac.	0.0021	0.0021	0.0122	0.0000*
n-Butane	mole frac.	0.0022	0.0022	0.0174	0.0000*
i-Pentane	mole frac.	0.0012	0.0012	0.022	0.0000*
n-Pentane	mole frac.	0.0008	0.0008	0.0176	0.0000*
n-Hexane	mole frac.	0.0013	0.0013	0.075	0.0000*
n-Heptane	mole frac.	0.0017	0.0017	0.2599	0.0000*
n-Octane	mole frac.	0.0003	0.0003	0.151	0.0000*
n-Nonane	mole frac.	0.0001	0.0001	0.1026	0.0000*
n-Decane	mole frac.	0	0	0.0552	0.0000*
n-C11	mole frac.	0	0	0.0418	0.0000*
n-C12	mole frac.	0	0	0.042	0.0000*
n-C13	mole frac.	0	0	0.0421	0.0000*
n-C14	mole frac.	0	0	0.0988	0.0000*
H2O	mole frac.	0.0001	0.0001	0.0001	0.0000*
Nitrogen	mole frac.	0.002	0.002	0	0.0000*
CO2	mole frac.	0.0015	0.0015	0.0002	0.0000*

Stream		26	27	Q-3	28
Description					
Vapour frac.		0.182	1	2.0000*	0
Temperature	F	306.3858	341.8481	0.0000*	552.3481
Pressure	psia	60.0000*	60	0.0000*	60
Molar Flow	lbmole/hr	177.0537	132.0013	0.0000*	45.0524
Mass Flow	lb/hr	20908.2	12897.94	0.0000*	8010.258
LiqVol Flow	barrel/day	2027.409	1300.37	0.0000*	727.039
Enthalpy	Btu/hr	2.49E+06	3.30E+06	3.12E+07	2.08E+06
Density	lb/ft3	4.5279	0.7629	0	32.6597
Mole Wt.		118.0896	97.7107	0	177.7986
Spec. Heat	Btu/lb-F	0.6377	0.563	---	0.7843
Therm Cond	Btu/hr-ft-F	---	0.0147	---	0.0444
Viscosity	cP	---	0.0091	---	0.1328
Z Factor		---	0.8934	---	0.0301
Sur Tension	dyne/cm	---	---	---	5.2468
Std Density	lb/ft3	---	---	---	47.2399
Methane	mole frac.	0.0321	0.043	0.0000*	0
Ethane	mole frac.	0.0113	0.0151	0.0000*	0
Propane	mole frac.	0.0188	0.0252	0.0000*	0
i-Butane	mole frac.	0.0122	0.0163	0.0000*	0
n-Butane	mole frac.	0.0174	0.0234	0.0000*	0
i-Pentane	mole frac.	0.022	0.0295	0.0000*	0
n-Pentane	mole frac.	0.0176	0.0236	0.0000*	0
n-Hexane	mole frac.	0.075	0.1005	0.0000*	0
n-Heptane	mole frac.	0.2599	0.3486	0.0000*	0
n-Octane	mole frac.	0.151	0.2025	0.0000*	0
n-Nonane	mole frac.	0.1026	0.1361	0.0000*	0.0046
n-Decane	mole frac.	0.0552	0.0338	0.0000*	0.118
n-C11	mole frac.	0.0418	0.0017	0.0000*	0.1595
n-C12	mole frac.	0.042	0.0003	0.0000*	0.1643
n-C13	mole frac.	0.0421	0.0001	0.0000*	0.1652
n-C14	mole frac.	0.0988	0	0.0000*	0.3883
H2O	mole frac.	0.0001	0.0001	0.0000*	0
Nitrogen	mole frac.	0	0	0.0000*	0
CO2	mole frac.	0.0002	0.0003	0.0000*	0

Stream		E-1	29	E-11	30
Description					
Vapour frac.		2.0000*	0	2.0000*	0.0864
Temperature	F	0.0000*	250.0000*	0.0000*	200.0000*
Pressure	psia	0.0000*	60	0.0000*	60
Molar Flow	lbmole/hr	0.0000*	45.0524	0.0000*	132.0013
Mass Flow	lb/hr	0.0000*	8010.258	0.0000*	12897.9423
LiqVol Flow	barrel/day	0.0000*	727.039	0.0000*	1300.3702
Enthalpy	Btu/hr	6.19E+06	426264.8	3.12E+07	709388.7
Density	lb/ft3	0	42.3235	0	7.9745
Mole Wt.		0	177.7986	0	97.7107
Spec. Heat	Btu/lb-F	---	0.5934	---	0.5912
Therm Cond	Btu/hr-ft-F	---	0.0668	---	---
Viscosity	cP	---	0.4601	---	---
Z Factor		---	0.0331	---	---
Sur Tension	dyne/cm	---	16.9861	---	---
Std Density	lb/ft3	---	47.2399	---	---
Methane	mole frac.	0.0000*	0	0.0000*	0.043
Ethane	mole frac.	0.0000*	0	0.0000*	0.0151
Propane	mole frac.	0.0000*	0	0.0000*	0.0252
i-Butane	mole frac.	0.0000*	0	0.0000*	0.0163
n-Butane	mole frac.	0.0000*	0	0.0000*	0.0234
i-Pentane	mole frac.	0.0000*	0	0.0000*	0.0295
n-Pentane	mole frac.	0.0000*	0	0.0000*	0.0236
n-Hexane	mole frac.	0.0000*	0	0.0000*	0.1005
n-Heptane	mole frac.	0.0000*	0	0.0000*	0.3486
n-Octane	mole frac.	0.0000*	0.0001	0.0000*	0.2025
n-Nonane	mole frac.	0.0000*	0.0046	0.0000*	0.1361
n-Decane	mole frac.	0.0000*	0.118	0.0000*	0.0338
n-C11	mole frac.	0.0000*	0.1595	0.0000*	0.0017
n-C12	mole frac.	0.0000*	0.1643	0.0000*	0.0003
n-C13	mole frac.	0.0000*	0.1652	0.0000*	0.0001
n-C14	mole frac.	0.0000*	0.3883	0.0000*	0
H2O	mole frac.	0.0000*	0	0.0000*	0.0001
Nitrogen	mole frac.	0.0000*	0	0.0000*	0
CO2	mole frac.	0.0000*	0	0.0000*	0.0003

Stream		31	32	33	E-2
Description					
Vapour frac.		0	1	0	2.0000*
Temperature	F	200	200	200.2827	0.0000*
Pressure	psia	60	60	100	0.0000*
Molar Flow	lbmole/hr	120.5971	11.4042	120.5971	0.0000*
Mass Flow	lb/hr	12400.31	497.6357	12400.31	0.0000*
LiqVol Flow	barrel/day	1233.28	67.0898	1233.28	0.0000*
Enthalpy	Btu/hr	602623.3	106765.5	605774.6	3151.331
Density	lb/ft3	38.8354	0.3834	38.8583	0
Mole Wt.		102.8243	43.636	102.8243	0
Spec. Heat	Btu/lb-F	0.595	0.4969	0.5947	---
Therm Cond	Btu/hr-ft-F	0.0582	0.0169	0.0581	---
Viscosity	cP	0.2242	0.0116	0.224	---
Z Factor		0.0224	0.9647	0.0374	---
Sur Tension	dyne/cm	12.9261	---	12.9121	---
Std Density	lb/ft3	43.2534	---	43.2534	---
Methane	mole frac.	0.0072	0.4219	0.0072	0.0000*
Ethane	mole frac.	0.0062	0.1094	0.0062	0.0000*
Propane	mole frac.	0.0165	0.1169	0.0165	0.0000*
i-Butane	mole frac.	0.0133	0.048	0.0133	0.0000*
n-Butane	mole frac.	0.0202	0.0575	0.0202	0.0000*
i-Pentane	mole frac.	0.0284	0.0409	0.0284	0.0000*
n-Pentane	mole frac.	0.0231	0.0279	0.0231	0.0000*
n-Hexane	mole frac.	0.1049	0.0548	0.1049	0.0000*
n-Heptane	mole frac.	0.3733	0.0873	0.3733	0.0000*
n-Octane	mole frac.	0.2194	0.0232	0.2194	0.0000*
n-Nonane	mole frac.	0.1482	0.0073	0.1482	0.0000*
n-Decane	mole frac.	0.0369	0.0009	0.0369	0.0000*
n-C11	mole frac.	0.0018	0	0.0018	0.0000*
n-C12	mole frac.	0.0003	0	0.0003	0.0000*
n-C13	mole frac.	0.0001	0	0.0001	0.0000*
n-C14	mole frac.	0	0	0	0.0000*
H2O	mole frac.	0	0.0011	0	0.0000*
Nitrogen	mole frac.	0	0.0002	0	0.0000*
CO2	mole frac.	0.0001	0.0029	0.0001	0.0000*

Stream		COOL-3
Description		
Vapour frac.		2.0000*
Temperature	F	0.0000*
Pressure	psia	0.0000*
Molar Flow	lbmole/hr	0.0000*
Mass Flow	lb/hr	0.0000*
LiqVol Flow	barrel/day	0.0000*
Enthalpy	Btu/hr	2.59E+06
Density	lb/ft3	0
Mole Wt.		0
Spec. Heat	Btu/lb-F	---
Therm Cond	Btu/hr-ft-F	---
Viscosity	cP	---
Z Factor		---
Sur Tension	dyne/cm	---
Std Density	lb/ft3	---
Methane	mole frac.	0.0000*
Ethane	mole frac.	0.0000*
Propane	mole frac.	0.0000*
i-Butane	mole frac.	0.0000*
n-Butane	mole frac.	0.0000*
i-Pentane	mole frac.	0.0000*
n-Pentane	mole frac.	0.0000*
n-Hexane	mole frac.	0.0000*
n-Heptane	mole frac.	0.0000*
n-Octane	mole frac.	0.0000*
n-Nonane	mole frac.	0.0000*
n-Decane	mole frac.	0.0000*
n-C11	mole frac.	0.0000*
n-C12	mole frac.	0.0000*
n-C13	mole frac.	0.0000*
n-C14	mole frac.	0.0000*
H2O	mole frac.	0.0000*
Nitrogen	mole frac.	0.0000*
CO2	mole frac.	0.0000*

WORKSHEET USING OPERATING DATA (6:00 hrs)

Stream		**FEED**	**1**	**2**	**3**
Description					
Vapour frac.		1	0.9924	0	1
Temperature	F	150.0000*	107.0727	107.0727	107.0727
Pressure	psia	3149.9999*	1450.0000*	1450	1450
Molar Flow	lbmole/hr	25000.0004*	25000	190.5441	24809.46
Mass Flow	lb/hr	449754.2	449754.2	16484.59	433269.6
LiqVol Flow	barrel/day	95915.01	95915.01	1729.605	94185.4
Enthalpy	Btu/hr	9.70E+07	9.70E+07	51529.62	9.70E+07
Density	lb/ft3	10.0841	5.1522	40.192	4.9868
Mole Wt.		17.9902	17.9902	86.5132	17.4639
Spec. Heat	Btu/lb-F	0.7684	0.6929	0.5434	0.6986
Therm Cond	Btu/hr-ft-F	0.0376	---	0.0674	0.0262
Viscosity	cP	0.0214	---	0.3634	0.0149
Z Factor		0.8589	---	0.5132	0.8349
Sur Tension	dyne/cm	---	---	12.1004	---
Std Density	lb/ft3	---	---	41.7057	---
Methane	mole frac.	0.9457*	0.9457	0.3482	0.9503
Ethane	mole frac.	0.0255*	0.0255	0.0282	0.0255
Propane	mole frac.	0.0086*	0.0086	0.0213	0.0085
i-Butane	mole frac.	0.0022*	0.0022	0.0096	0.0021
n-Butane	mole frac.	0.0023*	0.0023	0.0126	0.0022
i-Pentane	mole frac.	0.0014*	0.0014	0.0132	0.0013
n-Pentane	mole frac.	0.0009*	0.0009	0.0101	0.0008
n-Hexane	mole frac.	0.0018*	0.0018	0.0389	0.0015
n-Heptane	mole frac.	0.0035*	0.0035	0.132	0.0025
n-Octane	mole frac.	0.0014*	0.0014	0.0828	0.0008
n-Nonane	mole frac.	0.0008*	0.0008	0.0646	0.0003
n-Decane	mole frac.	0.0004*	0.0004	0.0398	0.0001
n-C11	mole frac.	0.0003*	0.0003	0.0336	0
n-C12	mole frac.	0.0003*	0.0003	0.0358	0
n-C13	mole frac.	0.0003*	0.0003	0.0375	0
n-C14	mole frac.	0.0007*	0.0007	0.09	0
H2O	mole frac.	0.0005*	0.0005	0.0004	0.0005
Nitrogen	mole frac.	0.0020*	0.002	0.0003	0.002
CO2	mole frac.	0.0015*	0.0015	0.0011	0.0015

Stream		3-B	3-A	3-C	Q-1
Description					
Vapour frac.		1	1	1	2.0000*
Temperature	F	107.0727	107.0727	140	0.0000*
Pressure	psia	1450	1450	1440	0.0000*
Molar Flow	lbmole/hr	22809.45	2000.0000*	2000	0.0000*
Mass Flow	lb/hr	398341.8	34927.78	34927.78	0.0000*
LiqVol Flow	barrel/day	86592.7	7592.702	7592.702	0.0000*
Enthalpy	Btu/hr	8.92E+07	7.82E+06	8.62E+06	799805.2
Density	lb/ft3	4.9868	4.9868	4.4993	0
Mole Wt.		17.4639	17.4639	17.4639	0
Spec. Heat	Btu/lb-F	0.6986	0.6986	0.6781	---
Therm Cond	Btu/hr-ft-F	0.0262	0.0262	0.0271	---
Viscosity	cP	0.0149	0.0149	0.0151	---
Z Factor		0.8349	0.8349	0.8685	---
Sur Tension	dyne/cm	---	---	---	---
Std Density	lb/ft3	---	---	---	---
Methane	mole frac.	0.9503	0.9503	0.9503	0.0000*
Ethane	mole frac.	0.0255	0.0255	0.0255	0.0000*
Propane	mole frac.	0.0085	0.0085	0.0085	0.0000*
i-Butane	mole frac.	0.0021	0.0021	0.0021	0.0000*
n-Butane	mole frac.	0.0022	0.0022	0.0022	0.0000*
i-Pentane	mole frac.	0.0013	0.0013	0.0013	0.0000*
n-Pentane	mole frac.	0.0008	0.0008	0.0008	0.0000*
n-Hexane	mole frac.	0.0015	0.0015	0.0015	0.0000*
n-Heptane	mole frac.	0.0025	0.0025	0.0025	0.0000*
n-Octane	mole frac.	0.0008	0.0008	0.0008	0.0000*
n-Nonane	mole frac.	0.0003	0.0003	0.0003	0.0000*
n-Decane	mole frac.	0.0001	0.0001	0.0001	0.0000*
n-C11	mole frac.	0	0	0	0.0000*
n-C12	mole frac.	0	0	0	0.0000*
n-C13	mole frac.	0	0	0	0.0000*
n-C14	mole frac.	0	0	0	0.0000*
H2O	mole frac.	0.0005	0.0005	0.0005	0.0000*
Nitrogen	mole frac.	0.002	0.002	0.002	0.0000*
CO2	mole frac.	0.0015	0.0015	0.0015	0.0000*

Stream		3-D	4	5	6
Description					
Vapour frac.		1	0.9968	0	1
Temperature	F	109.3121	73.6832	73.6832	73.6832
Pressure	psia	1440	680.0000*	680	680
Molar Flow	lbmole/hr	24809.46	24809.46	78.3875	24731.07
Mass Flow	lb/hr	433269.6	433269.6	6505.368	426764.3
LiqVol Flow	barrel/day	94185.4	94185.4	686.1114	93499.3
Enthalpy	Btu/hr	9.78E+07	9.78E+07	-78311.3	9.78E+07
Density	lb/ft3	4.9142	2.3424	40.7299	2.3093
Mole Wt.		17.4639	17.4639	82.9898	17.2562
Spec. Heat	Btu/lb-F	0.6957	0.6047	0.5234	0.6059
Therm Cond	Btu/hr-ft-F	0.0262	---	0.0682	0.0213
Viscosity	cP	0.0149	---	0.3268	0.0123
Z Factor		0.8381	---	0.2421	0.8878
Sur Tension	dyne/cm	---	---	14.9076	---
Std Density	lb/ft3	---	---	41.211	---
Methane	mole frac.	0.9503	0.9503	0.2091	0.9526
Ethane	mole frac.	0.0255	0.0255	0.025	0.0255
Propane	mole frac.	0.0085	0.0085	0.0251	0.0084
i-Butane	mole frac.	0.0021	0.0021	0.0138	0.0021
n-Butane	mole frac.	0.0022	0.0022	0.0194	0.0022
i-Pentane	mole frac.	0.0013	0.0013	0.0243	0.0012
n-Pentane	mole frac.	0.0008	0.0008	0.0196	0.0008
n-Hexane	mole frac.	0.0015	0.0015	0.0866	0.0012
n-Heptane	mole frac.	0.0025	0.0025	0.2931	0.0016
n-Octane	mole frac.	0.0008	0.0008	0.1483	0.0003
n-Nonane	mole frac.	0.0003	0.0003	0.0771	0.0001
n-Decane	mole frac.	0.0001	0.0001	0.0283	0
n-C11	mole frac.	0	0	0.0128	0
n-C12	mole frac.	0	0	0.0079	0
n-C13	mole frac.	0	0	0.004	0
n-C14	mole frac.	0	0	0.0044	0
H2O	mole frac.	0.0005	0.0005	0.0003	0.0005
Nitrogen	mole frac.	0.002	0.002	0.0002	0.002
CO2	mole frac.	0.0015	0.0015	0.0008	0.0015

Stream		7	8	9	10
Description					
Vapour frac.		0.1556	0.3263	0	1
Temperature	F	95.7517	88.1487	88.1487	88.1487
Pressure	psia	680	110.0000*	110	110
Molar Flow	lbmole/hr	268.9317	268.9317	181.1842	87.7475
Mass Flow	lb/hr	22989.96	22989.96	21282.87	1707.092
LiqVol Flow	barrel/day	2415.717	2415.717	2065.874	349.8433
Enthalpy	Btu/hr	-26781.7	-26781.7	-432514	405732.7
Density	lb/ft3	26.6774	4.5338	43.6577	0.3725
Mole Wt.		85.4862	85.4862	117.4654	19.4546
Spec. Heat	Btu/lb-F	0.5296	0.5116	0.5114	0.5148
Therm Cond	Btu/hr-ft-F	---	---	0.0701	0.0189
Viscosity	cP	---	---	0.559	0.0115
Z Factor		---	---	0.0503	0.9773
Sur Tension	dyne/cm	---	---	19.2276	---
Std Density	lb/ft3	---	---	44.4757	---
Methane	mole frac.	0.3077	0.3077	0.0323	0.8763
Ethane	mole frac.	0.0273	0.0273	0.0114	0.0601
Propane	mole frac.	0.0224	0.0224	0.0191	0.0292
i-Butane	mole frac.	0.0108	0.0108	0.0124	0.0076
n-Butane	mole frac.	0.0146	0.0146	0.0178	0.0079
i-Pentane	mole frac.	0.0164	0.0164	0.0224	0.004
n-Pentane	mole frac.	0.0129	0.0129	0.018	0.0025
n-Hexane	mole frac.	0.0528	0.0528	0.0767	0.0033
n-Heptane	mole frac.	0.179	0.179	0.2638	0.0038
n-Octane	mole frac.	0.1018	0.1018	0.1508	0.0007
n-Nonane	mole frac.	0.0682	0.0682	0.1012	0.0002
n-Decane	mole frac.	0.0365	0.0365	0.0541	0
n-C11	mole frac.	0.0276	0.0276	0.0409	0
n-C12	mole frac.	0.0277	0.0277	0.0411	0
n-C13	mole frac.	0.0277	0.0277	0.0411	0
n-C14	mole frac.	0.0651	0.0651	0.0966	0
H2O	mole frac.	0.0004	0.0004	0.0001	0.0009
Nitrogen	mole frac.	0.0003	0.0003	0	0.0009
CO2	mole frac.	0.001	0.001	0.0002	0.0026

Stream		11	6-A	COOL-1	12
Description					
Vapour frac.		0	0.9967	2.0000*	0
Temperature	F	88.1487	32.0000* *	0.0000*	32
Pressure	psia	110	680	0.0000*	680
Molar Flow	lbmole/hr	0	24731.07	0.0000*	73.1013
Mass Flow	lb/hr	0	426764.3	0.0000*	5128.8297
LiqVol Flow	barrel/day	0	93499.3	0.0000*	568.9929
Enthalpy	Btu/hr	0	8.62E+07	799805.2	-141705
Density	lb/ft3	52.7989	2.6137	0	40.0763
Mole Wt.		18.0165	17.2562	0	70.1606
Spec. Heat	Btu/lb-F	1.03	0.6207	---	0.5095
Therm Cond	Btu/hr-ft-F	0.3582	---	---	0.0693
Viscosity	cP	0.7772	---	---	0.3017
Z Factor		0.0064	---	---	0.2256
Sur Tension	dyne/cm	71.0228	---	---	14.6705
Std Density	lb/ft3	63.3299	---	---	39.0148
Methane	mole frac.	0	0.9526	0.0000*	0.2476
Ethane	mole frac.	0	0.0255	0.0000*	0.0352
Propane	mole frac.	0	0.0084	0.0000*	0.0394
i-Butane	mole frac.	0	0.0021	0.0000*	0.023
n-Butane	mole frac.	0	0.0022	0.0000*	0.0331
i-Pentane	mole frac.	0	0.0012	0.0000*	0.0418
n-Pentane	mole frac.	0	0.0008	0.0000*	0.034
n-Hexane	mole frac.	0	0.0012	0.0000*	0.1314
n-Heptane	mole frac.	0	0.0016	0.0000*	0.3069
n-Octane	mole frac.	0	0.0003	0.0000*	0.0825
n-Nonane	mole frac.	0	0.0001	0.0000*	0.0197
n-Decane	mole frac.	0	0	0.0000*	0.0032
n-C11	mole frac.	0	0	0.0000*	0.0006
n-C12	mole frac.	0	0	0.0000*	0.0002
n-C13	mole frac.	0	0	0.0000*	0
n-C14	mole frac.	0	0	0.0000*	0
H2O	mole frac.	0.9999	0.0005	0.0000*	0.0001
Nitrogen	mole frac.	0	0.002	0.0000*	0.0002
CO2	mole frac.	0.0001	0.0015	0.0000*	0.001

Stream		13	14	15	16
Description					
Vapour frac.		1	0	0.997	0.995
Temperature	F	32	32	32.0003	10.4000*
Pressure	psia	680	680	680	680
Molar Flow	lbmole/hr	24650.54	7.4258	24723.64	24723.64
Mass Flow	lb/hr	421501.6	133.7861	426630.5	426630.5
LiqVol Flow	barrel/day	92921.12	9.1794	93490.11	93490.11
Enthalpy	Btu/hr	8.65E+07	-116115	8.64E+07	8.02E+07
Density	lb/ft3	2.5836	64.1258	2.6129	2.8153
Mole Wt.		17.0991	18.0164	17.256	17.256
Spec. Heat	Btu/lb-F	0.622	1.0321	0.6206	0.6355
Therm Cond	Btu/hr-ft-F	0.0198	0.3287	---	---
Viscosity	cP	0.0117	1.7477	---	---
Z Factor		0.853	0.0362	---	---
Sur Tension	dyne/cm	---	76.3924	---	---
Std Density	lb/ft3	---	63.33	---	---
Methane	mole frac.	0.955	0	0.9529	0.9529
Ethane	mole frac.	0.0254	0	0.0255	0.0255
Propane	mole frac.	0.0084	0	0.0084	0.0084
i-Butane	mole frac.	0.002	0	0.0021	0.0021
n-Butane	mole frac.	0.0021	0	0.0022	0.0022
i-Pentane	mole frac.	0.0011	0	0.0012	0.0012
n-Pentane	mole frac.	0.0007	0	0.0008	0.0008
n-Hexane	mole frac.	0.0009	0	0.0012	0.0012
n-Heptane	mole frac.	0.0007	0	0.0016	0.0016
n-Octane	mole frac.	0.0001	0	0.0003	0.0003
n-Nonane	mole frac.	0	0	0.0001	0.0001
n-Decane	mole frac.	0	0	0	0
n-C11	mole frac.	0	0	0	0
n-C12	mole frac.	0	0	0	0
n-C13	mole frac.	0	0	0	0
n-C14	mole frac.	0	0	0	0
H2O	mole frac.	0.0002	0.9999	0.0002	0.0002
Nitrogen	mole frac.	0.002	0	0.002	0.002
CO2	mole frac.	0.0015	0	0.0015	0.0015

Stream		COOL-2	17	18	19
Description					
Vapour frac.		2.0000*	0	1	0
Temperature	F	0.0000*	10.4	10.4	10.4
Pressure	psia	0.0000*	680	680	680
Molar Flow	lbmole/hr	0.0000*	122.3584	24598.93	2.3553
Mass Flow	lb/hr	0.0000*	7914.782	418673.2	42.4359
LiqVol Flow	barrel/day	0.0000*	903.2551	92583.95	2.9117
Enthalpy	Btu/hr	6.13E+06	-292215	8.06E+07	-37775.9
Density	lb/ft3	0	39.771	2.7665	64.6698
Mole Wt.		0	64.6852	17.02	18.017
Spec. Heat	Btu/lb-F	---	0.5033	0.638	1.0352
Therm Cond	Btu/hr-ft-F	---	0.0701	0.0191	0.3176
Viscosity	cP	---	0.2969	0.0114	1.0993
Z Factor		---	0.2192	0.8293	0.0376
Sur Tension	dyne/cm	---	14.411	---	78.4456
Std Density	lb/ft3	---	37.8048	---	63.3307
Methane	mole frac.	0.0000*	0.2753	0.9564	0
Ethane	mole frac.	0.0000*	0.0429	0.0254	0
Propane	mole frac.	0.0000*	0.0507	0.0082	0
i-Butane	mole frac.	0.0000*	0.03	0.002	0
n-Butane	mole frac.	0.0000*	0.0435	0.002	0
i-Pentane	mole frac.	0.0000*	0.0529	0.001	0
n-Pentane	mole frac.	0.0000*	0.0422	0.0006	0
n-Hexane	mole frac.	0.0000*	0.1364	0.0006	0
n-Heptane	mole frac.	0.0000*	0.2527	0.0003	0
n-Octane	mole frac.	0.0000*	0.0571	0	0
n-Nonane	mole frac.	0.0000*	0.0125	0	0
n-Decane	mole frac.	0.0000*	0.0019	0	0
n-C11	mole frac.	0.0000*	0.0004	0	0
n-C12	mole frac.	0.0000*	0.0001	0	0
n-C13	mole frac.	0.0000*	0	0	0
n-C14	mole frac.	0.0000*	0	0	0
H2O	mole frac.	0.0000*	0.0001	0.0001	0.9999
Nitrogen	mole frac.	0.0000*	0.0002	0.002	0
CO2	mole frac.	0.0000*	0.0012	0.0015	0.0001

Stream		20	Q-2	21	22
Description					
Vapour frac.		0.9951	2.0000*	1	1
Temperature	F	10.4002	0.0000*	116	109.1756
Pressure	psia	680	0.0000*	680	550.0000*
Molar Flow	lbmole/hr	24721.28	0.0000*	24721.28	24721.28
Mass Flow	lb/hr	426588	0.0000*	426588	426588
LiqVol Flow	barrel/day	93487.2	0.0000*	93487.2	93487.2
Enthalpy	Btu/hr	8.03E+07	2.84E+07	1.09E+08	1.09E+08
Density	lb/ft3	2.8151	0	2.0758	1.678
Mole Wt.		17.2559	0	17.2559	17.2559
Spec. Heat	Btu/lb-F	0.6355	---	0.602	0.587
Therm Cond	Btu/hr-ft-F	---	---	0.0231	0.0223
Viscosity	cP	---	---	0.013	0.0126
Z Factor		---	---	0.915	0.9265
Sur Tension	dyne/cm	---	---	---	---
Std Density	lb/ft3	---	---	---	---
Methane	mole frac.	0.953	0.0000*	0.953	0.953
Ethane	mole frac.	0.0255	0.0000*	0.0255	0.0255
Propane	mole frac.	0.0084	0.0000*	0.0084	0.0084
i-Butane	mole frac.	0.0021	0.0000*	0.0021	0.0021
n-Butane	mole frac.	0.0022	0.0000*	0.0022	0.0022
i-Pentane	mole frac.	0.0012	0.0000*	0.0012	0.0012
n-Pentane	mole frac.	0.0008	0.0000*	0.0008	0.0008
n-Hexane	mole frac.	0.0012	0.0000*	0.0012	0.0012
n-Heptane	mole frac.	0.0016	0.0000*	0.0016	0.0016
n-Octane	mole frac.	0.0003	0.0000*	0.0003	0.0003
n-Nonane	mole frac.	0.0001	0.0000*	0.0001	0.0001
n-Decane	mole frac.	0	0.0000*	0	0
n-C11	mole frac.	0	0.0000*	0	0
n-C12	mole frac.	0	0.0000*	0	0
n-C13	mole frac.	0	0.0000*	0	0
n-C14	mole frac.	0	0.0000*	0	0
H2O	mole frac.	0.0001	0.0000*	0.0001	0.0001
Nitrogen	mole frac.	0.002	0.0000*	0.002	0.002
CO2	mole frac.	0.0015	0.0000*	0.0015	0.0015

Stream		23	24	25	Q-5
Description					
Vapour frac.		0	1	0.0848	2.0000*
Temperature	F	109.1756	109.1756	319.19	0.0000*
Pressure	psia	550	550	110	0.0000*
Molar Flow	lbmole/hr	0	24721.28	181.1842	0.0000*
Mass Flow	lb/hr	0	426588	21282.87	0.0000*
LiqVol Flow	barrel/day	0	93487.2	2065.874	0.0000*
Enthalpy	Btu/hr	0	1.09E+08	2.55E+06	2.98E+06
Density	lb/ft3	1.678	1.678	13.0211	0
Mole Wt.		17.2559	17.2559	117.4654	0
Spec. Heat	Btu/lb-F	0.587	0.587	0.6584	---
Therm Cond	Btu/hr-ft-F	0.0376	0.0223	---	---
Viscosity	cP	0.0062	0.0126	---	---
Z Factor		0.9265	0.9265	---	---
Sur Tension	dyne/cm	0.1655	---	---	---
Std Density	lb/ft3	---	---	---	---
Methane	mole frac.	0.953	0.953	0.0323	0.0000*
Ethane	mole frac.	0.0255	0.0255	0.0114	0.0000*
Propane	mole frac.	0.0084	0.0084	0.0191	0.0000*
i-Butane	mole frac.	0.0021	0.0021	0.0124	0.0000*
n-Butane	mole frac.	0.0022	0.0022	0.0178	0.0000*
i-Pentane	mole frac.	0.0012	0.0012	0.0224	0.0000*
n-Pentane	mole frac.	0.0008	0.0008	0.018	0.0000*
n-Hexane	mole frac.	0.0012	0.0012	0.0767	0.0000*
n-Heptane	mole frac.	0.0016	0.0016	0.2638	0.0000*
n-Octane	mole frac.	0.0003	0.0003	0.1508	0.0000*
n-Nonane	mole frac.	0.0001	0.0001	0.1012	0.0000*
n-Decane	mole frac.	0	0	0.0541	0.0000*
n-C11	mole frac.	0	0	0.0409	0.0000*
n-C12	mole frac.	0	0	0.0411	0.0000*
n-C13	mole frac.	0	0	0.0411	0.0000*
n-C14	mole frac.	0	0	0.0966	0.0000*
H2O	mole frac.	0.0001	0.0001	0.0001	0.0000*
Nitrogen	mole frac.	0.002	0.002	0	0.0000*
CO2	mole frac.	0.0015	0.0015	0.0002	0.0000*

Stream		26	27	Q-3	28
Description					
Vapour frac.		0.1875	1	2.0000*	0
Temperature	F	305.9341	333.7083 *	0.0000*	540.434
Pressure	psia	60.0000*	60	0.0000*	60
Molar Flow	lbmole/hr	181.1842	131.9994	0.0000*	49.1848
Mass Flow	lb/hr	21282.87	12695.97	0.0000*	8586.8992
LiqVol Flow	barrel/day	2065.874	1284.778	0.0000*	781.0955
Enthalpy	Btu/hr	2.55E+06	3.21E+06	799805.2	2.16E+06
Density	lb/ft3	4.3932	0.7586	0	32.8848
Mole Wt.		117.4654	96.182	0	174.5846
Spec. Heat	Btu/lb-F	0.6372	0.559	---	0.778
Therm Cond	Btu/hr-ft-F	---	---	---	0.0448
Viscosity	cP	---	---	---	0.135
Z Factor		---	---	---	0.0297
Sur Tension	dyne/cm	---	---	---	5.4208
Std Density	lb/ft3	---	---	---	47.1354
Methane	mole frac.	0.0323	0.0443	0.0000*	0
Ethane	mole frac.	0.0114	0.0157	0.0000*	0
Propane	mole frac.	0.0191	0.0262	0.0000*	0
i-Butane	mole frac.	0.0124	0.017	0.0000*	0
n-Butane	mole frac.	0.0178	0.0244	0.0000*	0
i-Pentane	mole frac.	0.0224	0.0308	0.0000*	0
n-Pentane	mole frac.	0.018	0.0247	0.0000*	0
n-Hexane	mole frac.	0.0767	0.1053	0.0000*	0
n-Heptane	mole frac.	0.2638	0.3621	0.0000*	0
n-Octane	mole frac.	0.1508	0.2069	0.0000*	0.0003
n-Nonane	mole frac.	0.1012	0.1301	0.0000*	0.0237
n-Decane	mole frac.	0.0541	0.0111	0.0000*	0.1696
n-C11	mole frac.	0.0409	0.0008	0.0000*	0.1485
n-C12	mole frac.	0.0411	0.0002	0.0000*	0.1508
n-C13	mole frac.	0.0411	0	0.0000*	0.1514
n-C14	mole frac.	0.0966	0	0.0000*	0.3557
H2O	mole frac.	0.0001	0.0001	0.0000*	0
Nitrogen	mole frac.	0	0	0.0000*	0
CO2	mole frac.	0.0002	0.0003	0.0000*	0