

PRECIPITATE PUMP TANK

FAULT TREE ANALYSIS

PREPARED FOR

WESTINGHOUSE SAVANNAH RIVER COMPANY

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1.0 INTRODUCTION

A probabilistic fault tree analysis (FTA) was conducted to assess the annual frequency of a benzene/air fire/explosion within two precipitate pump tanks located within the auxiliary and low point pump pits, called respectively the auxiliary precipitate tank (APT) and the low point precipitate tank (LPPT). The purpose of the study is to assess the adequacy of the design proposed in this report in preventing fire or explosion within these tanks, i.e., specifically compute the frequency of fire or explosion and determine if it is less than the design goal of 1×10^{-4} per year. These pump pits are part of the interarea transfer facilities which receive and transfer radioactive slurry, aqueous recycle waste and precipitate slurry between the H-Area tank farm and the S-Area vitrification building.

The precipitate slurry contains tetraphenylborate solution which undergoes radiolysis to produce benzene. In addition this solution contains radioactive cesium, strontium and plutonium. Release of benzene to the tank vapor space can result in an explosive concentration if oxygen is present. For this reason, both precipitate pump tanks (PPTs) are inerted with a nitrogen purge system to reduce oxygen concentration below the minimum oxidant concentration (MOC). Each tank is vented to a process vent system with two exhaust fans that maintain each tank under a slight vacuum. The process vent system removes tank vapors and radioactive particulates and maintains the concentration of combustibles below the LEL.

1.1 PHR #1

A companion document to this report is PHR #1, "Process Hazards Review, System No. 1, Interarea Transfer System" (Ref. 1). The PHR used checklists and a decision tree process to identify that fire and explosion within the precipitate pump tanks warrants the use of FTA for the following reasons:

1. The event is a major hazard rating 3, i.e., system downtime exceeds 6 months when fire or explosion occurs.

2. The presence of benzene in process fluids is a departure from conventional SRS ways.
3. The event is an explosion hazard that is not ventable.

1.2 1991 FTA Study

A previous fault tree study was conducted in January 1991. This study assumed that the benzene concentration was always above the lower explosive limit (LEL) in each tank. This study considered all possible modes of operation, i.e.,

1. Fill
2. Standby
3. Pumpout
4. Transfer Jet
5. Backup Transfer Pump
6. Maintenance.

The 1991 study considered events which would cause oxygen concentration to increase above the MOC. These events include:

1. Loss of N₂ purge supply
2. Air inleakage caused by
 - i) Flange leaks
 - ii) Hanford connectors
 - iii) Loss of sump seal.

As shown in Fig. 1, a series of design changes were proposed to reduce the annual frequency of fire and explosion below the design goal of $1 \times 10^{-4} \text{ yr}^{-1}$. Design B has a greater degree of redundancy than Design A. One design change included installation of block

valve(s) on the vent system exhaust which would close in the event of a high oxygen concentration in the precipitate tanks, thereby removing the vacuum from the precipitate tanks, avoid the leakage of air inward and keep oxygen concentration below the MOC. To achieve an annual frequency less than $1 \times 10^{-4} \text{ yr}^{-1}$, the 1991 study recommended that the Design B modifications, as shown in Table 1, be incorporated.

1.3 Current FTA Study

Since this 1991 study was conducted, it was learned that the assumption that the benzene concentration is always above the LEL was highly conservative and made many of the suggested design modifications in Table 1 unnecessary. Calculations in Ref. 2 show that if the precipitate slurry is adequately agitated before the slurry is sent to the pump pits, benzene concentration, in most cases, is below the LEL if the N_2 purge to the precipitate tanks is available.

The salient features of the current proposed design for the precipitate pump tanks are shown in Fig. 2 and are described below:

- Installation of the main vent valve (HCV-8772), which closes in the event of low low nitrogen flow, high oxygen concentration or both exhaust fans not working.
- Installation of a bypass vent valve (SV-8773), which is used to sample the tank contents for oxygen concentration when the main vent valve (HCV-8772) is closed.

The interlocks for this design are shown in Table 2. The logic for operation of the bypass vent valve is shown in Table 3.

The remainder of this report describes the FTA that was conducted for the precipitate pump tank system shown in Fig. 2. The FTA computed an annual frequency of fire/explosion to be $3.4 \times 10^{-6} \text{ yr}^{-1}$ for the auxiliary and low point precipitate tanks, which is a factor of about 30 less than the design goal of $1 \times 10^{-4} \text{ yr}^{-1}$. It is important to understand the assumptions that were made in conducting the FTA, i.e., assumptions regarding the operation of the pump pits as well as the scope and bounds of the analysis. For

example, the frequency for calibration of the oxygen analyzers was assumed to be 1 month, another assumption was that only the normal modes of operation--fill, standby and pumpout--were considered in the FTA.

2.0 REPORT CONTENTS

This report is written in the same order as the FTA was conducted for this study. The series of steps employed to conduct the FTA is described below.

- STEP 1: Top Event Definition (Section 3)
- STEP 2: System Understanding (Section 4)
- STEP 3: Fault Tree Construction (Section 5)
- STEP 4: Qualitative Analysis; Generate the System Modes of Failure Called the Min Cut Sets (Section 6)
- STEP 5: Reliability Data such as Failure Rates, Calibration Frequencies and Fault Duration Times (Section 7)
- STEP 6: Probabilistic Analysis; Compute Top Event Occurrence Frequency (Section 8)
- STEP 7: Importance Analysis, i.e., Determine Which Failures Contribute Most to the Frequency of Fire/Explosion (Section 9)
- STEP 8: Conclusions, Recommendations, Results (Section 10)

These same steps were used to conduct the FTA for PHR 32, Ref. 3. The methodology used to conduct these steps are discussed in more detail in that report.

3.0 TOP EVENT DEFINITION

This section delineates the sequence of events that is necessary for a benzene/air fire/explosion to occur in the PPTs. For fire or explosion to occur, the following three events must occur (note this generates an AND gate in the fault tree with three inputs):

1. Benzene concentration between the lower explosive limit (LEL) and upper explosive limit (UEL)
2. Oxygen concentration above the minimum oxidant concentration (MOC)
3. Ignitions source present.

The occurrence of events 1 and 2 represent formation of an explosive concentration.

As described below, the fault tree structure is different depending upon the concentration of benzene in the precipitate slurry. In most cases, the benzene vapor concentration is below the LEL and for benzene concentration to increase above the LEL requires that the following events occur:

1. Loss of N_2 purge (causes benzene concentration to increase)
2. Benzene evolution continues (agitator remains on).

However, formation of an explosive concentration requires oxygen concentration to increase above the MOC which in turn requires an air leak into the PPT. However, the air leak cannot be too great, since the air would dilute the benzene concentration below the LEL. Specifics of this scenario are discussed in Section 3.1.

Rarely, the slurry is not adequately agitated before being sent to the PPTs. As a result, the benzene concentration in the slurry is high and its vapor concentration is always above the LEL. Only the oxygen concentration can be controlled in preventing formation of

an explosive concentration. If oxygen concentration increases above MOC, an explosive concentration will result. Events which can cause the oxygen concentration to increase above the MOC are:

1. Air inleakage
2. Insufficient purge supply.

Specifics for this case, called the high benzene concentration case, are discussed in Section 3.2.

3.1 Normal Concentration Benzene Case, 29/30 Transfers (Benzene Concentration Below the LEL)

In the majority of the cases (assumed to be 29 out of 30 for this study), the precipitate slurry is adequately agitated in tank 49 or 50 before the slurry is sent to the pump pits. In this case the normal N_2 purge of 30 scfm is sufficient to dilute the benzene concentration below the LEL. As a result, a self-sustaining chemical reaction of benzene with oxygen cannot occur regardless of the oxygen concentration.

Upon loss of the nitrogen purge system, there are two factors that must be considered to determine whether an explosive concentration can exist in the PPTs:

1. Rate of benzene evolution, i.e., is the PPT agitator ON or OFF?
2. Amount of air inleakage.

Table 5 considers two cases--case 1 without agitation and case 2 with agitation. Each case in turn considers 3 rates of air inleakage, 0, 2 and 10 cfm. Without agitation, the benzene release rate is very low and it takes over 1500 minutes (25 hours) to reach LEL, assuming no air inleakage. We assume for this study with probability 1 that the operator can restore the nitrogen purge system within 25 hours; hence case 1 is not considered in the FTA.

Case 2 in Table 5 considers the situation in which the agitator is not turned off when N_2 purge is lost. Note that failure to turn

the agitator off requires the simultaneous failure of two interlocks in Table 2, i.e.,

- nitrogen flow low low
- oxygen concentration high.

Loss of N₂ purge results in an increase in oxygen concentration. Three subcases (2A, 2B and 2C) are considered depending upon the amount of air inleakage. It is important to note that air inleakage occurs only if there is a vacuum on the PPT, i.e., that either the main vent valve HCV-8772 fails to close or that the bypass vent valve fails open. With both the bypass vent valve and main vent valve fully closed, the PPT is isolated and oxygen concentration cannot increase significantly. Hence case 2A is not considered in the FTA. With the main vent valve fully opened, air dilution is sufficient to keep benzene concentration below the LEL. It is important to note that a large air inleakage event, such as a connector leak, is not considered in the FTA when benzene concentration is low since a large air inleakage dilutes the benzene below the LEL and fire/explosion cannot occur.

Case 2B considers 2 scfm air inleakage caused by either one of the following two events:

1. Bypass vent valve open and main vent valve closed
2. Main vent valve partially open and bypass vent valve closed.

In this case, it takes 44 minutes to reach LEL and 67 minutes to reach MOC. These time delays are important when we consider mitigation by the operator such as restoring a failed N₂ purge supply system. If no mitigation by the operator is possible, then these time delays are irrelevant and we assume that these events occur instantaneously.

Figure 3 is the generic fault tree top structure for fire/explosion to occur according to the case 2B scenario. Insufficient N₂ purge supply is the initiating event which causes both the benzene concentration and oxygen concentration to increase. Oxygen

concentration increases because there is a vacuum on the PPT and the PPT is not leak tight; hence air is sucked into the tank. However, the air leakage must not considerably exceed 2 cfm, otherwise benzene vapor in the PPT air space would be diluted below the LEL.

There are two events identified that cause 2 cfm air inleakage following loss of N₂ purge:

1. Main vent valve (HCV-8772) fails to close fully (i.e., remains partially open)
2. Bypass vent valve (SV-8773) fails open.

Note for the first event that the interlocks are activated as intended but the main vent valve fails to close fully.

There are two causes for the second event; the operator may erroneously leave the bypass vent valve opened too long or the bypass vent valve may fail open.

3.2 High Benzene Concentration Case, 1/30 Transfers

In this study, it is assumed 1 out of 30 times that the slurry is not adequately agitated which results in a benzene concentration above the LEL, i.e., when this vapor is fully mixed with air, the mixture is explosive. This case is similar to the 1991 study. The generic fault tree top structure is shown in Fig. 4. This figure shows the initiating event logic only and does not include mitigation by interlocks. Based on calculations performed in Ref. 5, it is estimated that after eight hours of agitation in the precipitate pump tank, the benzene concentration will have decreased to the normal concentration. Hence, the FTA described in Section 3.1 for case 2B is applicable eight hours after transfer to the precipitate pump tank.

4.0 SYSTEM DESCRIPTION/UNDERSTANDING

This section describes systems that are important with regard to mitigating fire or explosion in the precipitate tanks.

The two important systems with regard to controlling oxygen concentration are (1) the nitrogen purge system and (2) the process vent system. The nitrogen purge system is also important in maintaining benzene concentration below the LEL. Interlocks important in preventing fire or explosion are also discussed in this section.

4.1 Drawings and Zone Index Scheme

The drawings used to conduct the FTA are listed in Table 4. There are a total of 19 drawings designated by letters A through S. These drawings are for the low point precipitate tank. Drawings for the auxiliary precipitate tank are similar.

A zone index scheme consisting of two letters and one number is used for ease of locating components in drawings and in the fault trees. The first letter denotes the drawing listed in Table 4, the second letter denotes the row and the third digit denotes the column number. For example, the zone index of the Hanford connector that supplies nitrogen to the LPPT is [A-V-29] where the first digit A refers to drawing no. W 750040 in Table 4, "V" refers to row V and "29" refers to the row number of that drawing.

4.2 Nitrogen Purge System

Nitrogen gas is supplied to each of the two pump pit locations through overhead lines originating from the bulk nitrogen system in S-Area. See drawings B, C, D and E in Table 4 for drawings of the nitrogen supply system. Drawing E shows the vacuum insulated liquid nitrogen storage tank [E-N-33] and the vaporizer [E-O-21]. The vaporizer is heated by low pressure steam supply system, see drawings E, I, J, K and L.

The operation of the PPTs consist of 3 modes, the duration of each mode is indicated in parenthesis:

1. Fill (1 hour)
2. Standby (42 hours)
3. Pumpout (1 hour),

for a total cycle time of 44 hours.

As shown in drawing B, there are three branches which supply nitrogen to the LPPT,

- supplemental purge line consisting of HCV-7468 [B-K-30], 15 scfm
- normal purge line consisting of SV-7469 [B-M-31], 27 scfm
- bypass line consisting of FI-7469 [B-?-??], 3 scfm.

Usual flow is $27 + 3 = 30$ scfm during fill and standby. The nitrogen flow is increased to 45 scfm during pumpout by the transfer pump in order to compensate for the volume being removed by pumping. HCV-7468, the supplemental purge valve, is interlocked to open when the transfer pump is running.

A backup bottled nitrogen system (drawing C) is provided at each pump pit in order to provide an uninterrupted nitrogen supply should the primary system fail. The backup system is actuated by a low pressure condition in the main supply.

The 1991 FTA study showed that the following two failures on the nitrogen supply line dominated probabilistically:

- pressure control valve (PCV-7172) [B-M-35] fails closed
- filter -062 [B-M-35] plugged.

Each of these failures result in an insufficient N_2 purge flow, i.e., these events represent single failures that result in loss of N_2 purge supply.

This study includes the option to add a parallel branch B to existing branch A for N₂ supply. This redundant line consists of the following components:

- two manual isolation valves
- filter
- pressure control valve
- pressure relief valve.

A sensitivity study is conducted in Section 8 to determine the reduction in the frequency of fire or explosion with the incorporation of the redundant branch B.

Branch B is assumed to be in standby; in the event of the failure of branch A, a procedure is assumed that the operator will isolate branch A and valve in branch B. This is accomplished by first closing the manual valves on branch A and then opening the manual valves on branch B.

4.3 Process Vent System (Figure 2)

A process vent system (PVS) is provided at each PPT to remove process tank vapors, radioactive particulates prior to release to atmosphere and to maintain combustibles in the PPT (benzene and hydrogen) below the LEL.

The PPT is vented to the PVS through two parallel valves:

1. The main vent valve (HVS-8772)
2. The bypass vent valve (SV-8773).

As shown in Table 3, the bypass vent valve is interlocked closed when the main vent valve is opened. In addition, the bypass vent valve cannot be opened when both fans are not running.

As shown in Table 2, the main vent valve closes in the event of nitrogen flow low low or oxygen concentration high.

The function of the bypass vent valve is to operate in emergency conditions when the main vent valve is closed. The bypass vent valve provides for sampling of the tank contents for oxygen concentration.

4.4 Connections to the PPTs

Connections can be a source of air inleakage since the PPTs are under a slight vacuum. For each tank, these connections include:

- 27 Hanford Connectors
- 5 Flanges (to pump, agitator, spare and vent valve flange)
- Air leaks through other lines (leakage requires multiple failures) such as,
 - i) cold feed
 - ii) interarea transfer lines
 - iii) spray jet
 - iv) precipitate feed tank
 - v) sump jet.

The above connections can be found on drawings A and B.

4.5 Process Interlocks

In general, the function of process interlocks is to sense abnormal values of system variables and shut the system down to a safe state. Interlocks in this study 1) sense precursor events to an explosive concentration, such as low N_2 purge flow or high oxygen concentration, and 2) prevent fire/explosion by performing control actions such as closing the main vent valve and turning off potential ignition sources.

In this study, credit is given to both softwired interlocks as well as hardwired interlocks. Softwired interlocks require that the DCS works properly. For hardwired interlocks, a relay takes the place of the DCS.

Table 6 lists the control elements that comprise interlocks for low low N_2 flow. The low-low trip setting will be set by operations. There are 3 softwired interlocks described. For an interlock to work, all control elements comprising the interlock must work (i.e., serial relationship).

Table 7 lists the hardwired interlocks for high oxygen concentration. Note that there are two oxygen analyzers. There are a total of 6 hardwired interlocks. Hardwired interlocks are activated when oxygen concentration reaches 60% of MOC.

Table 8 is similar to Table 7 except Table 8 lists the softwired interlocks for high oxygen concentration. The softwired interlocks work at a lower oxygen concentration and activate first.

Note that for the case in which benzene concentration is below the LEL, turning off the agitator when either 1) N_2 flow is low low or 2) oxygen concentration is high is a means of maintaining benzene concentration below the LEL. This is in a sense an interlock not directly described in Tables 6, 7 or 8.

In the next section, we describe the set of interlocks, described by an AND gate in the fault tree, which must fail for the Top Event to occur (as shown on sheets 19 and 20 in fault tree in Appendix A). Since the interlocks described in Tables 6, 7 and 8 are comprised of serial components, failure of a single interlock is described by an OR gate in the fault tree which means that the interlock fails if any control element comprising the interlock fails (as shown on sheets 21 through 26 in Appendix A).

5.0 FAULT TREE CONSTRUCTION

This section describes the assumptions that were made in constructing the fault tree and the procedure by which the fault tree is constructed.

The fault tree is structured so that the undesired event appears as the Top Event in the fault tree. The sequences of events that lead to the undesired event are depicted below the Top Event and are logically linked by branches to the undesired event by standard OR and AND gates. Those events that have a more basic cause are developed further until the sequences of events finally lead to the primary causes, called basic events, for which there are failure rate data available. The basic events appear as circles and diamonds on the bottom of the fault tree and represent the limit of resolution. Basic events consist of human error, environmental conditions and equipment failure. The combination of basic events that insure occurrence of the Top Event are called the min cut sets, also known as the modes of system failure.

5.1 Assumptions

The assumptions made to construct the fault tree are listed below:

1. Only the normal modes of operation are considered, i.e., fill, standby and pumpout. Abnormal modes of operation are not considered, i.e., sump jet, transfer jet and maintenance.
2. Credit is given to the DCS in activating an interlock.

5.2 Fault Tree Construction

The fault tree top structure for the two cases considered (benzene concentration normal and high) is described in Section 3. This structure is generic in nature and mixes mode of operation.

This section describes the specific details of constructing the fault tree shown in Appendix A. One way of generating erroneous

fault tree logic is to mix modes of operation in which the initiating event, mitigating event logic or both are different, depending upon the mode of operation. Also, potential ignition sources are different. Erroneous fault trees can generate erroneous min cut sets, i.e., min cut sets that cannot cause the Top Event to occur. To avoid this error, the fault tree is constructed according to six levels, top to bottom, as described below. These levels are indicated in the fault tree in Appendix A.

- LEVEL 1 Top Event, fire or explosion within LPPT (APPT)
- LEVEL 2 Top Event, segmented according to benzene concentration
 - A. Benzene concentration normal (vapor concentration usually below LEL), 29/30 transfers
 - B. Benzene concentration high (vapor concentration always above LEL), 1/30 transfers (first 8 hours after transfer)
- LEVEL 3 Top Events further segmented according to operational phases
 - A. Fill and standby (43 hrs/44 hrs)
 - B. Pumpout (1 hr/44 hrs)
- LEVEL 4 Operational phases segmented even further according to initiating events that cause an explosive concentration to occur
 - A. Loss of normal N₂ purge (fill, standby, pumpout)
 - B. Air inleakage (1/30 transfers, all modes)
 - C. Loss of supplemental purge (pumpout)

In this step we consider mitigation logic, success criteria and ignition sources.

LEVEL 5 Inputs to fire triangle, a three-input AND gate

A. Ignition sources

i) Tank static charge (all modes)

ii) Agitator (all modes)

iii) Transfer pump (pumpout)

B. Benzene concentration below LEL (29 out of 30 transfers) or above the LEL (1 out of 30 transfers)

C. Oxygen concentration above MOC

i) Loss of normal N₂ purge (fill, standby, pumpout)

ii) Air inleakage (all modes for 1 out of 30 transfers)

iii) Loss of supplemental purge (pumpout)

LEVEL 6 Failure of mitigators, i.e., interlocks, (generates AND gates) that ameliorate the effect of initiating event, e.g.,

A. Failure to close PVS vent valve

B. Failure to provide supplemental purge

C. Failure to turn off pumps/agitators, etc.

Fault tree development of each level is discussed below. Refer to the fault tree in Appendix A for the discussion below.

5.2.1 Top Event (Level 1, Sheet 1)

The top event is fire or explosion within the low point precipitate tank (LPPT). It is assumed that this fault tree applies to the APT due to the nearly identical designs.

5.2.2 Top Event Segmented According to Benzene Concentration, Two Cases (Level 2, Sheet 1)

As described in Section 3.0, two cases are considered, batches in which the benzene concentration is normal and batches in which benzene concentration is high. When benzene concentration is normal, turning off the agitator is an important factor in the rate of benzene evolution. We use descriptor events as basic events to denote the fraction of time when the benzene concentration is initially high, 3.3%, or initially normal, 96.7%, denoted by eight digit alpha numeric names, BENZENEH and BENZENEN. For the 1 in 30 batches when the benzene concentration is initially high, the concentration is considered normal during the period after the first eight hours in the 44 hour cycle (36 hours). Hence, the benzene concentration is normal for an additional $1/30 \times 36/44 = 2.7\%$ of the time. The total fractional time the benzene concentration is normal is

$$2.7\% + 96.7\% = 99.4\% \approx 100\%$$

We round off to 100% for convenience.

In a similar manner, the fractional amount of time that benzene concentration is high is $3.3\% \times 8/44 = .6\%$.

5.2.3 Top Event Segmented According to Operations Phases (Level 3, Sheet 1)

The fault tree is further segmented according to operational phases

- fill and standby, 43 hours (30 scfm N₂ flow)
- pumpout, 1 hour (45 scfm N₂ flow).

During fill and standby, there are two potential ignition sources identified--static charge and the agitator. During pumpout, there is an additional potential ignition source, the transfer pump. Also, supplemental purge is required during pumpout for maintaining oxygen concentration below the MOC, i.e., different criteria for success. That is why there is a separate fault tree for pumpout.

5.2.4 Top Event Segmented Even Further According to Initiating Events that Cause an Explosive Concentration to Occur (Level 4, Sheets 2 and 4)

The following two initiating events can cause oxygen concentration to increase above the MOC:

1. Insufficient N₂ purge flow
2. Air inleakage.

Below we describe the reasons why the mitigating logic is different for these two initiating events.

When N₂ purge flow is insufficient, there are two interlocks which must fail for oxygen concentration to increase above the MOC:

- low-low N₂ flow interlock (Table 6)
- high oxygen concentration interlocks (Tables 7 and 8).

If the low-low N₂ flow interlock fails to close the vent valve, oxygen concentration will increase due to air inleakage and the high oxygen concentration interlocks will also attempt to close the main vent valve.

In the event of air inleakage, we consider only the high oxygen concentration interlocks activating. Note that air inleakage events are considered in the FTA only when the initial benzene concentration is above LEL. (As described in Table 5, when the initial benzene concentration is below LEL, an air inleakage maintains benzene concentration below the LEL regardless of whether the agitator is ON or OFF.)

5.2.5 Inputs to Fire Triangle (Level 5)

Levels 1 through 4 provide boundary conditions for the FTA at level 5. At this level, the conditions for fire/explosion are specified. Specifically, the individual initiating events, i.e., failures, that can cause 1) an ignition source to occur, 2) benzene

concentration to increase, and 3) oxygen concentration to increase, are specified.

5.2.6 Failure of Mitigators, e.g., Interlocks that Ameliorate the Effect of Initiating Events (Level 6)

Interlocks prevent the formation of an explosive concentration or turn off potential ignition sources when precursor conditions for an explosive concentration are detected, such as oxygen concentration 60% of MOC. For fire or explosion to occur, initiating events necessary for fire or explosion must occur and interlocks must fail given the occurrence of these initiating events.

6.0 GENERATE MIN CUT SETS

Once the fault tree is generated, the next step is to generate the min cut sets. Min cut sets, called the system modes of failure, are combinations of basic events that cause the top event to occur. The computer code FTAP was used to find the min cut sets.

By using the true/false option in FTAP, min cut sets were obtained for the following cases, the number of min cut sets are indicated in parenthesis.

1. Fire or explosion in the LPPT (75)
2. Explosive concentration in the LPPT (348)
3. Fire or explosion in the LPPT, no redundant line B present in N₂ purge line (87)
4. Explosive concentration in LPPT, no redundant line B present in N₂ purge line (357).

A cutoff value of $1 \times 10^{-12} \text{ yr}^{-1}$ was used for eliminating min cut sets in FTAP. Cases 2 and 4 assume the existence of an ignition source; the following gate events were set equal to true (the first digit denotes the sheet number, the second digit denotes the gate number):

LP-02-03
LP-03-03
LP-04-04
LP-04-05

Cases 3 and 4 assume that a single N₂ purge line exists, gate event LP-14-03 was set equal to true.

As an example of a min cut set, examine the following min cut set of order 6 which describes how fire or explosion can occur (order refers to the number of basic events in a min cut set):

8-DIGIT

NAME	BASIC EVENT DESCRIPTION
BENZENEN	BATCH BENZENE CONC NORMAL--29/30 TRANSFERS
FILLSTAN	TIME PERIOD FILL/STANDBY, 43 HRS
LAG----I	AGITATOR IGNITION SOURCE
LCBAGITD	AGITATOR MCC CONTACTS JI-7171 FAIL TO OPEN
LVIM-35C	PCV-7172A FAILS CLOSED
LVS8772K	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE (FULLY)

This min cut set contributes to 9.6% of the risk for case 3 and its rank is number 1. The first two basic events are descriptor events, i.e., this min cut set describes fire or explosion during the period in which benzene concentration is normal, i.e., below the LEL (29 out or 30 transfers) and the operational mode is fill or standby. The agitator malfunctions and is the ignition source. The agitator fails to turn off because the contacts in the control circuit that supplies power to the agitator fail to open. The agitator failing to turn off is the cause of continued benzene generation which causes benzene concentration to increase above the LEL. The regulator in the nitrogen supply line fails closed causing insufficient N₂ purge flow. The main vent valve fails to fully close permitting 2 cfm flow of air into the tank which in turn causes oxygen concentration to increase above the MOC but does not dilute the evolved benzene below the LEL.

7.0 RELIABILITY DATA

7.1 Types of Basic Events

A min cut set is a set of basic events, which is a qualitative concept, i.e., the concept does not consider probabilities of occurrence. In this section, such probabilities are considered.

Basic events in this study represented three generic types of events:

1. Human error
2. Random active component failures
3. Random passive component failures.

There are two types of human error events, latent and dynamic. If the error occurs before the occurrence of the initiating event, such as a maintenance error, then it is a latent error. If the error occurs in response to an initiating event, then the error is dynamic.

An active component refers to a component that switches or modifies energy such as pumps, valves, relays, etc. Passive components refer to components that support or contain energy--components such as pressure vessels, pipes, wires, etc. In general human error has a higher probability of occurrence than active component failures, and active component failures have a higher probability of occurrence than passive failures.

7.2 Identification of Initiating and Enabling Events

Because the PPTs are new systems, we do not have any failure data obtained from operating experience. To predict the frequency of fire or explosion we need to obtain reliability data for the basic events. To compute the top event occurrence frequency, we must compute the frequency of occurrence for the min cut sets. To do this, we first must identify two types of basic events that are contained in the min cut sets:

1. Initiating events
2. Enabling events.

Initiating events, i.e., deviation events, cause perturbations in system variables and causes the top event to occur if mitigation of the initiating event does not occur. Enabling events permit the initiating event to cause system failure and are of two types for this study:

- Pre-existing conditions required for fire or explosion to occur
- Mitigative failures, e.g., oxygen analyzer failure, operator fails to respond.

In general, the frequency of occurrence for initiating events is computed given the occurrence of the initiating event. The probability that an enabling condition is present (e.g. analyzer failure) or that an enabling event occurs (e.g. operator fails to respond) is computed. The later conditional probability is called enabling event unavailability.

7.3 Initiating Event Failure Frequency

The failure frequency is the unconditional probability of failure per unit time and the failure rate, λ , is the conditional probability of failure per unit time. Stated in other terms, the failure frequency is the average number of failures per unit time; the failure rate is the probability of failure at an instant of time t given no failure at $[0,t]$. The failure frequency of an initiating event can be estimated by λ . The failure rates used in this study are listed in Tables 9 and 10. The sources of data used in this study (in order of importance regarding applicability) are:

1. WSRS data
2. "Some Published and Estimated Failure Rates for Use in Fault Tree Analysis," called the Du Pont data in this study

3. "Offshore Reliability Data," published by OREDA participants, called the OREDA data in this study
4. "Interim Reliability Evaluation Program Procedures Guide," called the IREP data in this study
5. "The Reactor Safety Study," called WASH 1400 data in this study.

7.4 Enabling Event Unavailability

There are two types of enabling events:

1. Equipment failure
2. Human error.

Equipment failure can occur at the time of the demand (e.g., a relay failure) or prior to the demand (e.g., an analyzer failure). In the first case, failure rates on demand, λ_d , are given. In the second case, a failure rate must be specified as well as an inspection interval θ which represent the maximum amount of time a latent failure can occur, assuming perfect inspection (otherwise a latent failure can exist for a time greater than θ time units). If $\lambda \theta < .1$, then a good upper bound estimate for the average time-integrated average component unavailability is,

$$\sim \frac{\lambda \theta}{2}$$

This expression assumes that the probability of the occurrence of an initiating event is equally likely in the time interval $[0, \theta]$.

Inspection intervals of key components are listed below:

- O₂ analyzers 6852 and 6853 are inspected monthly according to manufacturer specifications.

If one O₂ analyzer fails during the run, operation is still permitted. However, operation is not permitted

when both analyzers are failed. We assume that the first failure is announced and the second failure is unannounced. This is because there are electronics in the analyzer to detect the failure. We assume that the second failure has a failure rate a factor 10 less than the first failure to allow for the detection failure within the analyzer. Reliability data in Table 9 indicates that an analyzer fails at an average frequency of once every four months. If an analyzer fails more frequently than once every four months, more frequent calibrations are required.

- Relays/interlocks in Tables 6, 7 and 8 are tested yearly and verify that all control elements work including analyzers and sensors. (This includes operation of both vent valves, i.e., it is verified that the main vent valve will close upon demand and that the bypass vent valve remains closed during operation.)

It is assumed that an inactive N_2 flow transmitter FIT-7648 [B-M-33] would be detected within one operating cycle of the failure, i.e., 44 hours. During pumpout, flow increases to 45 cfm. If flow transmitter FIT-7648 fails to sense an increase in flow, the operator would stop the transfer pump. Hence, the failure of FIT-7648 is announced.

We convert a demand failure rate, λ_d , into a time dependent failure λ by assuming the component is tested monthly, then use the following expression:

$$\lambda_d = \frac{\lambda \theta}{2}$$

If λ is given in units of hr^{-1} , then

$$\lambda(hr^{-1}) = \frac{2\lambda_d}{\theta} = \frac{2\lambda_d}{720} = \frac{\lambda_d}{360}$$

Human error can occur prior to demand, e.g., a maintenance fault where a valve is inadvertently closed or an interlock is bypassed. Human error can also occur after the demand, e.g., failure to valve in the redundant N₂ purge line. In this case the human error is a dynamic error. Key failure rates assumed for operator error are listed below:

- Interlock bypassed 1×10^{-3} /demand (WSRS data)
- Omission 10^{-2} /demand, failure to valve in redundant purge line within one hour (emergency backup procedure) [dynamic error]. This probability is based upon a time line correlation shown in Fig. 5 which is taken from Ref. 4.
- Commission 10^{-5} /hour (1/10 years), e.g., inadvertently closing an N₂ purge valve.

7.5 Ignition Source Duration Times

It is assumed that a pump or agitator can be an ignition source only when it operates. The following equipment is assumed to operate for the amount of time listed below during each 44 hour operating cycle:

PPT Agitator	44 hours
PPT Transfer Pump	1 hour

If an agitator or pump develops bad bearings, it is assumed that the agitator or pump can only operate one cycle before destruction.

It is assumed that a tank static charge occurs at a frequency of $1 \times 10^{-9} \text{ yr}^{-1}$.

8.0 PROBABILISTIC ANALYSIS

8.1 Procedure

In the PHR 32 FTA Report, the procedure was described by which fault trees were probabilistically evaluated to compute the top event occurrence frequencies, basic event and min cut set importance measures. Basically, the procedure consists of the following steps:

1. Find min cut sets. The computer code FTAP was used to do this (Section 6).
2. Identify initiating and enabling events in the fault tree (Section 7.2).
3. Find reliability data for the basic events; specify failure rates, inspection intervals, human error probabilities (Section 7).
4. Compute average top event occurrence frequency, the expected number of top event occurrences per unit time. The computer code IMPORTANCE was used to do this. This quantity was computed as a time integrated average over the 44 hour operating cycle.
5. Compute importance of initiating and enabling events and min cut sets. The computer code IMPORTANCE was used to do this. The importance results are described in Section 9.

The FTA Report for PHR 32 illustrates with a simplified example the calculations involved with the above steps.

8.2 Top Event Occurrence Frequencies

This section describes the results of the probabilistic computation for the four top events listed in Section 6.0 and in Table 11. Table 11 lists the four cases, the "total" top event occurrence

frequency (column 5) and the individual frequencies for the two cases:

A. Benzene concentration below the LEL (29/30 batches)

B. Benzene concentration above the LEL (1/30 batches).

The "total" top event occurrence frequency is the sum of frequencies for cases A and B. The annual frequency of fire or explosion is of the order $1 \times 10^{-6} \text{ yr}^{-1}$. The frequency of an explosive concentration is of the order $1 \times 10^{-4} \text{ yr}^{-1}$. This calculation assumes that an ignition source exists all the time and is an upper bound to the frequency of fire or explosion. The analysis also shows that a redundant N_2 supply line is not required.

Table 11 states that the frequency of an explosive concentration is greater when benzene liquid concentration is high (which occurs .6% of the time). However, the frequency of fire or explosion is greater when benzene liquid concentration is normal (which occurs 99.4% of the time). The reason for this seeming contradiction is that, for an explosive concentration to occur when benzene concentration is normal, requires continued benzene evolution by operation of the agitator. This means that at least one other failure is required for an explosive concentration to occur which is not required for the case in which the benzene concentration is normal.

9.0 IMPORTANCE ANALYSIS

Importance measures assess the quantitative contribution of initiating events, enabling events and min cut sets in contributing to the top event occurrence frequency. Importance measures are weighting functions with values between 0 and 1. They are conditional probabilities. Initiating event importance is the sum of the frequency of all min cut sets containing the initiating event divided by the total top event occurrence frequency. The sum of all initiating event importances are unity. It is the conditional probability that an initiating event causes the top event to occur given the occurrence of the top event. Min cut set importance is the min cut set frequency divided by the total top event occurrence frequency. It is the conditional probability that a min cut set occurs given the occurrence of the top event. The sum of all min cut set importances are also unity. Enabling event importance is the sum of the frequencies of all min cut sets containing the enabling event. Since several enabling events can occur when a min cut set occurs, the sum of enabling event importances in general exceeds unity. Importance identifies components whose failures are the most important to the risk of fire or explosion in the LPPT. The computer code IMPORTANCE was used to generate importance ranking for each of the four top events in Table 11.

The IMPORTANCE output for cases 3 and 4 in Table 11 are given in Appendices B and C.

9.1 Ranking of Initiating and Enabling Events

The ranking of initiating and enabling events and the total importance for cases 3 and 4 in Table 11 are listed in Tables 12 and 13. These cases are for explosive concentration and for fire and explosion in the LPPT without a redundant N_2 purge supply line. Basic events of total importance of greater than .01 are listed along with the inspection intervals. Note that in addition to equipment failure and human error, importance of basic events which describe batch benzene concentration

1. BENZENEH

2. BENZENEN

as well as the possible modes of operation

1. FILLSTAH

2. FILLSTAN

3. PUMPOUT-

are listed in Tables 12 and 13. In this way, we can find out which benzene concentration and which operational modes dominate the risk of fire or explosion in the LPPT.

Table 12 shows that for a given a formation of an explosive concentration, 84.2% of the time the batch benzene concentration is high (event BENZENEH) and 15.8% of the time the batch benzene concentration is normal (event BENZENEN).

However, Table 13 gives an opposite conclusion for fire and explosion; 72.2% of the time when fire or explosion occurs, benzene concentration is initially normal and 24.8% of the time benzene concentration is high. Air inleakage events rank higher in Table 12 than Table 13; the opposite conclusion is true for insufficient N₂ purge supply events.

As stated in Section 8.2, the reasons for these seeming contradictions are that, for an explosive concentration to occur when benzene concentration is initially below the LEL, requires continued benzene evolution by operation of the agitator. This means that at least one other failure is required for an explosive concentration to occur which is not required for the case in which the benzene concentration is initially above the LEL.

9.2 Min Cut Set Importance

Appendices B and C list the importance of each min cut set for cases 3 and 4 in Table 11. One feature of the computer code IMPORTANCE is that it gives the residual and cumulative importance

of min cut sets according to rank. Consider the case of fire/explosion in the LPPT without a redundant N₂ purge supply, Appendix B. As shown on page 4 of Appendix B, min cut sets of rank 1 comprise 9.6% of the top event occurrence frequency; min cut sets of rank 1 and 2 comprise 17.3% of the top event frequency, etc. The residual importances are 90.4% and 82.6% in each case. We use this feature in this study to generate "summary" fault trees that comprise 99% of the top event occurrence frequency. Summary fault trees include the most important min cut sets and are described in Section 9.3 for case 3 in Table 11.

9.3 Summary Fault Trees

This section describes the summary fault trees for fire/explosion in the LPPT without a redundant N₂ supply line, i.e., case 3 in Table 11.

The purpose of generating summary fault trees is to describe the most risk significant min cut sets in terms of a fault tree logic which bears direct resemblance to the detailed fault trees described in Appendix A. One ultimate goal of a risk study is to present insights that are qualitative in nature, i.e., without reference to probabilities. Summary fault trees accomplish this goal. In addition, summary fault trees (as well as top level fault trees) are good display tools to management who in general is not interested in the details of the analysis but want to know the dominant risk contributors.

Figure 6 displays the summary fault tree for fire or explosion in the LPPT without a redundant N₂ supply line. Figure 6 consists of 5 sheets. Gate events are coded to an alphanumeric scheme starting with three letters SFE. For example, to understand this coding scheme, SFE--1-2, represents gate 2 on sheet 1.

On sheet 1, the fault tree is segmented according to batch concentration:

- Fire or explosion within the LPPT -- batch benzene concentration normal, 29/30 transfers, gate event SFE--1-2

- Fire or explosion within the LPPT -- batch benzene concentration high, 1/30 transfers, gate event SFE--1-2.

9.3.1 High Benzene Concentration Case

We discuss the high benzene concentration case first. In this case, it is always assumed that the benzene concentration is always above the LEL. The initiating events which dominate the risk are air inleakages, as described by gate event SFE--1-6. (Note that this case is similar to the 1991 FTA; however, the set of interlocks considered in this study is different.) When there is a high oxygen concentration in the LPPT (60% of MOC), then according to the interlocks listed in Tables 7 and 8, the main vent valve should close and the agitator and transfer pump, if running, should be turned off. The air inleakage events, which are initiating events in causing oxygen concentration to increase, are listed in sheet 5. The types of air inleakage events are:

- air leakage through Hanford connectors
- air leakage through flanges
- air leakage through sump jet, loss of sump seal.

As described by the development of gate SFE--5-3, failure of the operator to replenish water in the sump can result in loss of sump seal if either the operator ignores the low level alarm or the sump pump bubbler level indication fails.

We now discuss the failure of the interlocks to close the main vent valve and to turn off the agitator. As described on sheet 4, failure of these interlocks are dominated by the same set of events:

- oxygen analyzers inactive
- transmitter inactive
- block valves to analyzers closed (due to human error).

9.3.2 Normal Benzene Concentration Case

The summary fault tree development for the case in which the benzene concentration is initially normal is given on sheet 2. Two time periods are included:

1. Fill/Standby (F/S)
2. Pumpout (P).

As described in Table 5, case 2B, the initiating event to be considered for this case is insufficient N_2 purge supply. This event causes both oxygen and benzene concentration to increase. For an explosive concentration to result, air inleakage cannot significantly exceed 2 cfm, otherwise air inleakage would dilute the benzene concentration below the LEL. The two air inleakage events considered in the FTA are:

1. Bypass valve open and main vent valve closed
2. Main vent valve partially open and bypass vent valve closed.

It is assumed that with insufficient N_2 purge supply, that the PVV exhaust fans remain ON, maintain a vacuum on the LPPT and suck air through the LPPT connections which are not leak tight. In addition, in order for benzene concentration to increase above the LEL, it is required that the agitator remain ON in order to achieve sufficient benzene evolution.

With insufficient N_2 purge supply, the interlocks that can
1) prevent benzene concentration to increase above the LEL and
2) turn off the potential agitator ignition source are interlocks which turn off the agitator, i.e, interlocks 2, 6, 7, 12 and 13 listed in Table 8.

The initiating events that cause insufficient N_2 purge supply are listed on sheet 3 in Fig. 6. There are four types of events listed:

1. Insufficient flow through normal supply line, gate event SFE--3-2
2. Flow diversion causes insufficient N₂ purge supply, gate event SFE--3-3
3. Insufficient flow through branch A, gate event SFE--3-4
4. Vaporizer fails to provide heat.

Note that with a redundant N₂ supply line (case 1 in Table 11), gate event SFE--3-4 would not appear as a dominant cause of insufficient N₂ purge supply. Basic events on sheet 2 that apply to both modes of operation, i.e, fill/standby and pumpout are denoted by "F/S & P" below the basic event description. Those basic events that only apply to fill/standby are simply denoted by "F/S."

The dominant cause of failing to turn off the agitator is the basic event LCBAGITD, "Agitator MCC contacts fail to open." In addition, it is important to note that the agitator must malfunction to be an ignition source, denoted by basic event LAG----I, "Agitator Ignition Source."

10.0 CONCLUSIONS, RECOMMENDATIONS AND RESULTS

A probabilistic fault tree analysis (FTA) was conducted to assess the annual frequency of a benzene/air fire/explosion within two precipitate pump tanks, the auxiliary precipitate tank (APT) and the low point precipitate tank (LPPT). The purpose of the study is to assess the adequacy of the design proposed in this report in preventing fire or explosion within these tanks, i.e., specifically compute the frequency of fire or explosion and determine if it is less than the design goal of 1×10^{-4} per year.

The fault tree in Appendix A was segmented according to the batch benzene concentration:

- Benzene concentration high, assumed to occur in 1 out of 30 transfers
- Benzene concentration normal, assumed to occur in 29 out of 30 transfers.

Table 11 states that the frequency of an explosive concentration is greater when benzene concentration is high (which occurs .6% of the time). However, the frequency of fire or explosion is greater when benzene concentration is normal (which occurs 99.4% of the time). The reason for this seeming contradiction is that, for an explosive concentration to occur when benzene concentration is normal, continued benzene evolution by operation of the agitator is required. This means that at least one other failure is required for an explosive concentration to occur which is not required for the case in which the benzene concentration is initially above the LEL.

The annual frequency of the following Top Events were computed, annual frequencies are indicated in parenthesis:

1. Fire or explosion in the LPPT with redundant N_2 line ($2.4 \times 10^{-6} \text{ yr}^{-1}$)
2. Explosive concentration in the LPPT with redundant N_2 line ($1.3 \times 10^{-4} \text{ yr}^{-1}$)

3. Fire or explosion in the LPPT without redundant N₂ line ($3.4 \times 10^{-6} \text{ yr}^{-1}$)
4. Explosive concentration in LPPT without redundant N₂ line ($1.4 \times 10^{-4} \text{ yr}^{-1}$).

We see that the frequency of an explosive concentration is of the order of $1.0 \times 10^{-4} \text{ yr}^{-1}$. This assumes that an ignition source exists all the time and is an upper bound on the frequency of fire and explosion. We also see that the frequency of fire or explosion within the LPPT is of the order of $1.0 \times 10^{-6} \text{ yr}^{-1}$ which is a factor of 100 less than that the numeric goal of $1.0 \times 10^{-4} \text{ yr}^{-1}$. In addition, a redundant N₂ purge supply line is not required.

The assumptions made in the FTA are listed below:

Fault Tree Construction --

1. Only the normal modes of operation are considered, i.e., fill, standby and pumpout. Abnormal modes of operation are not considered, i.e., sump jet, transfer jet and maintenance.
2. Credit is given to the DCS in activating an interlock.

Inspection Intervals and Calibration Frequencies --

3. O₂ analyzers are inspected monthly according to manufacturer specifications.

If one O₂ analyzer fails during the run, operation is still permitted. However, operation is not permitted when both analyzers are failed. We assume that the first failure is announced and the second failure is unannounced. This is because there are electronics in the analyzer to detect the failure. We assume that the second failure has a failure rate a factor 10 less than the first failure to allow for the detection failure within the analyzer. Reliability data in Table 9 indicates that an analyzer fails at an average frequency of once every four months. If an analyzer fails more

frequently than once every four months, more frequent calibrations are required.

4. Relays/interlocks in Tables 6, 7 and 8 are tested yearly and verify that all control elements work including analyzers and sensors. (This includes operation of both vent valves, i.e., it is verified that the main vent valve will close upon demand and that the bypass vent valve remains closed during operation.)
5. The bubbler level indicator for the sump is calibrated monthly.
6. It is assumed that an inactive N₂ flow transmitter FIT-7648 [B-M-33] would be detected within one operating cycle of the failure, i.e., 44 hours. During pumpout, flow increases to 45 cfm. If flow transmitter FIT-7648 fails to sense an increase in flow, the operator would stop the transfer pump. Hence, the failure of FIT-7648 is announced.

Operation of the bypass vent valve should be under administrative control. If left open, it could be a source of air inleakage since it is in parallel with the main vent valve. If the bypass vent valve is opened, there should be an independent check to verify that this valve is closed.

In order that the failure of the N₂ flow transmitter be announced, it is recommended that the DCS be programmed to generate an alarm if any of the following false indications occur:

1. FIT-7648 does not indicate a nominal value of 30 cfm during all time periods except pumpout
2. FIT-7648 does not indicate a nominal value of 45 cfm during pumpout.

REFERENCES

1. PHR #1, "Process Hazards Review, System No. 1, Interarea Transfer System."
2. "Supporting Estimates for the Pump Pit Fault Tree Analysis," D.H. McGuire to H.K. Bethmann, OPS-DTC-920012, April 29, 1992.
3. PHR #32, "Process Hazards Review, System No. 32, Precipitate Processing Facilities."
4. A.D. Swain and H.E. Guttman, "Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications," Sandia National Laboratories, Report NUREG/CR-1278 (1983).
5. "Benzene Evolution from Precipitate Slurry Pump Pit Tanks," E.W. Holtzscheiter to C.B. Jones, WSRC-TR-91-0478TL, August 15, 1991.

TABLES

TABLE 1 -- DESIGN B
RECOMMENDED PUMP PIT DESIGN MODIFICATIONS
1991 FTA STUDY

CHANGE DESCRIPTION	COMMENTS
Add PVV Block Valve No. 1	Spring Return Fail Closed Valve, N2 Operated (3" Plug Valves)
Add PVV Block Valve No. 2	Spring Return Fail Closed Valve, N2 Operated
Add Hardwired Interlocks to O2 Analyzer 1	Ensure that no single device failure can compromise design (relay, etc.)
Add Hardwired Interlocks to O2 Analyzer 2	Ensure that no single device failure can compromise design (relay, etc.)
Add LEL Analyzer to PVV System	Ensure that no single device failure can compromise design (relay, etc.)
Add Isolation Valve on Sump Inlet to Precipitate Tank	Valve to be located as near as practical to tank nozzle to minimize potential leaks (isolating discharge line of pump jet)
Change Nitrogen Purge Valve from Air Operated to N2 Operated (Leakage in Diaphragm)	Not Part of Hardwired Circuit Requirements
Change Sump Jet Gas from Air to N2	
Add Hardwired Interlocks from Both O2 Analyzers and LEL Analyzer to Close Both PVV Block Valves and Stop Operation of the Agitator and Transfer Pumps	Fault Signal After Every Transfer, Circuit Test
Add New Transfer Pump for Backup Transfer in Place of Steam Jet Transfer of Tank Contents	Recommendation Derived from Interarea Pipeline Design Temperature of 70°C Maximum

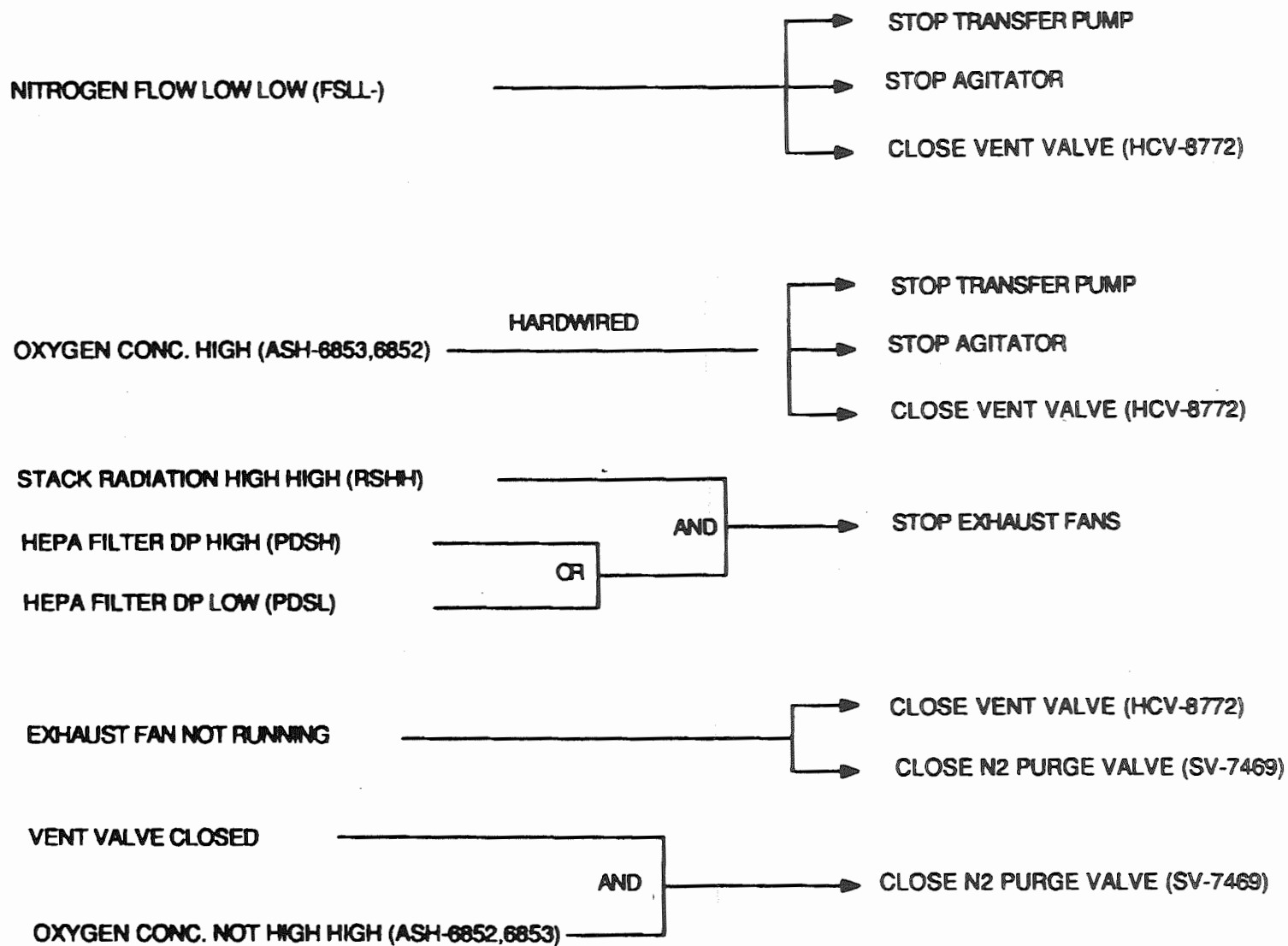
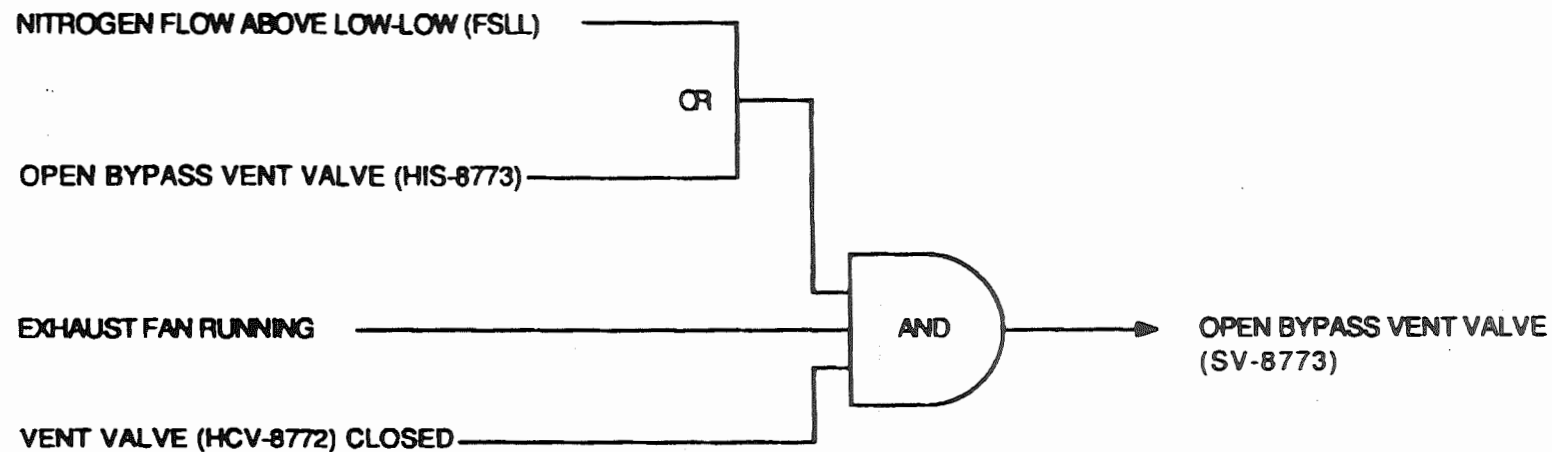


TABLE 2 -- INTERLOCKS FOR THE PRECIPITATE PUMP TANKS



EXAMPLE (NOT ACTUAL SETPOINTS):

SUPPLEMENTAL N ₂	15 SCFM
NORMAL N ₂	27
BYPASS N ₂	3

USUAL FLOW IS 30 SCFM, LOW-LOW FLOW IS ABOUT 4 SCFM

TABLE 3 -- LOGIC FOR BYPASS VENT VALVE SV-8773

TABLE 4 -- LIST OF DRAWINGS
LPPT - FTA

LETTER DESIGNATOR	DRAWING NUMBER	REVISION NUMBER	TITLE
A	W 750040	17	LOW POINT PRECIPITATE TANK (SHT 1 OF 2)
B	W 750041	16	LOW POINT PRECIPITATE TANK (SHT 2 OF 2)
C	W 751745	6	BACKUP NITROGEN SYSTEM
D	W 751650	28	NITROGEN SUPPLY SYSTEM
E	W 751008	12	BULK NITROGEN SYSTEM
F	W 750152	14	LOW POINT PROCESS VENT (SHT 1 OF 3)
G	W 750494	4	LOW POINT PROCESS VENT (SHT 3 OF 3)
H	W 750294	13	LOW POINT PROCESS VENT (SHT 2 OF 3)
I	W 751674	14	LOW PRESSURE STEAM/CONC HEADER PIPING
J	W 751630	8	STEAM DISTRIBUTION AND PRESSURE REDUCTION
K	W 751631	12	STEAM OSOH DISTRIBUTION
L	W 751632	13	STEAM OSOH DISTRIBUTION
M	W 750042	11	LOW POINT PRECIPITATE PUMP CELL
N	W 750155	15	LOW POINT PUMP PIT SERVICES
O	W 766000	1	LOW POINT PROCESS VENT VALVES CONTROL LOGIC DIAGRAM
P	W 766673	2	LOW POINT PRECIPITATE TANK NITROGEN PURGE BYPASS VALVE
Q	W 767046	13	LOW POINT PRECIPITATE PUMP TANK TRANSFER PUMP
R	W 767047	6	LOW POINT PRECIPITATE PUMP TANK AGITATOR
S	W 769309	1	LCS-281 ARRANGEMENT AND WIRING LOW POINT PUMP PIT

**TABLE 5 -- CONDITIONS REQUIRED FOR AN EXPLOSIVE CONCENTRATION
AGITATION/NO AGITATION**

When benzene concentration in the precipitate is normal, the following assumptions may be made in the event that the nitrogen purge is lost to the precipitate pump tank.

Assume the normal response time for an operator to valve in the redundant nitrogen supply line is 30 minutes.

SUBCASE	AIR INLEAKAGE (cfm)	POSSIBLE VENT VALVE POSITIONS	TIME REQUIRED TO REACH LEL (minutes)	TIME REQUIRED TO REACH MOC (minutes)
Case 1: With no agitation of the Precipitate Pump Tank				
A	0	Bypass vent valve closed Main vent valve closed	1500	infinite
B	2	Bypass vent valve open Main vent valve closed or Bypass vent valve closed Main vent valve partially open	>1500	67
C	10	Main vent valve fully open	infinite	13
Case 2: With agitation of the Precipitate Pump Tank				
A	0	Bypass vent valve closed Main vent valve closed	35	infinite
B	2	Bypass vent valve open Main vent valve closed or Bypass vent valve closed Main vent valve partially open	44	67
C	10	Main vent valve fully open	infinite	13

TABLE 6 -- INTERLOCK SUMMARY

LO-LO N2 FLOW (SOFTWARED, DCS DEPENDENCY)

INTERLOCK NUMBER	FUNCTION	SENSOR	INTERMEDIATE CONTROL ELEMENTS	FINAL CONTROL ELEMENT
1	CLOSE VENT VALVE (HCV-8772)	FIT - 7468	HIS - 7468, DCS	HCV - 8772
2	STOP AGITATOR	FIT - 7468	HIS - 7468, DCS	JI - 7171
3	STOP TRANSFER PUMP	FIT - 7468	HIS - 7468, DCS	JI - 7162

TABLE 7 -- INTERLOCK SUMMARY (HARDWIRED)

OXYGEN CONCENTRATION HIGH (ASH--6853, ASH--6852)

INTERLOCK NUMBER	FUNCTION	ANALYZER	INTERMEDIATE CONTROL ELEMENTS	FINAL CONTROL ELEMENT
4	CLOSE VENT VALVE (HCV-8772)	AE - 6852	AIT - 6852 ASH - 6852 RELAY - 281	HCV - 8772
5	CLOSE VENT VALVE (HCV-8772)	AE - 6853	AIT - 6853 ASH - 6853 RELAY - 281	HCV - 8772
6	STOP AGITATOR	AE - 6852	AIT - 6853 ASH - 6853 RELAY - 281	JI - 7171
7	STOP AGITATOR	AE - 6853	AIT - 6853 ASH - 6853 RELAY - 281	JI - 7171
8	STOP TRANSFER PUMP	AE - 6852	AIT - 6853 ASH - 6853 RELAY - 281	JI - 7162
9	STOP TRANSFER PUMP	AE - 6853	AIT - 6853 ASH - 6853 RELAY - 281	JI - 7162

TABLE 8 -- INTERLOCK SUMMARY (SOFTWIRED, DCS DEPENDENCY)

OXYGEN CONCENTRATION HIGH (ASH--6853, ASH--6852)

INTERLOCK NUMBER	FUNCTION	ANALYZER	INTERMEDIATE CONTROL ELEMENTS	FINAL CONTROL ELEMENT
10	CLOSE VENT VALVE (HCV-8772)	AE - 6852	AIT - 6852 DCS	HCV - 8772
11	CLOSE VENT VALVE (HCV-8772)	AE - 6853	AIT - 6853 DCS	HCV - 8772
12	STOP AGITATOR	AE - 6852	AIT - 6853 DCS	JI - 7171
13	STOP AGITATOR	AE - 6853	AIT - 6853 DCS	JI - 7171
14	STOP TRANSFER PUMP	AE - 6852	AIT - 6853 DCS	JI - 7162
15	STOP TRANSFER PUMP	AE - 6853	AIT - 6853 DCS	JI - 7162

TABLE 9 -- COMPONENT CODES WITH FAILURE RATES

COM- PONENT CODE	COMPONENT	AVERAGE FAILURE RATE*	(REF, PAGE)	COMMENTS REGARDING FAILURE MODES
AG	Agitator	3.0 E-4 H	(duPont,19)	Reduced by a factor of 10 for pumps
AI	Analyzer	3.4 E-4 H 3.4 E-5 H	(duPont,4)	Announced/inactive Unannounced/inactive
BA	Battery	1.4 E-6 H	(duPont,7)	Dead
BL	Blower	7.6 E-5 H	(duPont,7)	Fails to run
BS	BUS AC	1.0 E-8 H	(IREP,127)	
BS	BUS DC			
CB	Circuit Breaker	3.0 E-3 D	(IREP,127)	Fails to transfer
CD	Condenser (Vent)	6.9 E-6 H	(duPont,33)	
CH	Chiller	6.9 E-6 H	(duPont,33)	Reactor cooler
CL	Control Logic Diagram	3.0 E-6 H	(IREP,128)	Inactive
CN	Controller	2.1 E-4 H 2.1 E-5 H	(duPont,11)	Inactive Inactive/solid state controller
CP	Computer (Digital)	2.0 E-5 H	SRP Data	
CV	Check Valve	1.2 E-6 H 1.0 E-4 D	(duPont,48) (duPont,48)	Leakage Fails to open
DA	Damper Isolation	2.0 E-5 H 3.0 E-3 D	(OREDA,279)	Inadvertantly closes Failure to close on demand
DC	Ditch Covers			
DG	Diesel Generator	3.0 E-2 D 0.19	(IREP,128)	DG fails to start 2nd DG fails to start given 1st DG fails to start
DO	Detector Optical	1.5 E-5 H	(duPont,38)	
DP	Dip Tube	1.3 E-6 H		Leaks
DT	Detector Thermistor	1.5 E-5 H	(duPont,38)	
FL	Flange	1.3 E-6 H	SRP Data	Leaks
FR	Filter	1.0 E-6 H	(duPont,14)	Plugged

COM- PONENT CODE	COMPONENT	AVERAGE FAILURE RATE*	(REF, PAGE)	COMMENTS REGARDING FAILURE MODES
HC	Hanford Connector	1.3 E-6 H	SRP Data	Leaks
HE	Heater			
HX	Heat Exchanger	1.5 E-5 H	(duPont, 33)	Fouled
IA	Instrument Alarm Flow			
IC	Instrument Connections			
IN	Inverter	1.0 E-4 H	(IREP, 128)	
IP	I/P Transducer	6.4 E-5 H	(duPont, 43)	
IT	Interlock	1.0 E-4 D	(duPont, 23)	
		1.0 E-3 D	SRP Data	Bypassed
LOSP	Offsite Power	0.33 Y	SRP Data	
LS	Limit Switch	1.0 E-4 D	(IREP, 127)	Fails to open/close
		1.2 E-6 H	(duPont, 40)	Transfers open/close
LV	Vent Lines			
N2	Nitrogen Supply	1.0 E-5 H	FTA	Loss of supply
NZ	Nozzle	2.7 E-7 H	(OREDA, 99)	Plugged
PE	Panel Electrical	3.0 E-6 H	(IREP, 128)	
PI	Pipe	9.0 E-9 H	(IREP, 129)	Plug/rupture
	Steam Coil	6.0 E-6 H	(duPont, 36)	
PP	Pump	5.7 E-5 H	(duPont, 34)	Fails to run
		3.0 E-3 D	(IREP, 126)	Fails to start
PT	Seal Pot	1.0 E-2		Dry
RE	Rectifier	1.0 E-6 H	(IREP, 128)	Loss of function
RY	Relay	3.0 E-6 H	(IREP, 128)	Transfer open
		3.0 E-4 D	(IREP, 128)	Fails to open on demand
SE	Seast (Gaskets)	2.5 E-5 H	(WASH1400)	Leakage
SF	Sensor Flow	7.8 E-5 H	(duPont, 15)	Inactive
SL	Sensor Level	2.0 E-4 H	(duPont, 23)	Inactive
SP	Pressure Sensor	3.4 E-4 H	(duPont, 31)	Inactive
ST	Sensor Temperature	3.3 E-5 H	(duPont, 42)	Inactive
SW	Switch	3.0 E-5 H	(IREP, 129)	Inactive
TA	Temperature Alarm	1.9 E-4 H	(duPont,)	Inactive

COM- PONENT CODE	COMPONENT	AVERAGE FAILURE RATE*	(REF, PAGE)	COMMENTS REGARDING FAILURE MODES
TI	Agastat Relay	3.3 E-5 H	(duPont, 42)	Inactive
TK	Tank	7.3 E-10H	(duPont, 37)	Rupture
TM	Thermistor, Probe	8.0 E-6 H	FRADA	Inactive
TW	Cooling Tower		(duPont, 54)	
VA	Valve Gate	3.0 E-3 D	(IREP, 126)	Fails to open/close
		8.3 E-6 H		
VB	Butterfly Valve	2.3 E-5 H	(duPont, 48)	
VD	Drain Valve			
VF	Fire Water Valve	2.4 E-2 D	(OREDA, 97)	Fails to open
VG	Valve Globe			
VI	Pressure Control Valve	1.6 E-5 H	(duPont, 49)	Low flow
VK	Block Valve	3.0 E-3 D	(IREP, 126)	Fails to open/close
		8.3 E-5 H		
VL	Flow Control Valve	6.2 E-5 H	(duPont, 48)	Stick open (fails to close)
		2.2 E-6 H		Fails closed
		3.0 E-3 D	(IREP, 126)	Failure to open or close on demand
		8.3 E-6 H		
VM	Motor Operated Valve	3.0 E-3 D	(IREP, 126)	Fails to open/close
		1.0 E-7 H	(IREP, 126)	Failure to remain open
VO	Valve Pilot			
VP	Valve Plug			
VP	Vaporizer	6.9 E-6 H	(duPont, 32)	
VS	Valve Solenoid	1.0 E-3 D	(duPont, 52)	Fails to open
		1.2 E-5 H	(duPont, 47)	Transfers closed
VT	Needle Valve			
VX	Check Valve	1.0 E-4 D	(IREP, 126)	Fails to open per demand
VY	Valve Pressure Relief	2.0 E-9 H	(duPont, 51)	Fails open
VZ	Strainer Valve	2.8 E-7 H		Plugged

* H means per hour
Y means per year
D means per demand

TABLE 10 -- FAILURE MODE CODES WITH FAILURE RATES

CODE	FAILURE MODE	FAILURE RATE*	(REF, PAGE)	APPLICABLE COMPONENT
A	Does Not Start			
B	Open Circuit			
C	Closed Valve	2.2 E-6 H	(duPont, 49)	Control valve
D	Does Not Open			
E	Engaged			
F	Loss of function			
G	Disengaged			
H	Heat Exchanger Fouled			
I	Ignition Source	1.1 E-6 H	(duPont, 19)	Motor
		3.0 E-3 H	(duPont, 14)	Pump
		3.0 E-4 H	Assumed	Agitator with Hg Seals
		3.0 E-4 H	Assumed	Blower
		1.1 E-5 H	Assumed	Heater
J	Short Across			
K	Does Not close			
L	Leakage	4.0 E-7 H	(duPont, 28)	Pipe
M	Exceeds Limit			
N	No input			
O	Open Valve	6.2 E-5 H	(duPont, 49)	Control valve
P	Plugged	6.0 E-6 H	(duPont, 30)	Process piping
Q	Shortage to Power			
R	Rupture	6.0 E-6 H	(duPont, 37, 38)	Process piping
S	Short to Ground			
T	Operator Error (Omission)	1.0 E-2 D		Following an accident
U	Operator Error (Comission)	1.0 E-5 H		During normal operation, no independent check of error
		1.0 E-7 H		With independent check of error

CODE	FAILURE MODE	FAILURE RATE*	(REF, PAGE)	APPLICABLE COMPONENT
V	Does Not Run			
W	Does Not Actuate			
X	Maintenance Fault	1.0 E-4 D		Closed manual valve
		4.6 E-6 H		Closed manual valve
Y	Fails Low			
Z	Fails High			
1	Inadvertently Actuates			
2	Works as Intended			
3	Conditional Event			

* H means per hour
D means per demand

TABLE 11 -- RESULTS
PROBABILISTIC ANALYSIS

CASE NO.	DESCRIPTION	A ANNUAL FREQUENCY 29/30 BATCHES	B ANNUAL FREQUENCY 1/30 BATCHES	TOTAL ANNUAL FREQUENCY (A + B)
1	FIRE/EXPLOSION LPPT	$1.53 \times 10^{-6} \text{ YR}^{-1}$	$8.69 \times 10^{-7} \text{ YR}^{-1}$	$2.4 \times 10^{-6} \text{ YR}^{-1}$
2	EXPLOSIVE CONCENTRATION LPPT	$1.30 \times 10^{-5} \text{ YR}^{-1}$	$1.17 \times 10^{-4} \text{ YR}^{-1}$	$1.3 \times 10^{-4} \text{ YR}^{-1}$
3	FIRE/EXPLOSION LPPT WITHOUT REDUNDANT N ₂ SUPPLY	$2.56 \times 10^{-6} \text{ YR}^{-1}$	$8.43 \times 10^{-7} \text{ YR}^{-1}$	$3.4 \times 10^{-6} \text{ YR}^{-1}$
4	EXPLOSIVE CONCENTRATION LPPT WITHOUT REDUNDANT N ₂ SUPPLY	$2.21 \times 10^{-5} \text{ YR}^{-1}$	$1.18 \times 10^{-4} \text{ YR}^{-1}$	$1.4 \times 10^{-4} \text{ YR}^{-1}$

TABLE 12 -- IMPORTANCE RANKING BASIC EVENTS EXPLOSIVE CONCENTRATION WITHOUT REDUNDANT SUPPLY $1.4 \times 10^{-6} \text{ YR}^{-1}$

8-DIGIT NAME	LOCATION INDEX	IMPORTANCE VALUE				INSPECTION INTERVAL **	FULL BASIC EVENT DESCRIPTION
		INITIATOR* (1)	ENABLER (2)	TOTAL (1) + (2)	RANK TOTAL		
FILLSTAH			.842	0.842	1	N/A	TIME PERIOD FILL/STANDBY FIRST 8 HOURS
LC6H6UEL			.842	0.842	1	N/A	BENZENE CONC IN LPPT BETWEEN LEL AND UEL
BENZENEH			.841	0.841	2	N/A	BATCH BENZENE CONC HIGH--1/30 TRANSFERS
LVS8772K			.484	0.484	3	1 YEAR	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE
LSV8773O			.387	0.387	4	1 YEAR	BYPASS VENT VALVE SV-8773 FAILS OPEN
BENZENEN			.158	0.158	5	N/A	BATCH BENZENE CONC NORMAL--29/30 TRANSFERS
LCBAGITD			.157	0.157	6	N/A	AGITATOR MCC CONTACTS JI-7171 FAIL TO OPEN
FILLSTAN			.154	0.154	7	N/A	TIME PERIOD FILL/STANDBY 43 HOURS
LFLVENTO	[A-W-15]	.133		0.133	8	ANNOUNCED	AIR LEAK THRU VENT VALVE FLANGE
LVPVENTO	[A-W-15]	.133		0.133	8	ANNOUNCED	LPPT OVERFLOW VALVE FAILS OPEN
LHC1027L		.122		0.122	9	ANNOUNCED	AIR LEAK THRU 1 OF 27 HANFORD CONNECTORS
LVIM-35C	[B-M-35]	.122		0.122	9	ANNOUNCED	PCV-7172A FAILS CLOSED
LVS7469C	[B-M-29]	.092		0.092	10	ANNOUNCED	SV-7469 FAILS CLOSED
LVTSVNSC	[B-M-29]	.092		0.092	10	ANNOUNCED	SV-74 FAILS CLOSED--NORMAL SUPPLY NEEDLE VALVE
LSV8773X			.074	0.074	11	N/A	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE
LVGM-28X	[B-M-28,31]	.070		0.070	12	ANNOUNCED	OPERATOR CLOSES ANY 1 OF 2 MANUAL VALVES
LVGM-34X	[B-M-34,37]	.070		0.070	12	ANNOUNCED	BRANCH A MANUAL VALVES ANY 1 OF 2
LOPH20-T		.059		0.059	13	1 MONTH	OPERATOR FAILS TO REPLENISH SUMP WATER

* A blank indicates that the event is an enabling event only

** Announced failure means that the failure is detected when it occurs

		IMPORTANCE VALUE					
8-DIGIT NAME	LOCATION INDEX	INITIATOR* (1)	ENABLER (2)	TOTAL (1) + (2)	RANK TOTAL	INSPECTION INTERVAL **	FULL BASIC EVENT DESCRIPTION
LUA6852F			.053	0.053	14	1 MONTH	O2 ANALYZER 6852 INACTIVE
LUA6853F			.051	0.051	15	1 MONTH	O2 ANALYZER 6853 INACTIVE
1SLSUMPF			.048	0.048	16	1 MONTH	SUMP PUMP BUBBLER INACTIVE
LP-BUBBL	[A-V-31,34] [A-V-31,34]	.027		0.027	17	ANNOUNCED	BUBBLER JUMPER LEAK ANY 1 OF 4 FLOW DIVERSIONS
LHCN2LPL		.020		0.020	18	ANNOUNCED	LPPT N2 JUMPER LEAK ANY 1 OF 2

* A blank indicates that the event is an enabling event only

** Announced failure means that the failure is detected when it occurs

TABLE 13 -- IMPORTANCE RANKING BASIC EVENTS FIRE/EXPLOSION WITHOUT REDUNDANT N2 SUPPLY $3.4 \times 10^{-6} \text{ YR}^{-1}$

8-DIGIT NAME	LOCATION INDEX	IMPORTANCE VALUE				INSPECTION INTERVAL **	FULL BASIC EVENT DESCRIPTION
		INITIATOR* (1)	ENABLER (2)	TOTAL (1) + (2)	RANK TOTAL		
LAG---I	[B-X-17]	.494	.506	1.000	1	44 HOURS	AGITATOR IGNITION SOURCE
LCBAGITD			.759	0.759	2	DEMAND	AGITATOR MCC CONTACTS JI-7171 FAIL TO OPEN
BENZENEN			.752	0.752	3	N/A	BATCH BENZENE CONC NORMAL--29/30 TRANSFERS
FILLSTAN			.737	0.737	4	N/A	TIME PERIOD FILL/STANDBY 43 HRS
LVS8772K			.391	0.391	5	1 YEAR	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE
LSV8773O			.310	0.310	6	1 YEAR	BYPASS VENT VALVE SV-8773 FAILS OPEN
LC6H6UEL			.248	0.248	7	N/A	BENZENE CONC BETWEEN LEL AND UEL
BENZENEH			.248	0.248	7	N/A	BATCH BENZENE HIGH--1/30 TRANSFERS
FILLSTAH			.248	0.248	7	N/A	TIME PERIOD FILL/STANDBY FIRST 8 HOURS
LUA6852F			.239	0.239	8	1 MONTH	O2 ANALYZER 6852 INACTIVE
LUA6853F			.232	0.232	9	1 MONTH	O2 ANALYZER 6853 INACTIVE
LVIM-35C	[B-M-35]	.097	.097	0.194	10	ANNOUNCED	PCV-7172A FAILS CLOSED
LVTSVNSC	[B-M-29]	.073	.073	0.146	11	ANNOUNCED	SV-74 FAILS CLOSED--NORMAL SUPPLY NEEDLE VALVE
LVS7469C	[B-M-29]	.073	.073	0.146	11	ANNOUNCED	SV-7469 FAILS CLOSED
LFRBR-AP	[B-M-36]	.059	.059	0.118	12	ANNOUNCED	BRANCH A FILTER PLUGGED
LVGM-34X	[B-M-34,37]	.055	.055	0.110	13	ANNOUNCED	BRANCH A MANUAL VALVES CLOSED ANY 1 OF 2
LVGM-28X	[B-M-28,31]	.055	.055	0.110	13	N/A	OPERATOR CLOSSES ANY 1 OF 2 MANUAL VALVES
LVPVENTO	[A-W-15]	.037	.037	0.074	14	ANNOUNCED	LPPT OVERFLOW VALVE FAILS OPEN

* A blank indicates that the event is an enabling event only

** Announced failure means that the failure is detected when it occurs

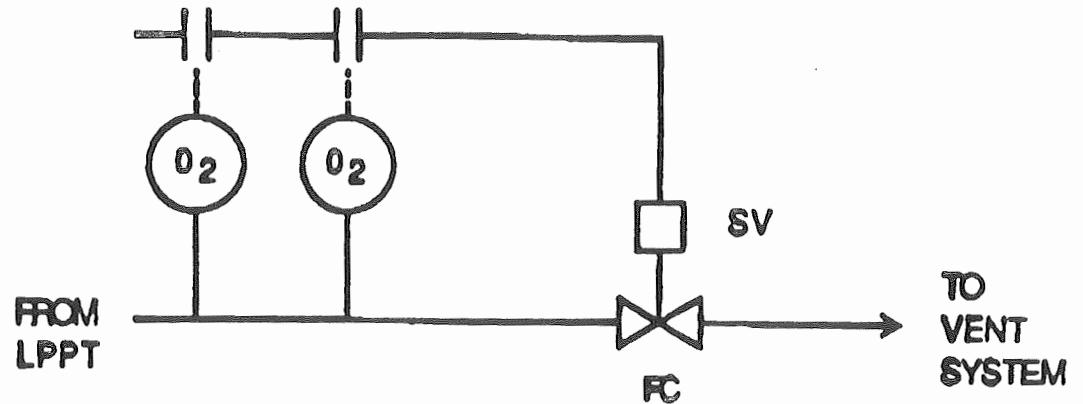
		IMPORTANCE VALUE					
8-DIGIT NAME	LOCATION INDEX	INITIATOR* (1)	ENABLER (2)	TOTAL (1) + (2)	RANK TOTAL	INSPECTION INTERVAL **	FULL BASIC EVENT DESCRIPTION
LFLVENTO	[A-W-15]	.037	.037	0.074	14	ANNOUNCED	AIR LEAK THRU VENT VALVE FLANGE
LHC1027L		.033	.034	0.067	15	ANNOUNCED	AIR LEAK THRU 1 OF 27 HANFORD CONNECTORS
LSV8773X			.058	0.058	16	N/A	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE
LVDSUPPX		.025	.025	0.050	17	ANNOUNCED	DRAIN VALVE SUPPLEMENTAL LINE LEFT OPEN
LHCN2LPL		.016	.016	0.032	18	ANNOUNCED	LPPT N2 JUMPERS LEAK ANY 1 OF 2
PUMPOUT-			.015	0.015	19	N/A	TIME PERIOD PUMPOUT
1SLSUMPF			.013	0.013	20	1 MONTH	SUMP PUMP BUBBLER INACTIVE
LOPH20-T		.012		0.012	21	1 MONTH	OPERATOR FAILS TO REPLENISH SUMP WATER

* A blank indicates that the event is an enabling event only
 ** Announced failure means that the failure is detected when it occurs

FIGURES

DESIGN A

CURRENT BASIS: High O₂ reading by either analyser will open circuit to SV, allowing SV to close.



DESIGN B

PROPOSED CHANGE: Add an LEL and a series block valve to improve improve reliability of isolating LPPT from vent system.

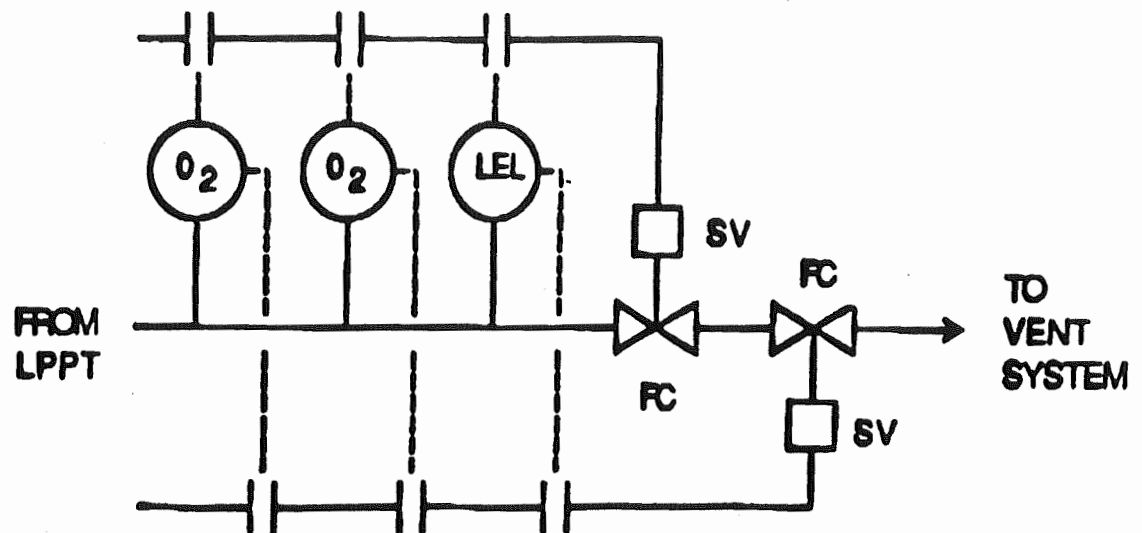


FIGURE 1 -- DESIGN CHANGES PROPOSED BY 1991 FTA STUDY

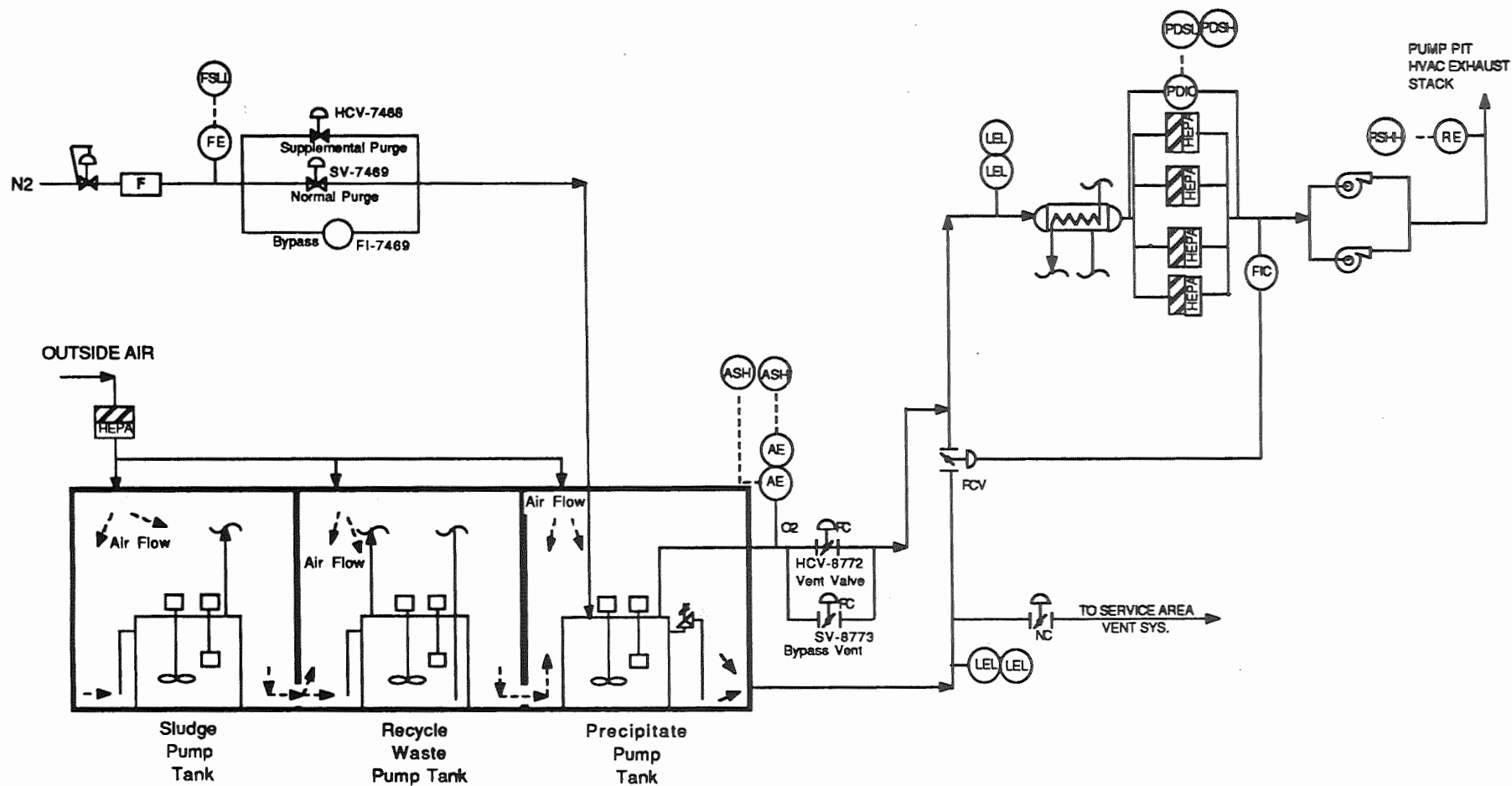


FIGURE 2 -- SALIENT FEATURES OF THE PROPOSED DESIGN
FOR THE PRECIPITATE PUMP TANKS

BENZENE CONCENTRATION NORMAL

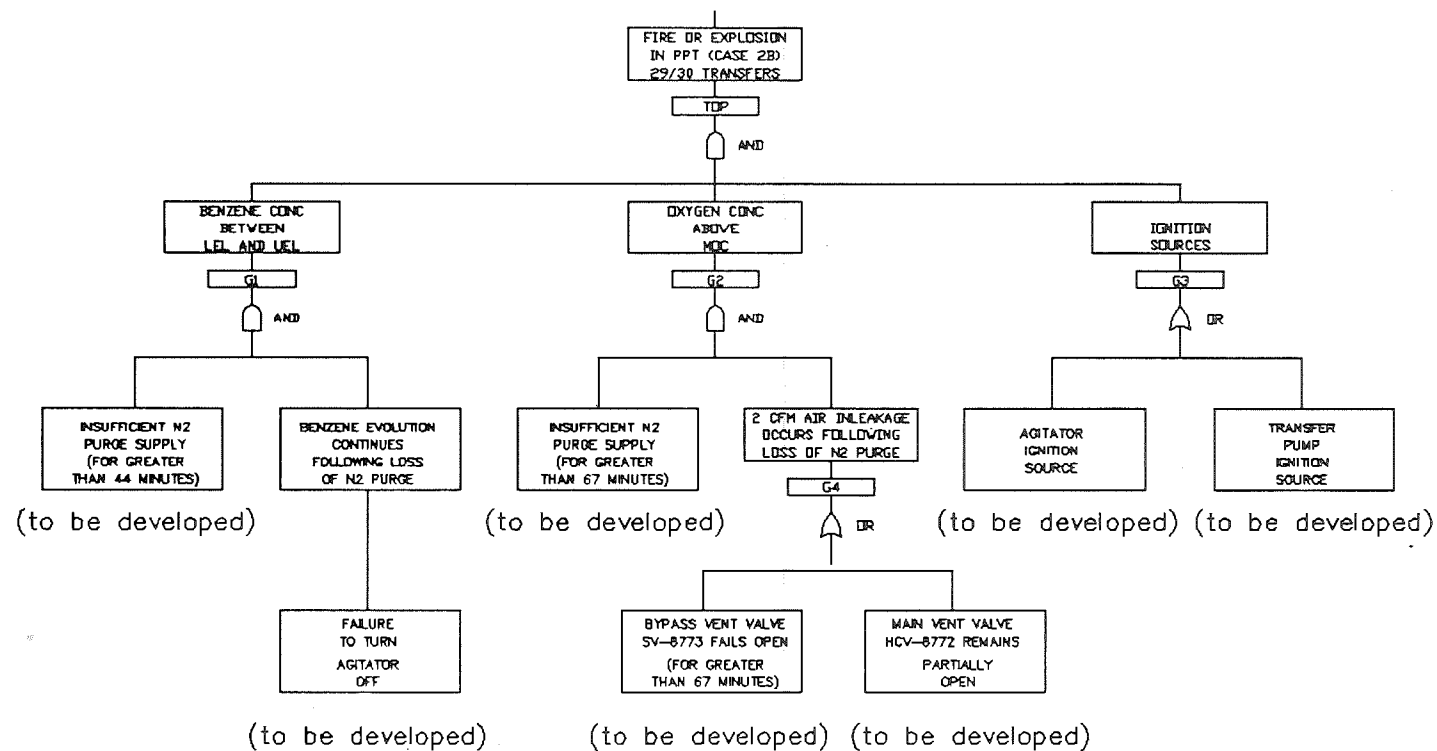


FIGURE 3 -- GENERIC FAULT TREE TOP STRUCTURE
CASE 2B; 29 OUT OF 30 TRANSFERS

BENZENE CONCENTRATION HIGH
FIRST 8 HOURS FOLLOWING TRANSFER

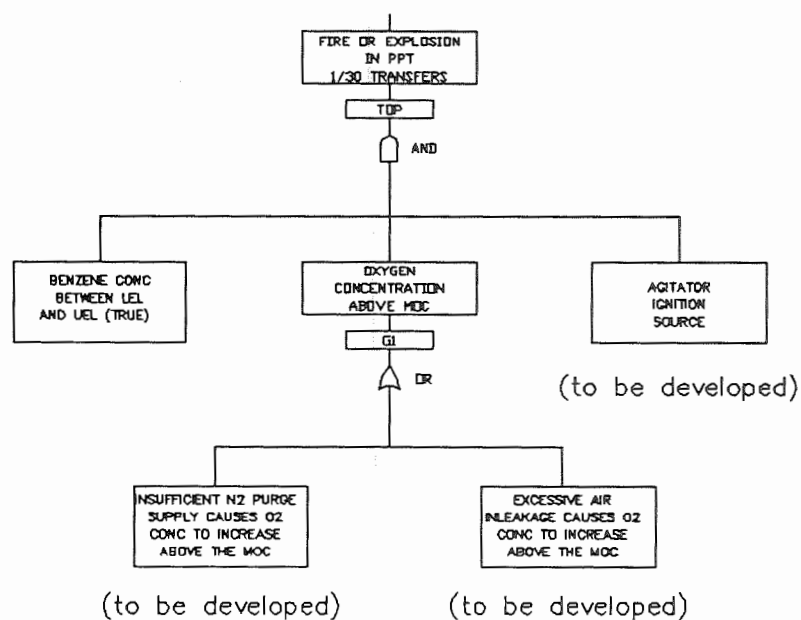


FIGURE 4 -- GENERIC FAULT TREE TOP STRUCTURE
FOR HIGH BENZENE CONCENTRATION
1/30 TRANSFERS FIRST 8 HOURS

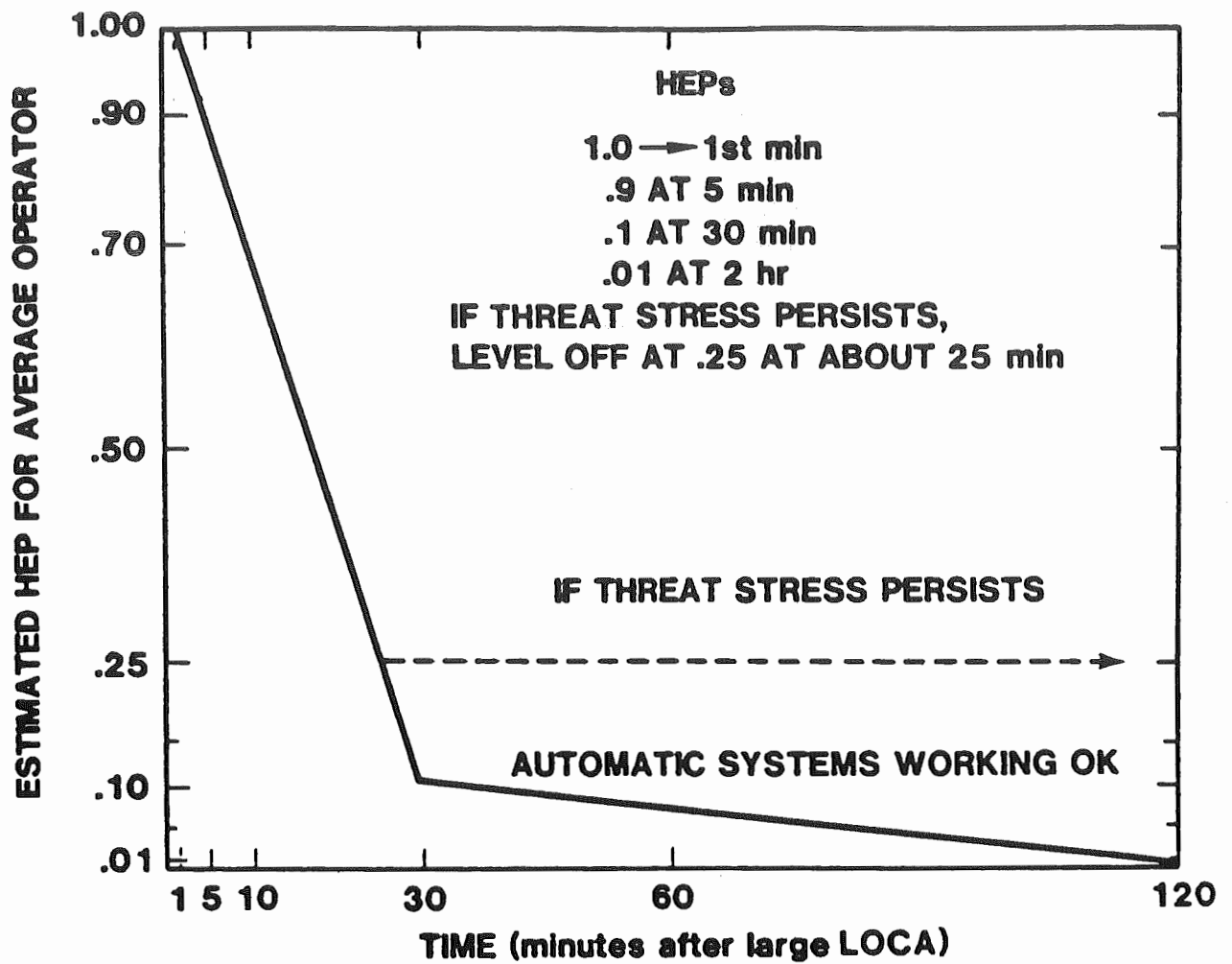
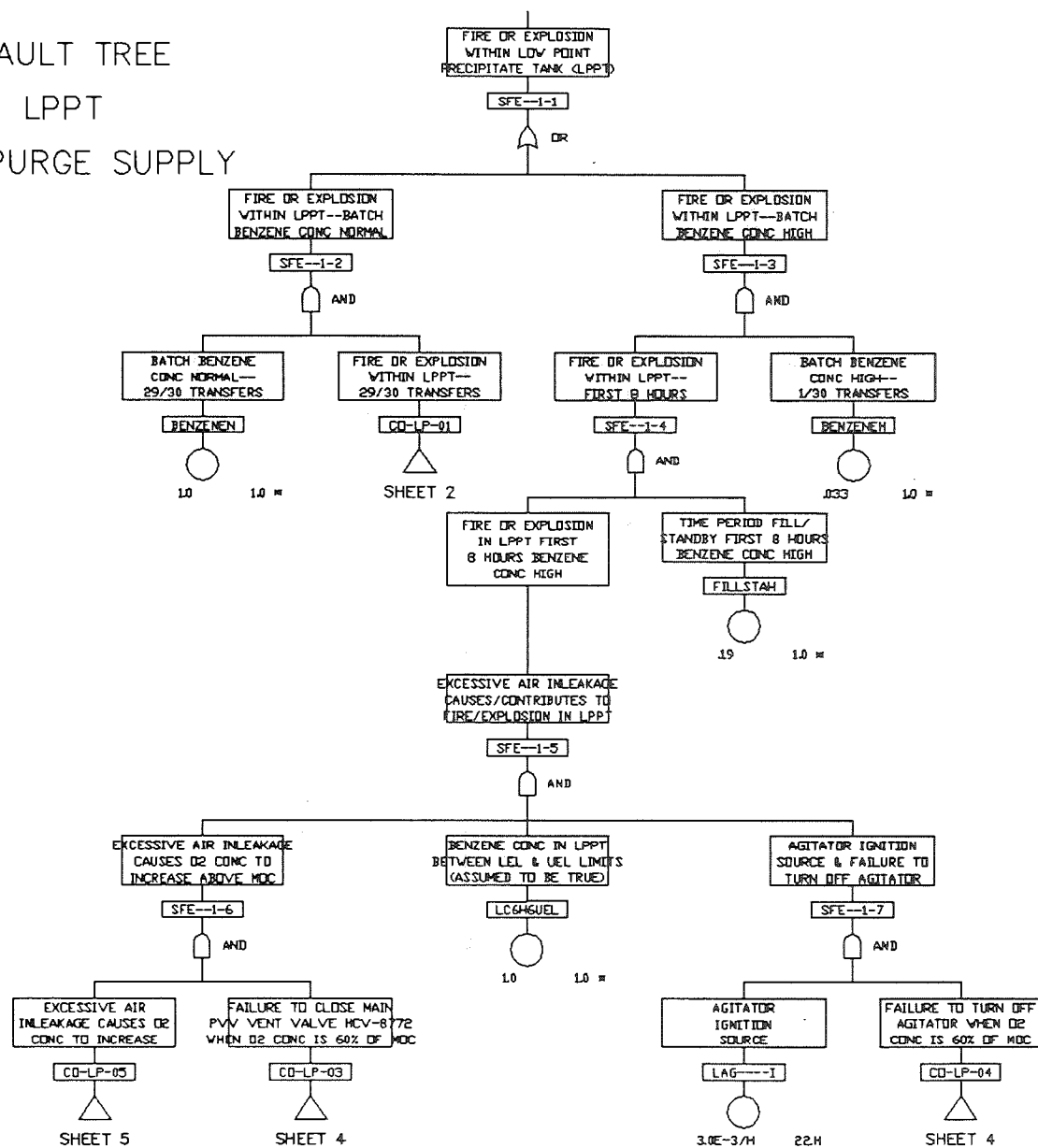


FIGURE 5 -- TIME LINE CORRELATION FOR HUMAN ERROR PROBABILITY (REF. 4)

FIGURE 6 -- SUMMARY FAULT TREE
FIRE OR EXPLOSION WITHIN LPPT
WITHOUT REDUNDANT N2 PURGE SUPPLY

SHEET 1

F-6



* DENOTES ENABLING EVENT

06-15-92

E:\BECHTEL\REPORT\FIGURES\FIG6-1

FIGURE 6 -- SUMMARY FAULT TREE
FIRE OR EXPLOSION WITHIN LPPT
WITHOUT REDUNDANT N2 PURGE SUPPLY
29/30 TRANSFERS
BENZENE CONC NORMAL

SHEET 2

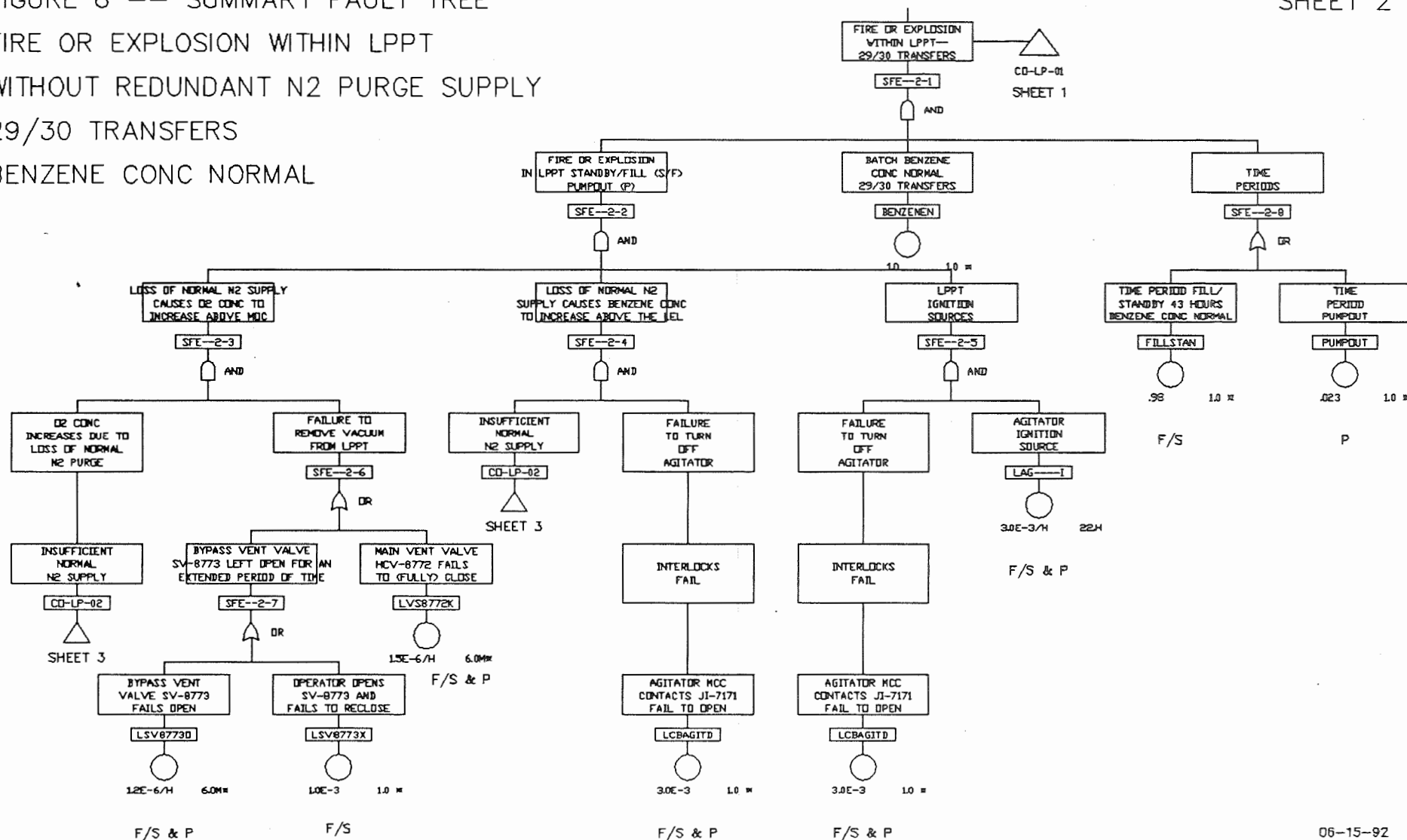
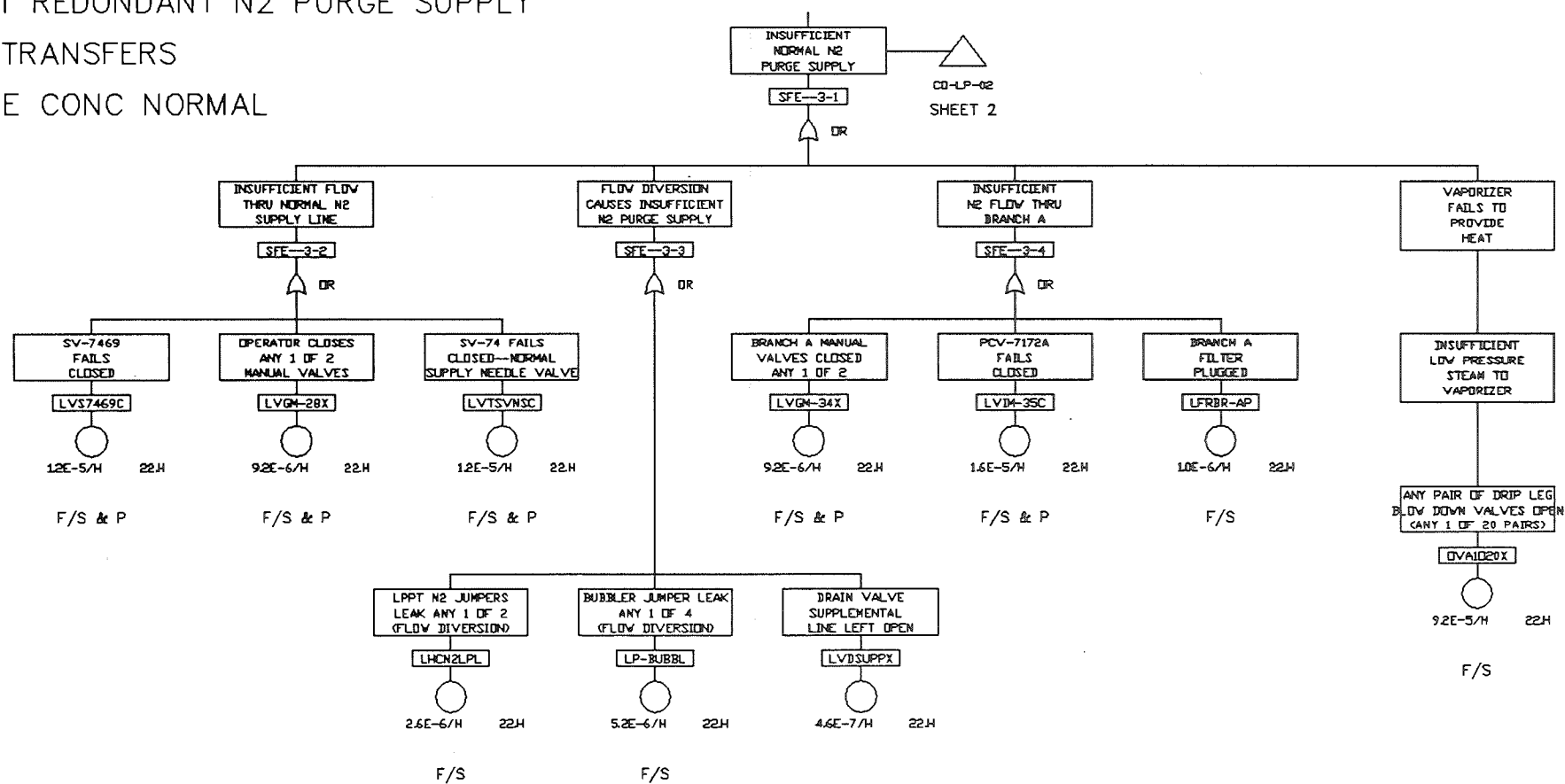


FIGURE 6 -- SUMMARY FAULT TREE
 FIRE OR EXPLOSION WITHIN LPPT
 WITHOUT REDUNDANT N2 PURGE SUPPLY
 29/30 TRANSFERS
 BENZENE CONC NORMAL

SHEET 3



06-15-92

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FIGURE 6 -- SUMMARY FAULT TREE
FIRE OR EXPLOSION WITHIN LPPT
WITHOUT REDUNDANT N2 PURGE SUPPLY

SHEET 4

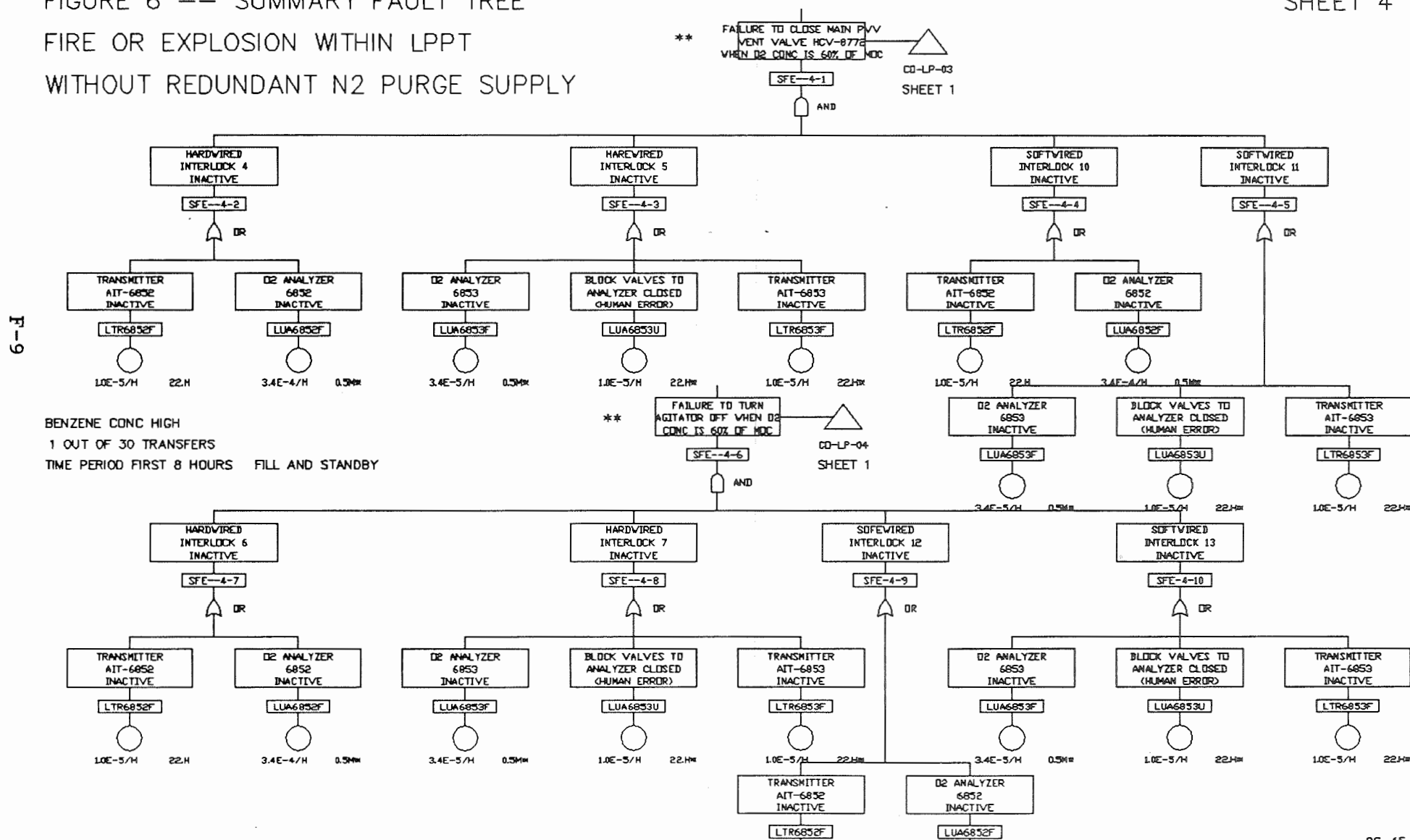
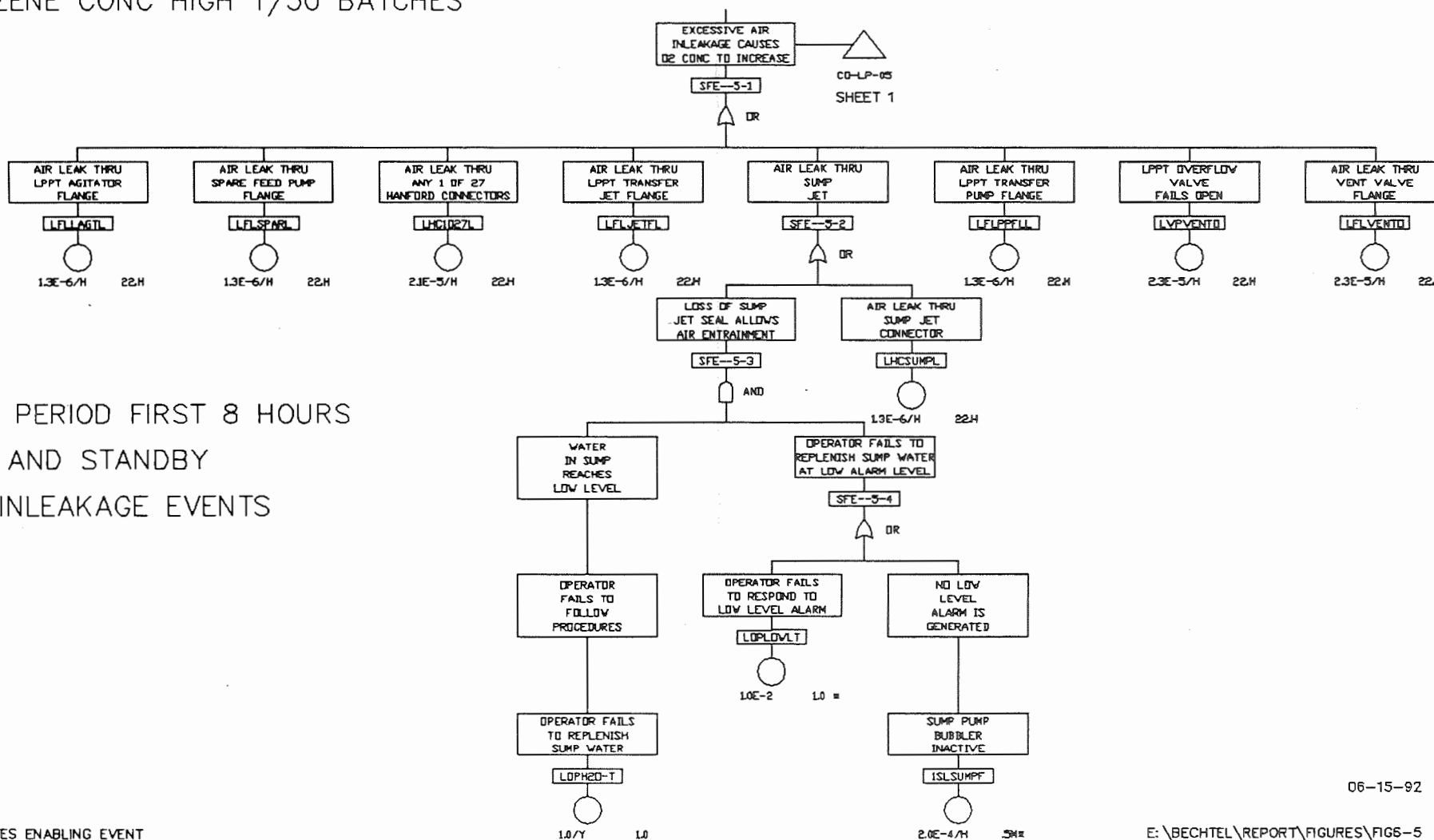


FIGURE 6 -- SUMMARY FAULT TREE
FIRE OR EXPLOSION WITHIN LPPT
BENZENE CONC HIGH 1/30 BATCHES

SHEET 5

F-10

TIME PERIOD FIRST 8 HOURS
FILL AND STANDBY
AIR INLEAKAGE EVENTS



* DENOTES ENABLING EVENT

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APPENDIX A

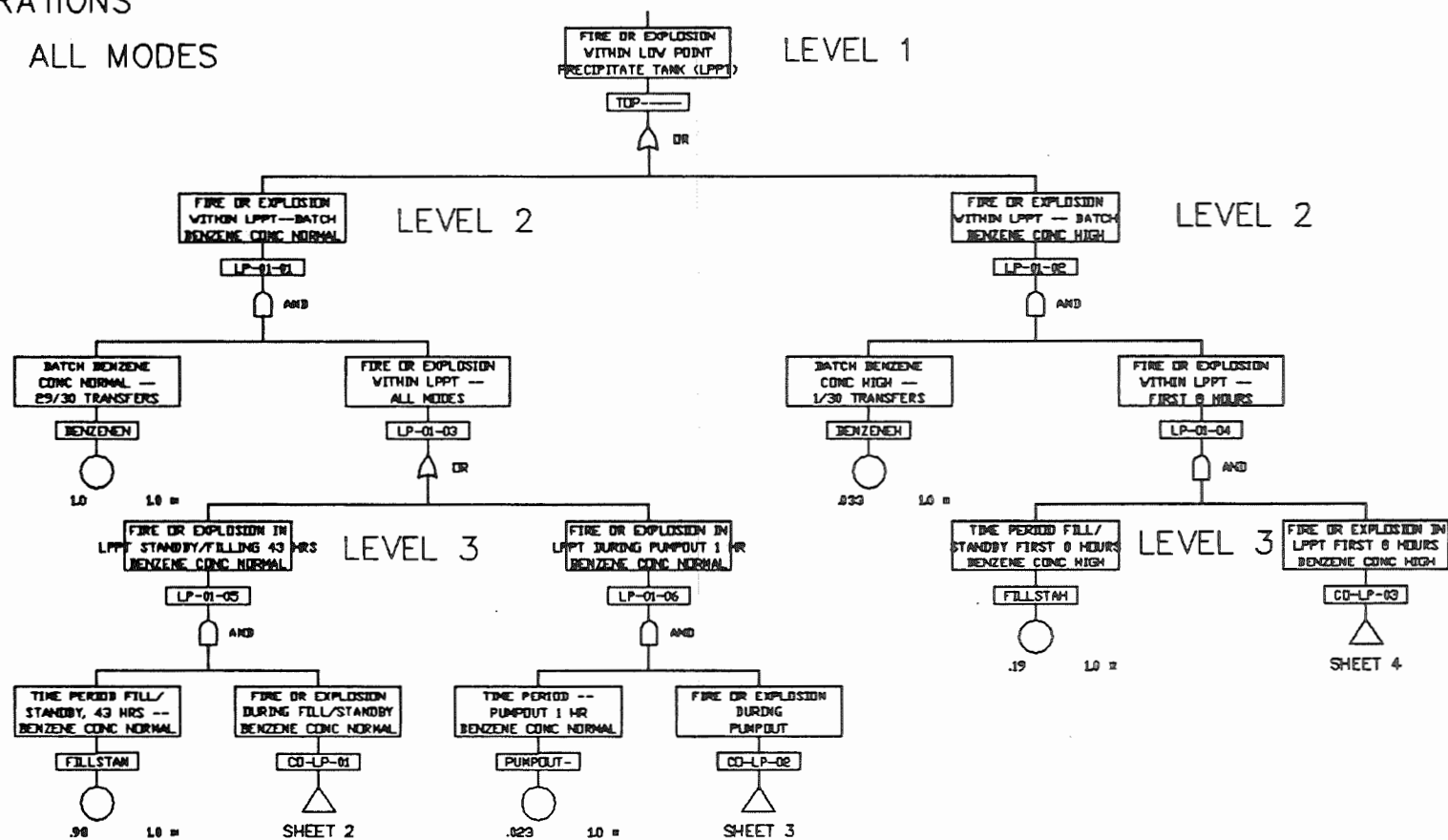
DETAILED FAULT TREES FOR FIRE OR EXPLOSION WITHIN THE LOW POINT PRECIPITATE TANK

FIRE OR EXPLOSION WITHIN LOW POINT PRECIPITATE TANK (LPPT)

ALL CONCENTRATIONS

TIME PERIOD: ALL MODES

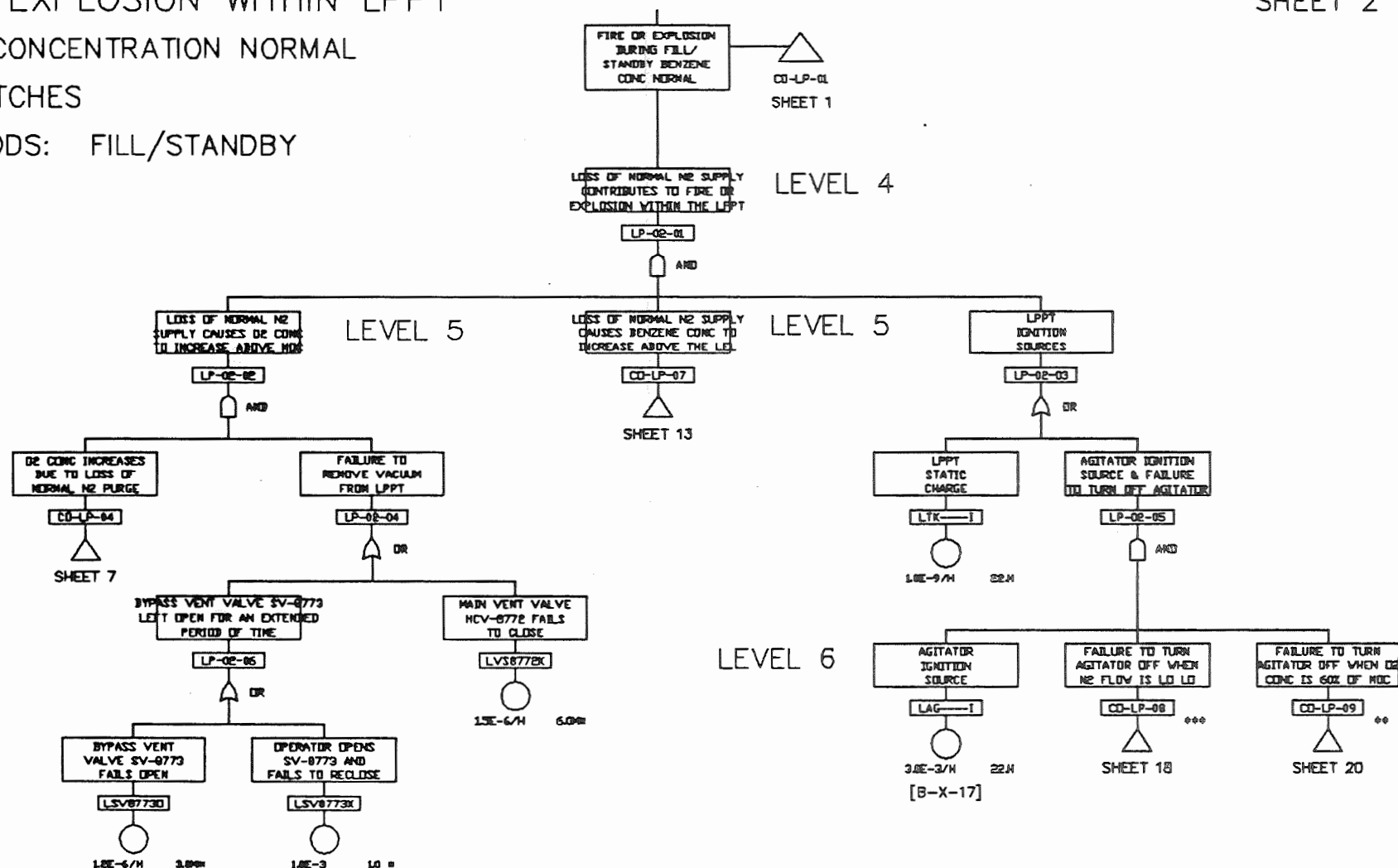
SHEET 1



05-21-92

FIRE OR EXPLOSION WITHIN LPPT
 BENZENE CONCENTRATION NORMAL
 29/30 BATCHES
 TIME PERIODS: FILL/STANDBY

SHEET 2



• DENOTES ENABLING EVENT

•• HARDWIRED INTERLOCK

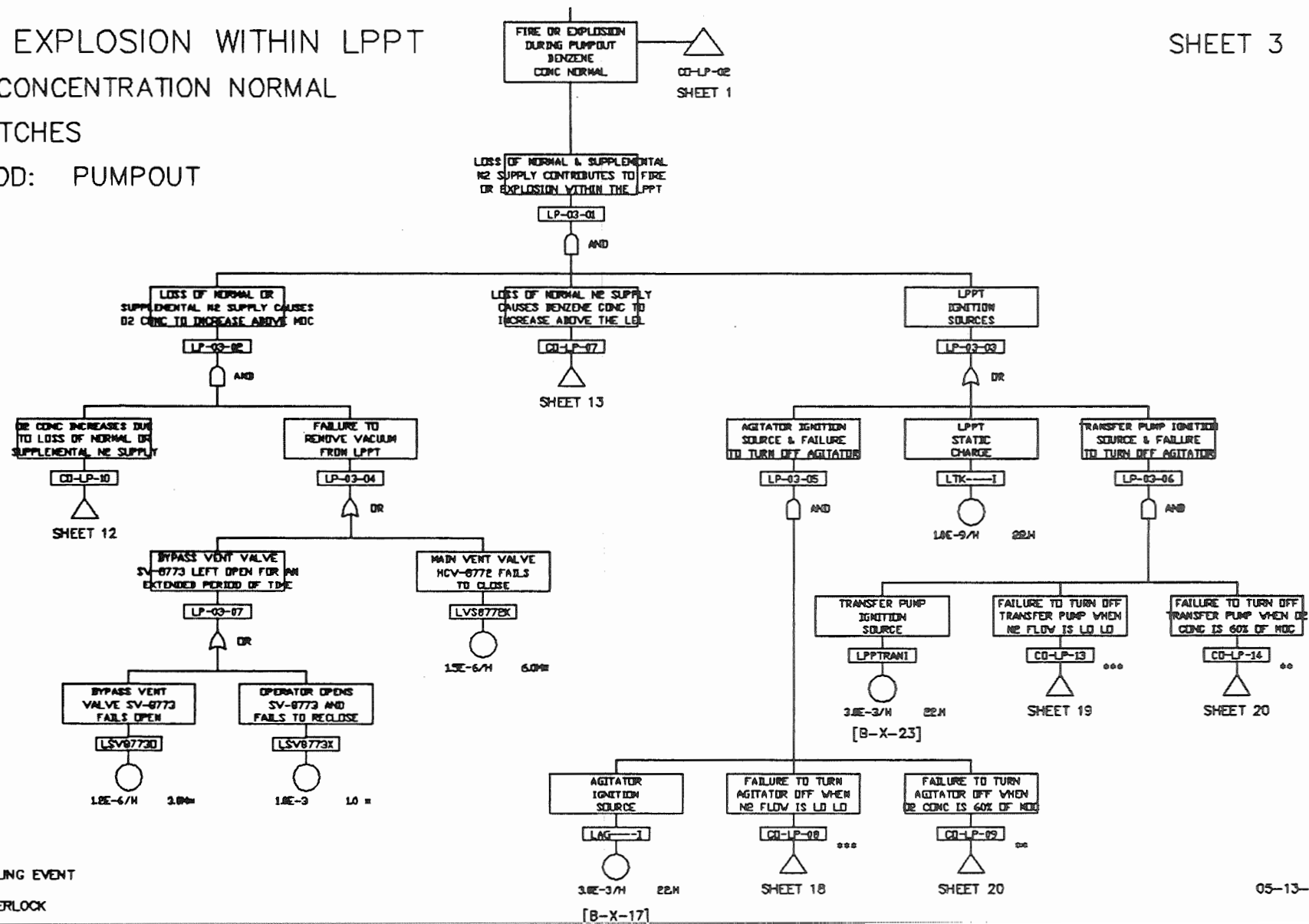
••• SOFTWARE INTERLOCK, DCS DEPENDENCY

05-13-92

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FIRE OR EXPLOSION WITHIN LPPT
 BENZENE CONCENTRATION NORMAL
 29/30 BATCHES
 TIME PERIOD: PUMPOUT

SHEET 3



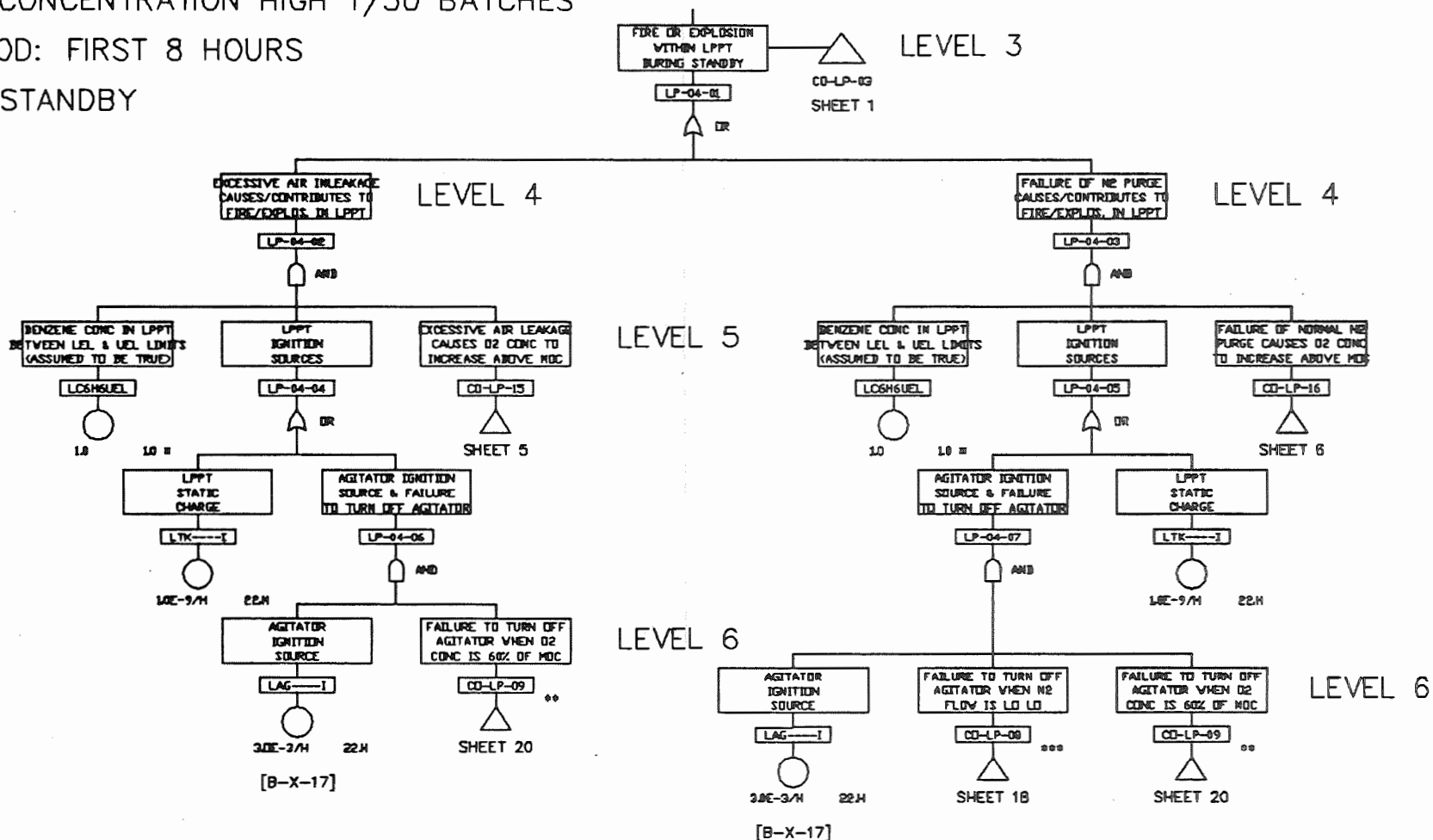
• DENOTES ENABLING EVENT

∞ HARDWIRED INTERLOCK

05-13-92

FIRE OR EXPLOSION WITHIN LPPT
 BENZENE CONCENTRATION HIGH 1/30 BATCHES
 TIME PERIOD: FIRST 8 HOURS
 FILL AND STANDBY

SHEET 4



• DENOTES ENABLING EVENT

== HARDWIRED INTERLOCK

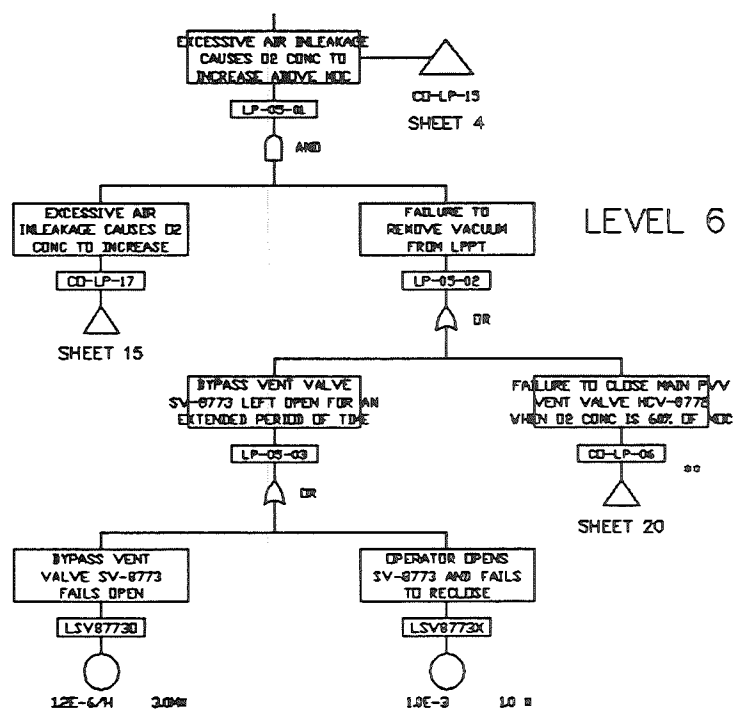
+++ SOFTWARE INTERLOCK, DCS DEPENDENCY

05-08-92

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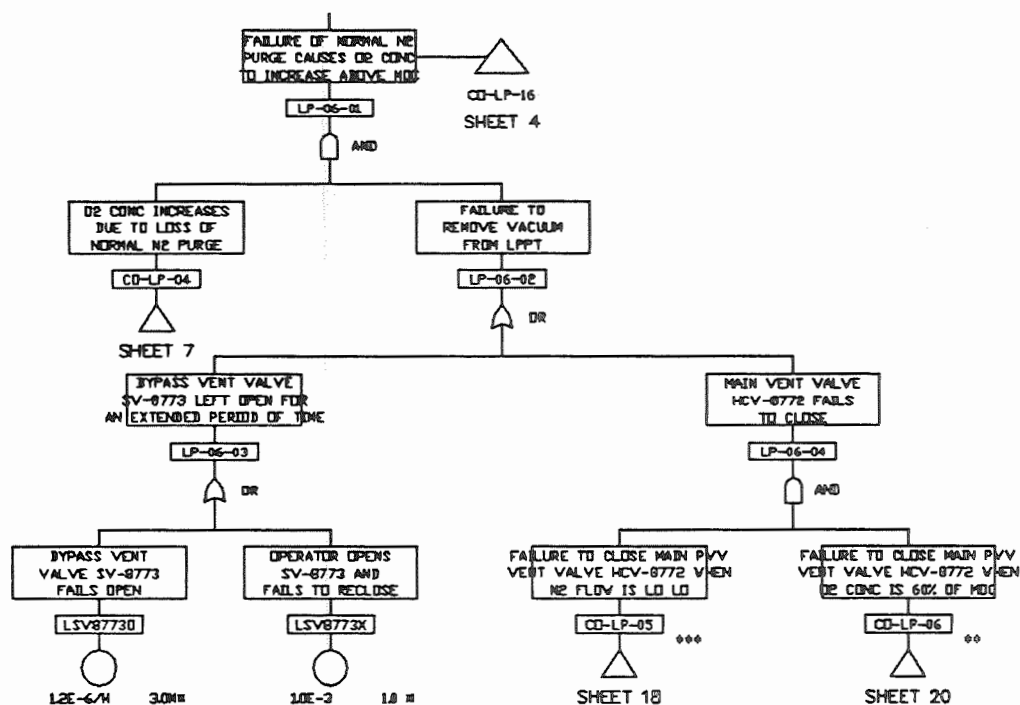
FIRE OR EXPLOSION WITHIN LPPT
 BENZENE CONCENTRATION HIGH 1/30 BATCHES
 TIME PERIOD: FIRST 8 HOURS
 FILL AND STANDBY

SHEET 5



FIRE OR EXPLOSION WITHIN LPPT
 BENZENE CONCENTRATION HIGH 1/30 BATCHES
 TIME PERIOD: FIRST 8 HOURS
 FILL AND STANDBY

SHEET 6



* DENOTES ENABLING EVENT

** HARDWIRED INTERLOCK

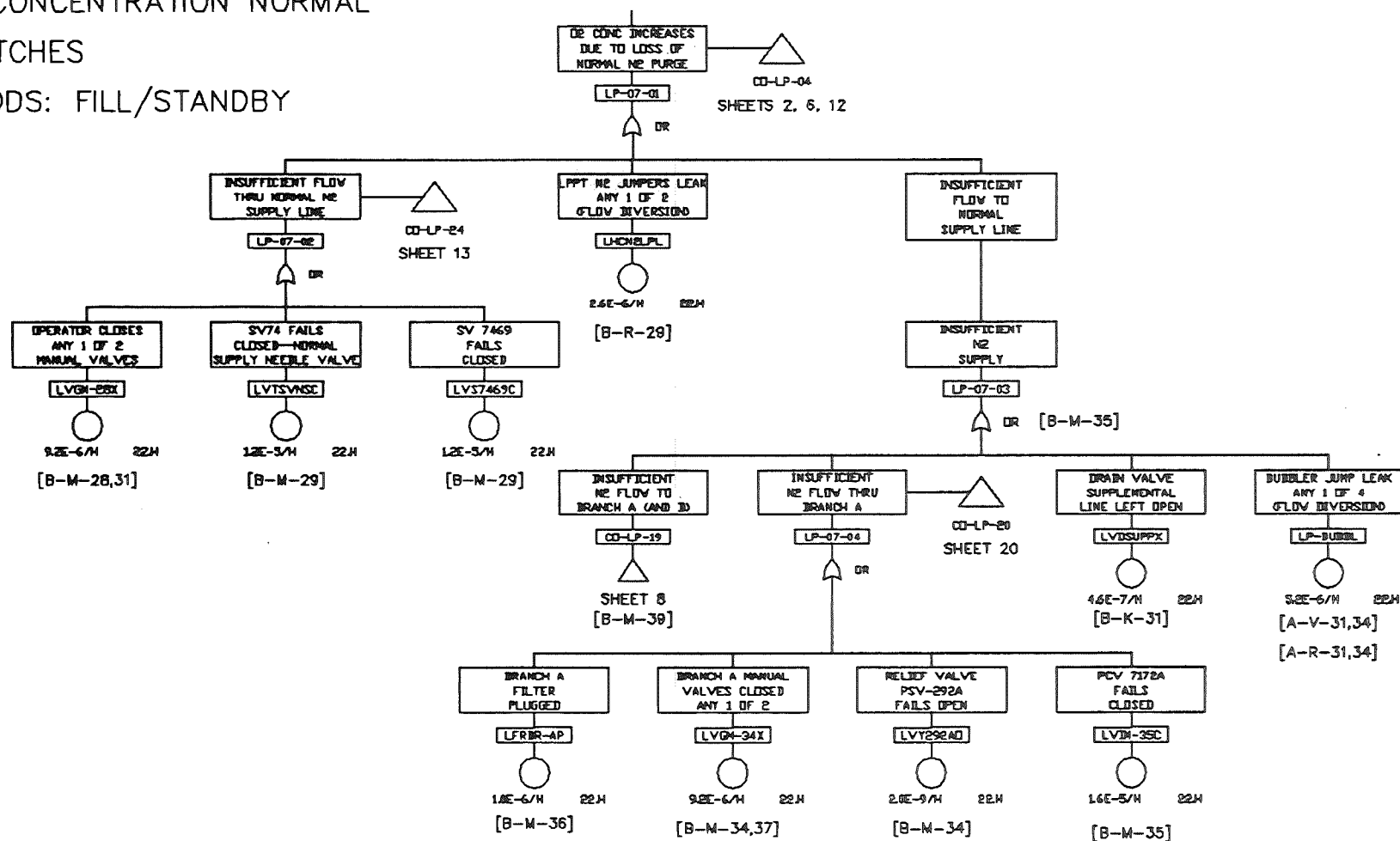
*** SOFTWARE INTERLOCK, DCS DEPENDENCY

04-27-92

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FIRE OR EXPLOSION WITHIN LPPT
 BENZENE CONCENTRATION NORMAL
 29/30 BATCHES
 TIME PERIODS: FILL/STANDBY

SHEET 7



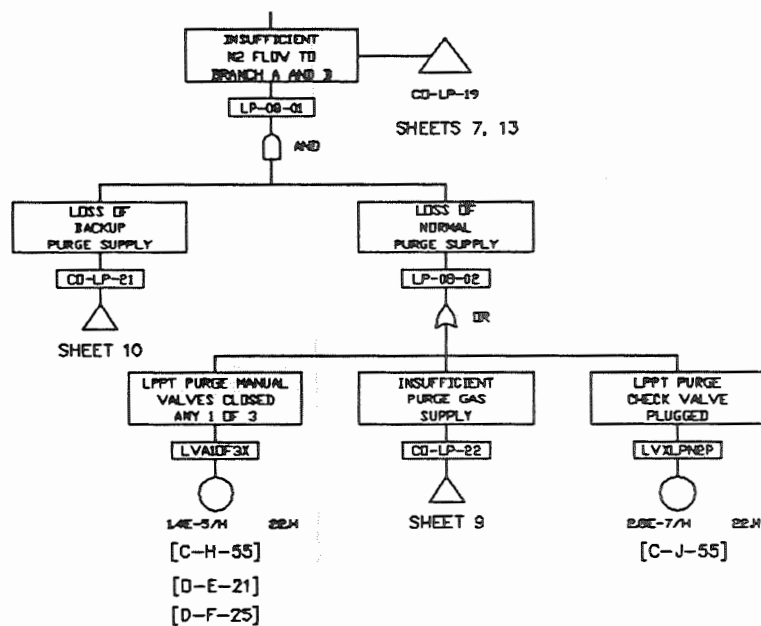
FIRE OR EXPLOSION WITHIN LPPT

ALL CONCENTRATIONS

TIME PERIOD: ALL MODES

FAILURE OF N2 SUPPLY

SHEET 8

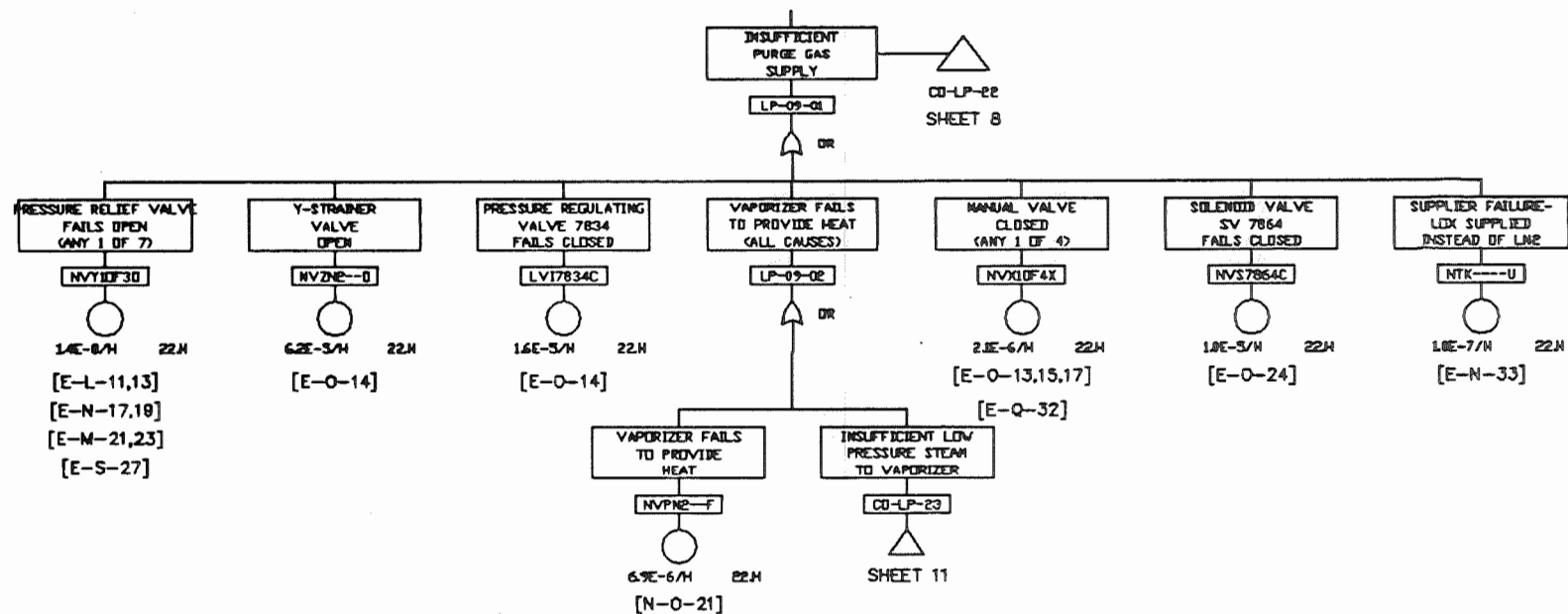


04-28-92

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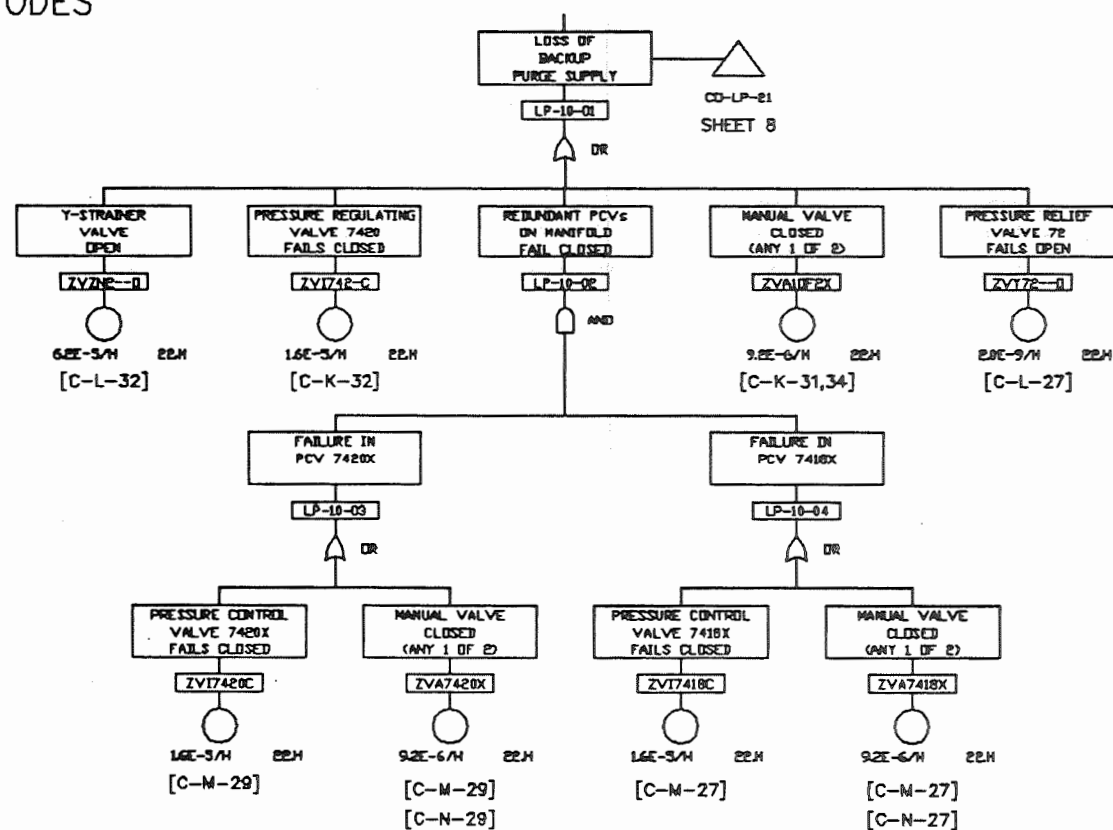
FIRE OR EXPLOSION WITHIN LPPT
 ALL CONCENTRATIONS
 TIME PERIOD: ALL MODES
 FAILURE OF BULK N2 SUPPLY

SHEET 9



FIRE OR EXPLOSION WITHIN LPPT
ALL CONCENTRATIONS
TIME PERIOD: ALL MODES

SHEET 10

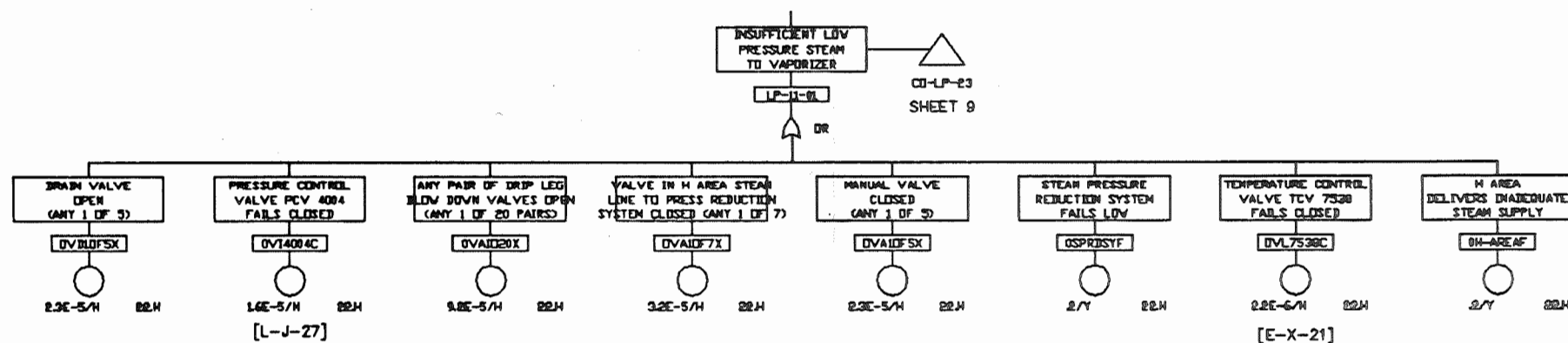


04-28-92

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FIRE OR EXPLOSION WITHIN LPPT
ALL CONCENTRATIONS
TIME PERIOD: ALL MODES

SHEET 11



REFER TO THE FOLLOWING DRAWINGS:

W751632, W751631, W756130, W751674, W751008

04-27-92

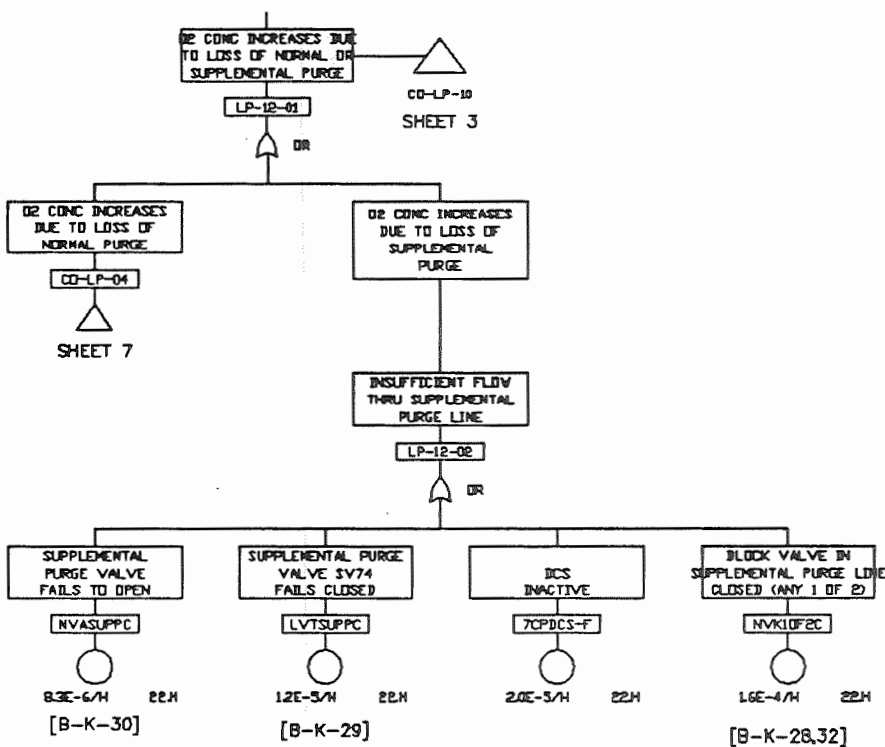
FIRE OR EXPLOSION WITHIN LPPT

BENZENE CONCENTRATION NORMAL

29/30 BATCHES

TIME PERIOD: PUMPOUT

SHEET 12

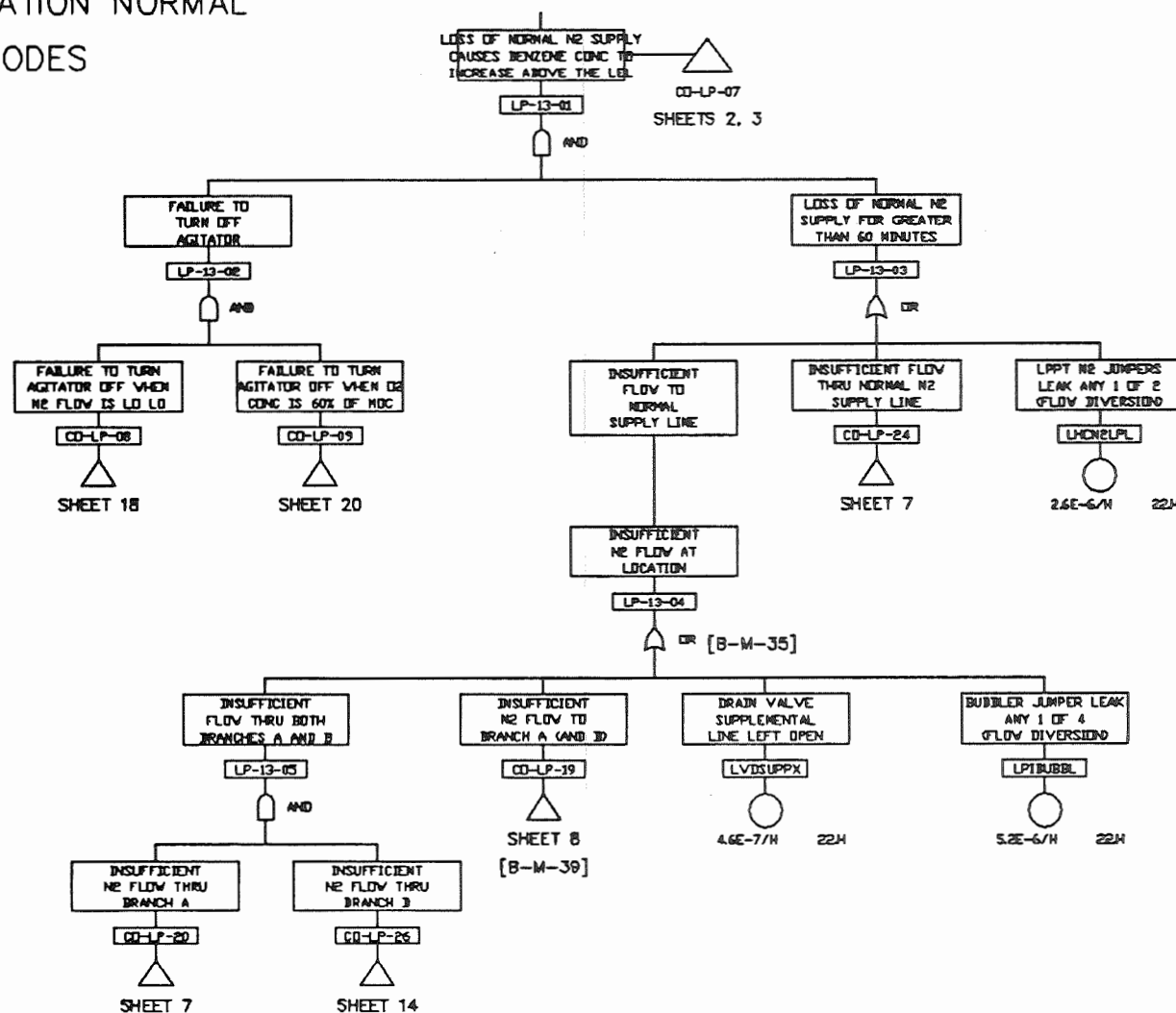


04-27-92

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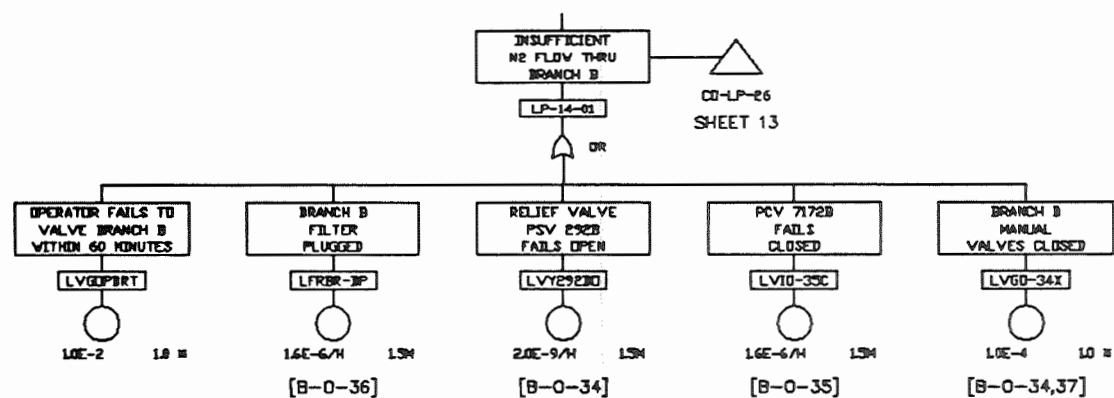
FIRE OR EXPLOSION WITHIN LPPT
 BENZENE CONCENTRATION NORMAL
 TIME PERIOD: ALL MODES

SHEET 13



FIRE OR EXPLOSION WITHIN LPPT
 BENZENE CONCENTRATION NORMAL
 TIME PERIOD: ALL MODES

SHEET 14



04-27-92

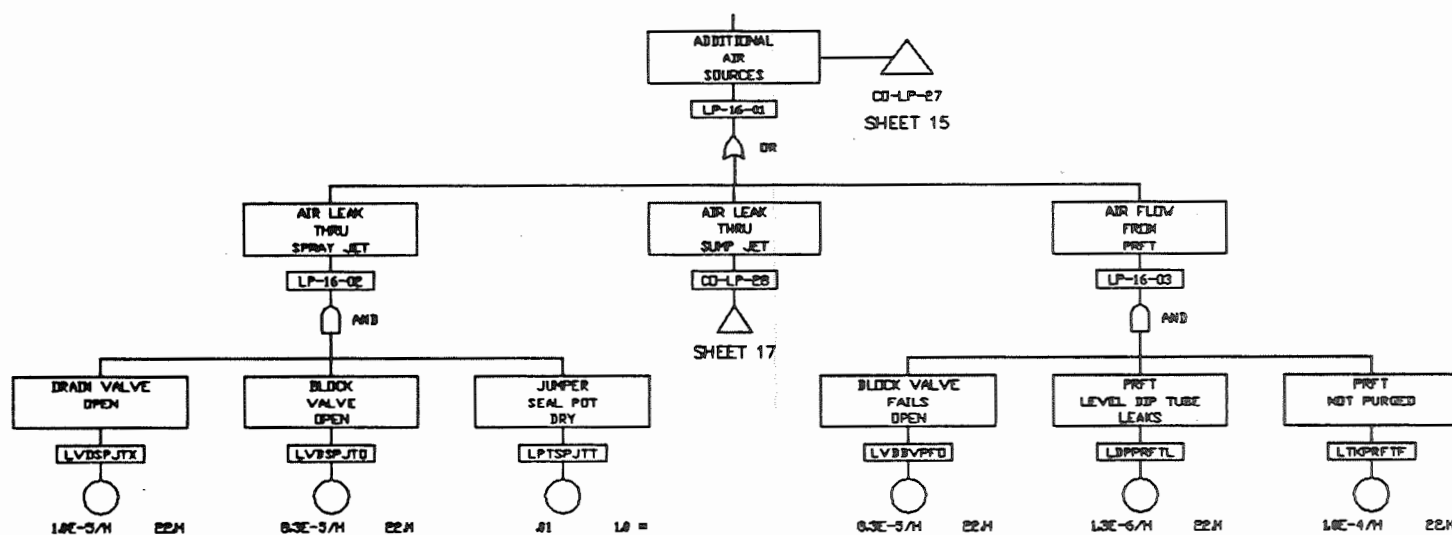
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SHEET 15



FIRE OR EXPLOSION WITHIN LPPT
 BENZENE CONCENTRATION HIGH 1/30 BATCHES
 TIME PERIOD: FIRST 8 HOURS
 FILL AND STANDBY

SHEET 16



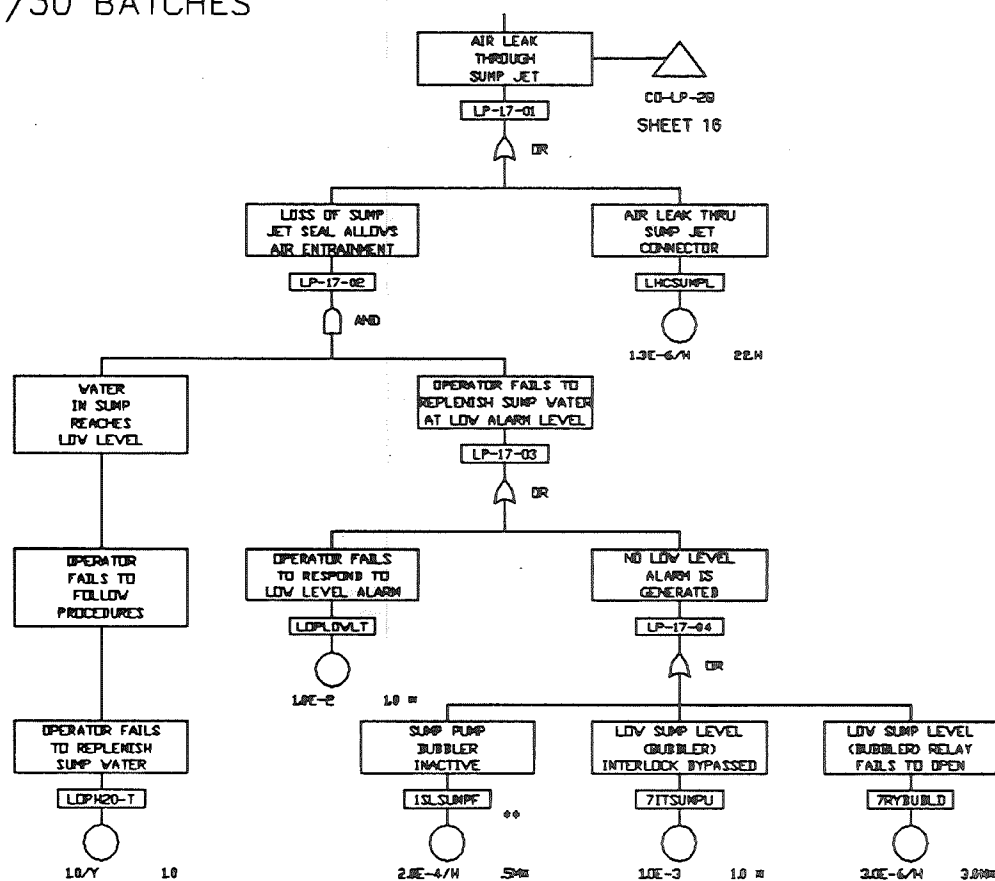
* DENOTES ENABLING EVENT

05-21-92

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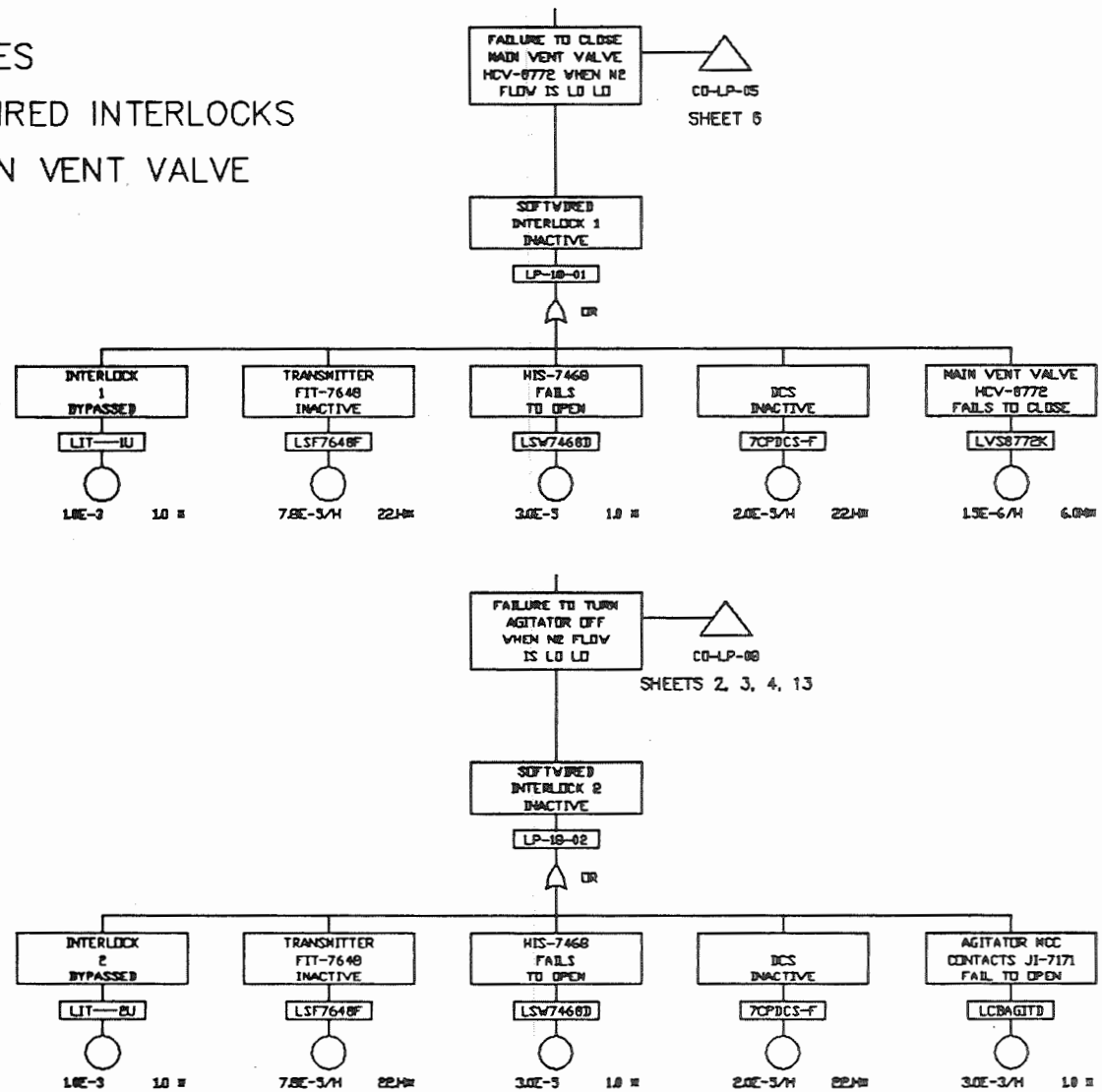
FIRE OR EXPLOSION WITHIN LPPT
 BENZENE CONCENTRATION HIGH 1/30 BATCHES
 TIME PERIOD: FIRST 8 HOURS
 FILL AND STANDBY

SHEET 17



FIRE OR EXPLOSION WITHIN LPPT
 ALL CONCENTRATIONS
 TIME PERIOD: ALL MODES
 LO LO N2 FLOW SOFTWARED INTERLOCKS
 FAILURE TO CLOSE MAIN VENT VALVE

SHEET 18



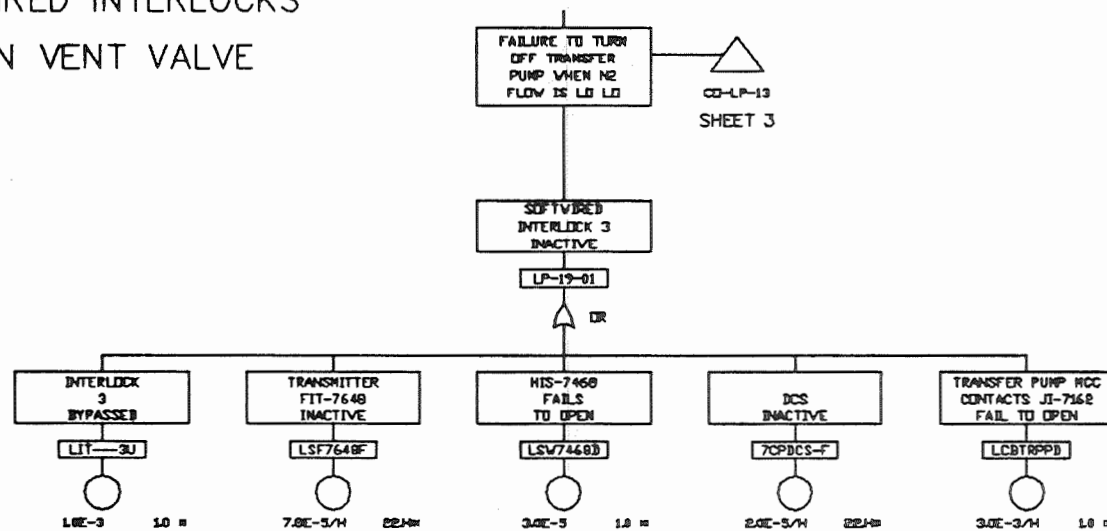
* DENOTES ENABLING EVENT

05-13-92

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FIRE OR EXPLOSION WITHIN LPPT
 ALL CONCENTRATIONS
 TIME PERIOD: ALL MODES
 LO LO N2 FLOW SOFTWARED INTERLOCKS
 FAILURE TO CLOSE MAIN VENT VALVE

SHEET 19



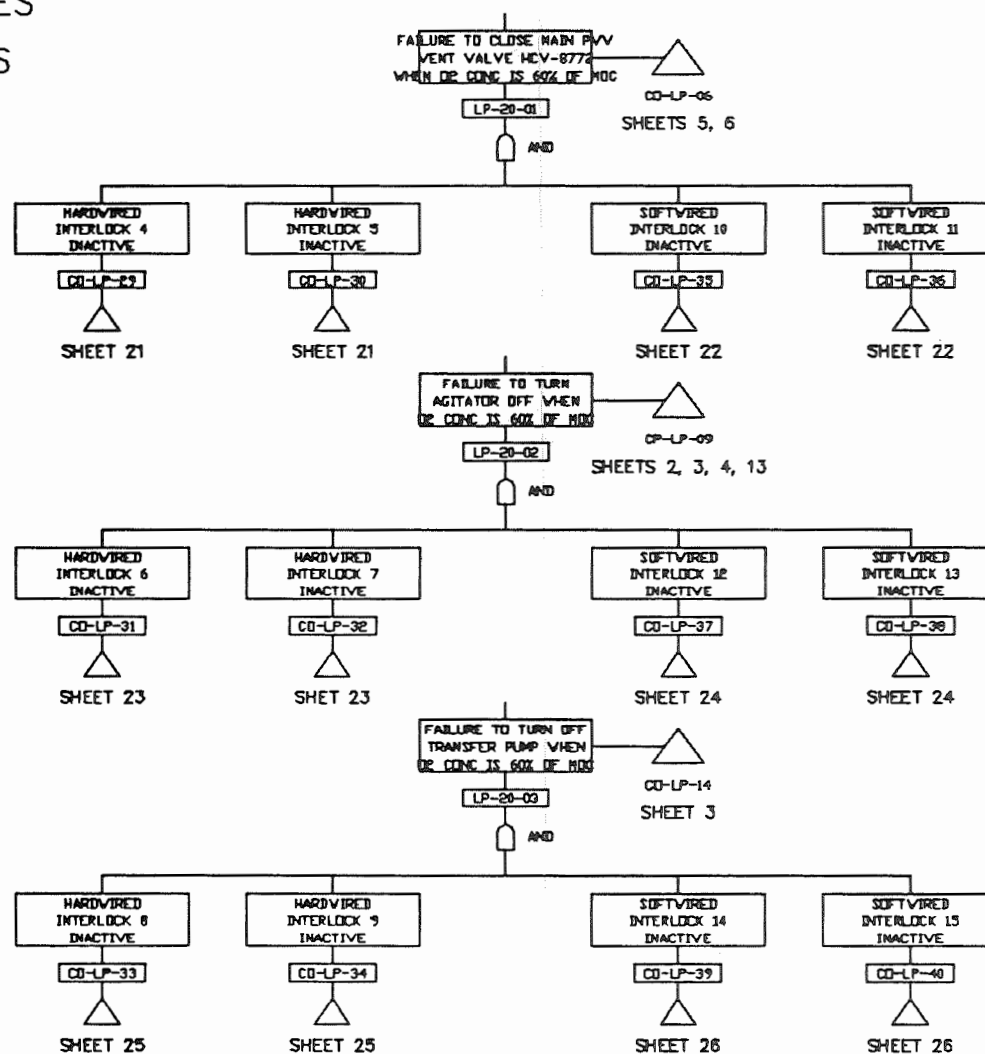
FIRE OR EXPLOSION WITHIN LPPT

ALL CONCENTRATIONS

TIME PERIOD: ALL MODES

FAILURE OF INTERLOCKS

SHEET 20



05-13-92

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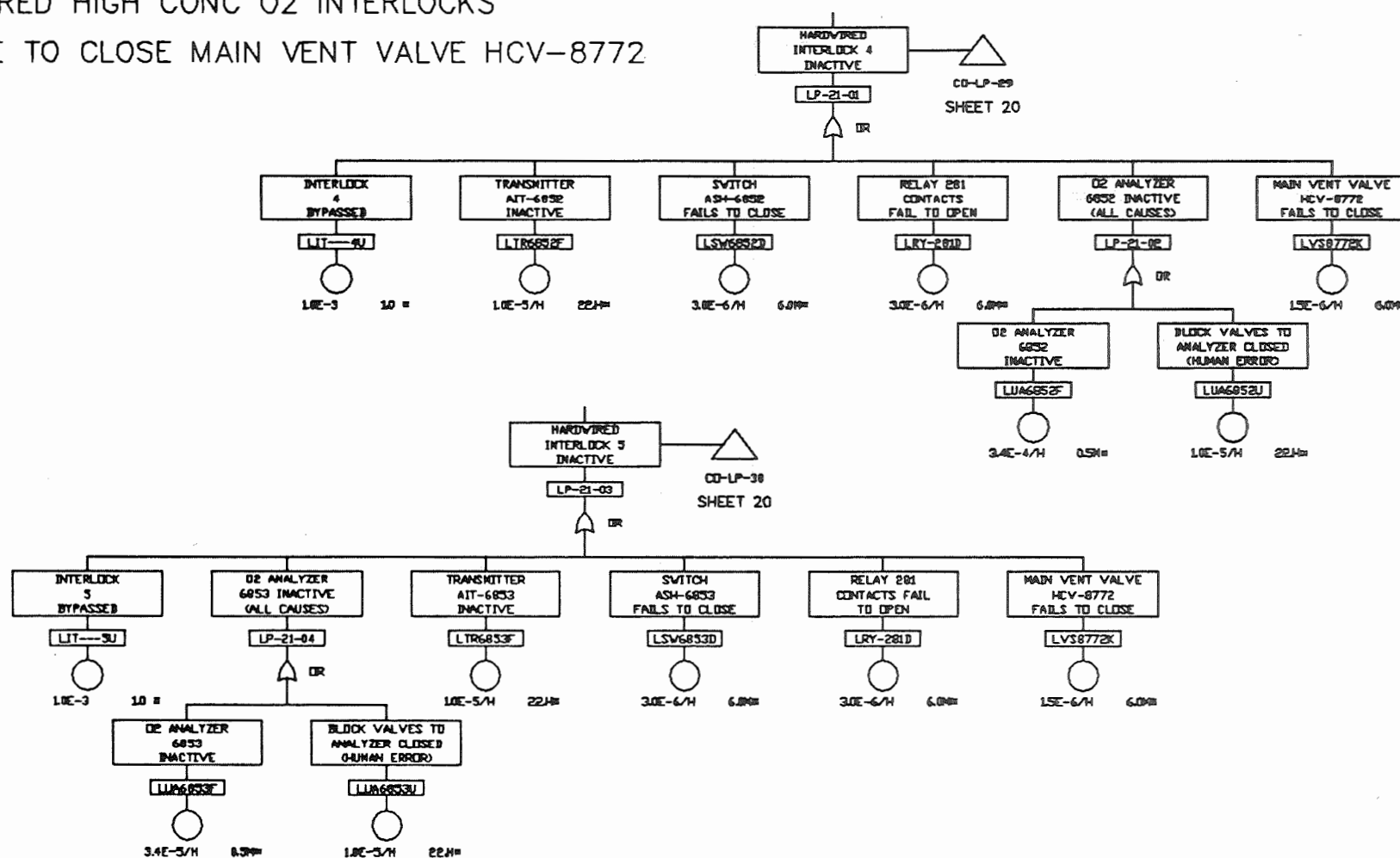
FIRE OR EXPLOSION WITHIN LPPT

SHEET 21

ALL CONCENTRATIONS TIME PERIOD: ALL MODES

HARDWIRED HIGH CONC O2 INTERLOCKS

FAILURE TO CLOSE MAIN VENT VALVE HCV-8772



* DENOTES ENABLING EVENT

05-21-02

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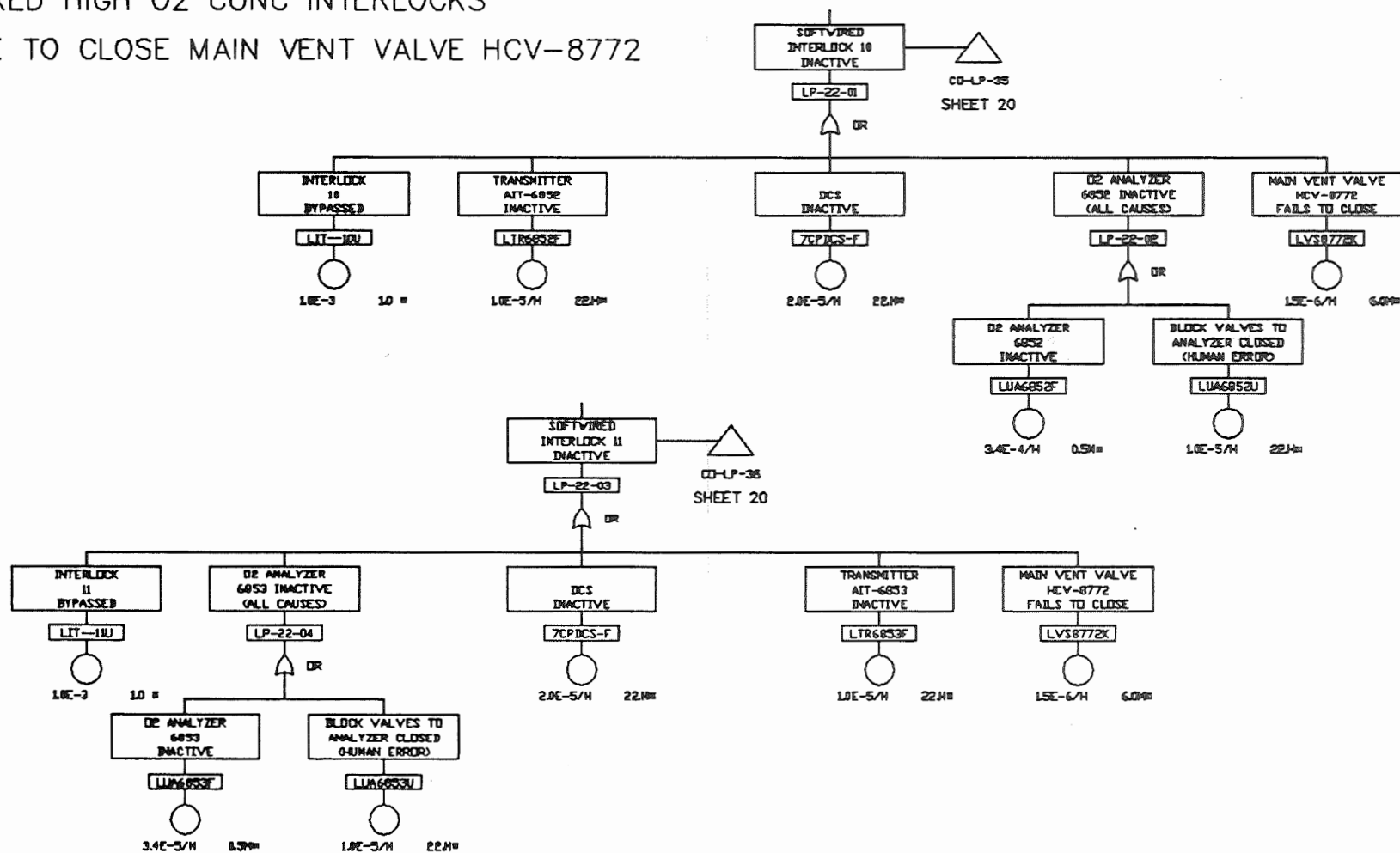
FIRE OR EXPLOSION WITHIN LPPT

SHEET 22

ALL CONCENTRATIONS TIME PERIOD: ALL MODES

SOFTWIRED HIGH O2 CONC INTERLOCKS

FAILURE TO CLOSE MAIN VENT VALVE HCV-8772



* DENOTES ENABLING EVENT

04-27-82

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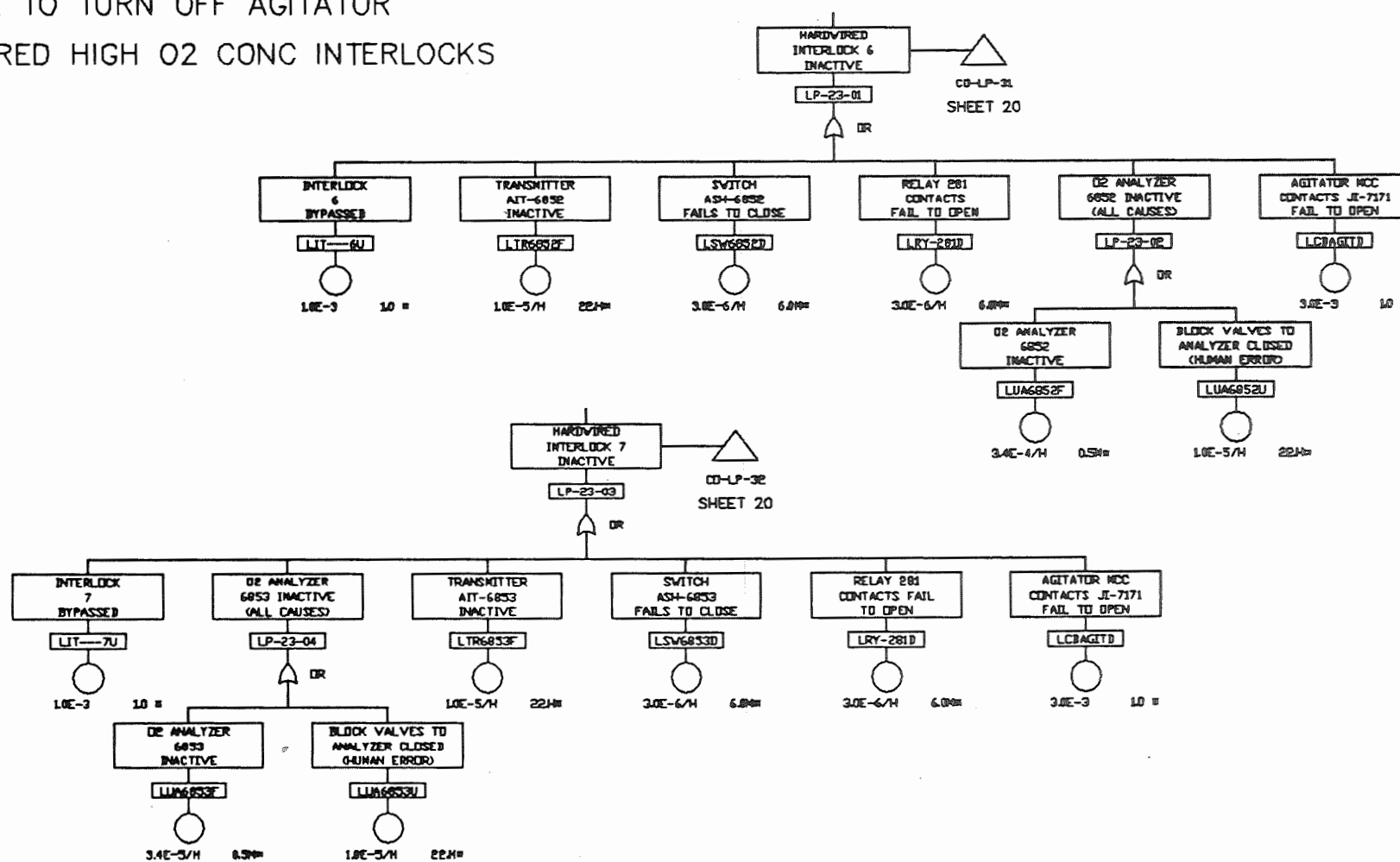
FIRE OR EXPLOSION WITHIN LPPT

TIME PERIOD: ALL MODES

FAILURE TO TURN OFF AGITATOR

HARDWIRED HIGH O2 CONC INTERLOCKS

SHEET 23



* DENOTES ENABLING EVENT

04-27-92

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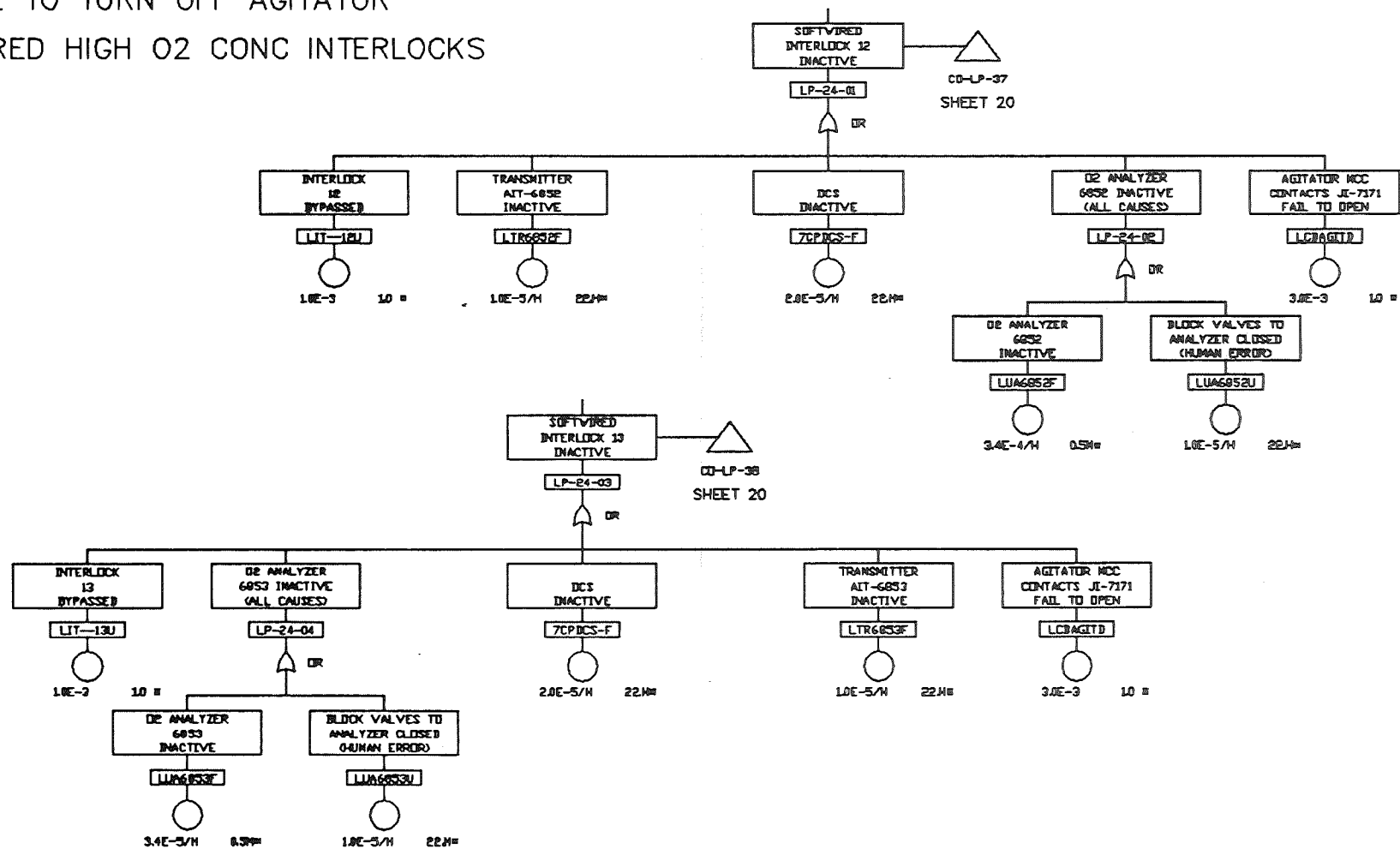
FIRE OR EXPLOSION WITHIN LPPT

SHEET 24

TIME PERIOD: ALL MODES

FAILURE TO TURN OFF AGITATOR

SOFTWARED HIGH O2 CONC INTERLOCKS



* DENOTES ENABLING EVENT

04-27-92

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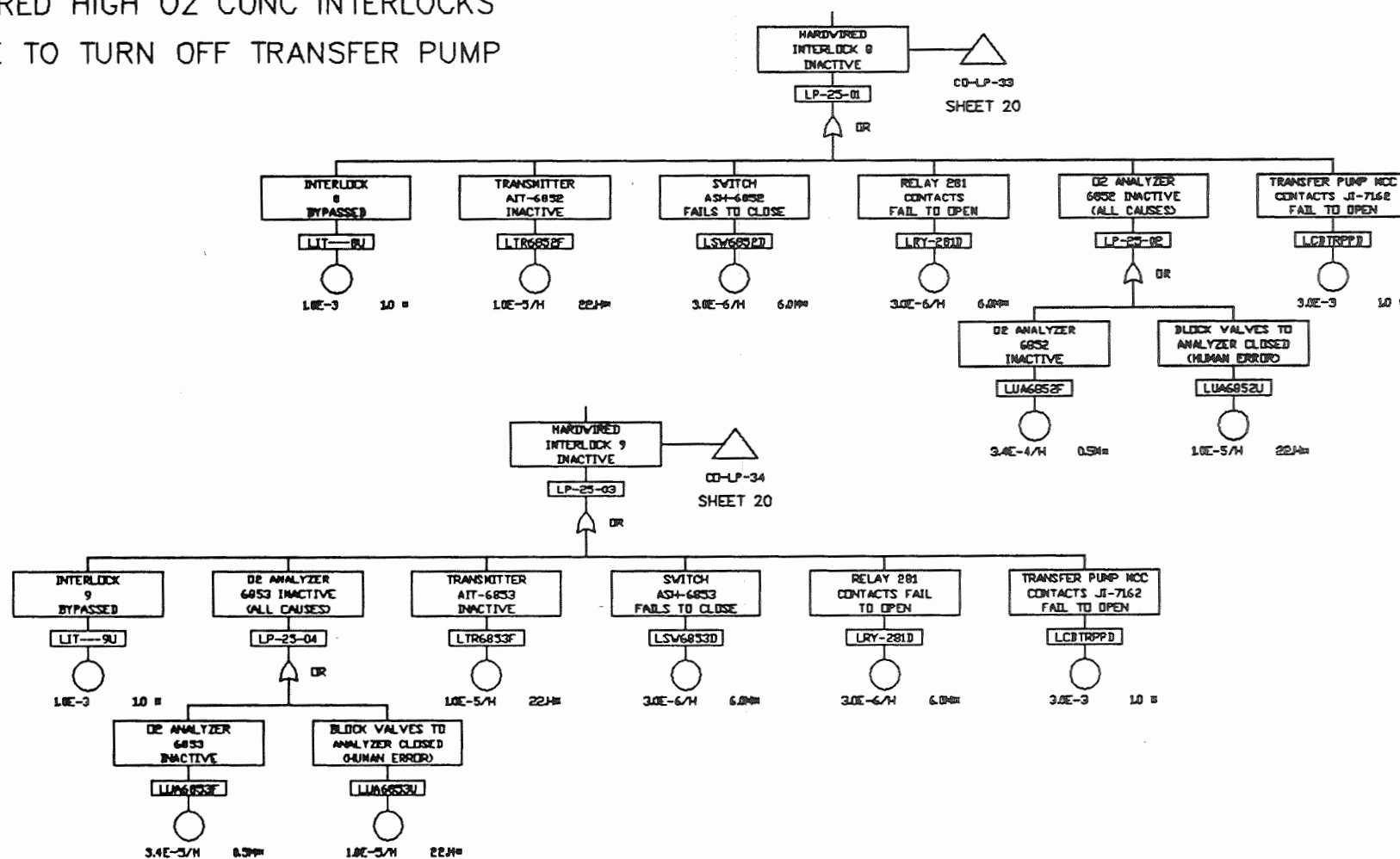
FIRE OR EXPLOSION WITHIN LPPT

SHEET 25

BENZENE CONC NORMAL TIME PERIOD: PUMPOUT

HARDWIRED HIGH O2 CONC INTERLOCKS

FAILURE TO TURN OFF TRANSFER PUMP



* DENOTES ENABLING EVENT

04-27-92

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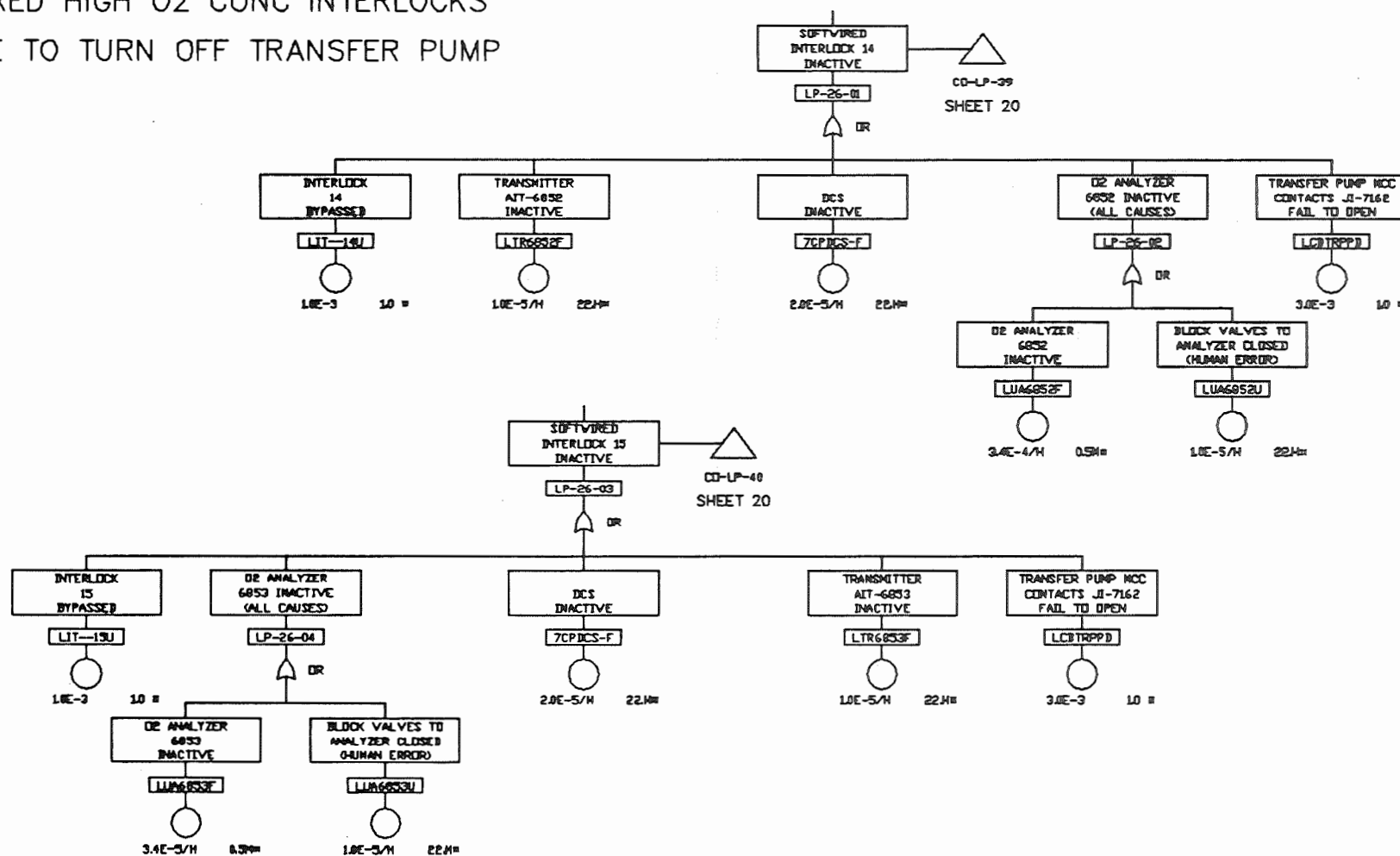
FIRE OR EXPLOSION WITHIN LPPT

SHEET 26

BENZENE CONC NORMAL TIME PERIOD: PUMPOUT

SOFTWARED HIGH O2 CONC INTERLOCKS

FAILURE TO TURN OFF TRANSFER PUMP



* DENOTES ENABLING EVENT

04-27-92

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APPENDIX B

IMPORTANCE OUTPUT

FIRE OR EXPLOSION WITHIN THE

LOW POINT PRECIPITATE TANK

WITHOUT REDUNDANT N₂ PURGE SUPPLY

*** TIME AND DATE OF RUN -- 00:46:24 MAY 20, 1992
INPUT FILE NAME : LPWO .II

FIRE/EXPLOSION LPPT W/O REDUNDANT N2 SUPPLY

INPUT DATA OPTION 1
FAILURE RATE AND MEAN FAULT DURATION GIVEN IN TERMS OF REAL TIME

STEADY STATE CALCULATIONS

EXPECTED NUMBER OFFAILURES CALCULATED FOR TIME = , 1.00Y 30.00Y

*** BASIC EVENT OPTIONS USED ***

	CRITICA- LITY	UPGRADING FUNCTION	FUSSELL- VESELY	INITIATOR (BARLOW- PROSCHAN)	ENABLER (CONTRIB- UTORY)	STRUCTURAL
BIRNBAUM	NO	NO	NO	YES	YES	NO

*** MIN CUT SET OPTIONS USED ***

INITIATOR (BARLOW-PROSCHAN)	FUSSELL-VESELY
YES	NO

INFORMATION ON DETAILED CUT SET OUTPUT -- NM =100 AND FACTOR = .100E-01

1 *****

FIRE/EXPLOSION LPPT W/O REDUNDANT N2 SUPPLY

*** BASIC EVENT DATA ***

FAILURE RATE	MEAN FAULT DURATION	NAME	ENABLER	DESCRIPTION
.200E+00/YEAR	22. HOURS	0H-AREAF		H AREA STEAM SUPPLY FAILS
.200E+00/YEAR	22. HOURS	0SPRDSYF		STEAM PRESSURE REDUCTION SYSTEM FAILS
.920E-04/HOUR	22. HOURS	0VAIO20X		ANY PAIR OF DRIP LEG BLOW DOWN VALVES OPEN (AN
.160E-04/HOUR	22. HOURS	0VI4004C		PRESSURE CONTROL VALVE PCV 4004 FAILS CLOSED
.200E-03/HOUR	.50 MONTHS	1SLSUMPF	*	SUMP PUMP BUBBLER INACTIVE
.200E-04/HOUR	22. HOURS	7CPDCS-F		DCS INACTIVE
.100E-02/HOUR	1.0 HOURS	7ITSUMPU	*	LOW SUMP LEVEL (BUBBLER) INTERLOCK BYPASSED
.300E-05/HOUR	3.0 MONTHS	7RYBUBLD	*	LOW SUMP LEVEL (BUBBLER) RELAY FAILS TO OPEN
.330E-01/HOUR	1.0 HOURS	BENZENEH	*	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
.100E+01/HOUR	1.0 HOURS	BENZENEN	*	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
.190E+00/HOUR	1.0 HOURS	FILLSTAH	*	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
.980E+00/HOUR	1.0 HOURS	FILLSTAN	*	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
.300E-02/HOUR	22. HOURS	LAG----I		AGITATOR IGNITION SOURCE
.100E+01/HOUR	1.0 HOURS	LC6H6UEL	*	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
.300E-02/HOUR	1.0 HOURS	LCBAGITD	*	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
.300E-02/HOUR	1.0 HOURS	LCBTRPPD	*	TRANSFER PUMP MCC CONTACTS J1-7162 FAIL TO OPE
.130E-05/HOUR	22. HOURS	LDPDTLL		LPPT INLET DIP TUBE LEAKS
.130E-05/HOUR	22. HOURS	LDPPRFTL		PRFT LEVEL DIP TUBE LEAKS
.130E-05/HOUR	22. HOURS	LFLBFCFO		BLIND FLANGE OPEN/COLD FEED
.130E-05/HOUR	22. HOURS	LFLJETFL		AIR LEAK THROUGH LPPT TRANSFER JET FLANGE
.130E-05/HOUR	22. HOURS	LFLLAGTL		AIR LEAK THROUGH LPPT AGITATOR FLANGE
.130E-05/HOUR	22. HOURS	LFLPPFLL		AIR LEAK THRU LPPT TRANSFER PUMP FLANGE
.130E-05/HOUR	22. HOURS	LFLSPARL		AIR LEAK THROUGH SPARE FEED PUMP FLANGE
.230E-04/HOUR	22. HOURS	LFLVENTO		AIR LEAK THROUGH VENT VALVE FLANGE

.100E-05/HOUR	22.	HOURS	LFRBR-AP	BRANCH A FILTER PLUGGED
.160E-05/HOUR	1.5	MONTHS	LFRBR-BP	BRANCH B FILTER PLUGGED
.210E-04/HOUR	22.	HOURS	LHC1027L	AIR LEAK THROUGH ANY 1 OF 27 HANFORD CONNECTOR
.260E-05/HOUR	22.	HOURS	LHCN2LPL	LPPT N2 JUMPERS LEAK ANY 1 OF 2 (FLOW DIVERSIO
.130E-05/HOUR	22.	HOURS	LHCSUMPL	AIR LEAK THRU SUMP JET CONNECTOR
.100E-02/HOUR	1.0	HOURS	LIT---1U	* INTERLOCK 1 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT---2U	* INTERLOCK 1 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT---3U	* INTERLOCK 1 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT---4U	* INTERLOCK 4 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT---5U	* INTERLOCK 5 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT---6U	* INTERLOCK 6 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT---7U	* INTERLOCK 7 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT---8U	* INTERLOCK 8 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT---9U	* INTERLOCK 9 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT--10U	* INTERLOCK 10 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT--11U	* INTERLOCK 11 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT--12U	* INTERLOCK 12 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT--13U	* INTERLOCK 13 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT--14U	* INTERLOCK 14 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT--15U	* INTERLOCK 15 BYPASSED
.100E+01/YEAR	1.0	HOURS	LOPH20-T	OPERATOR FAILS TO REPLENISH SUMP WATER
.100E-01/HOUR	1.0	HOURS	LOPLWLT	* OPERATOR FAILS TO RESPOND TO LOW LEVEL ALARM
.520E-05/HOUR	22.	HOURS	LP-BUBBL	BUBBLER JUMP LEAK ANY 1 OF 4 (FLOW DIVERSION)
.520E-05/HOUR	22.	HOURS	LPIBUBBL	BUBBLER JUMPER LEAK ANY 1 OF 4 (FLOW DIVERSION)
.300E-02/HOUR	22.	HOURS	LPPTRANI	TRANSFER PUMP IGNITION SOURCE
.100E-01/HOUR	1.0	HOURS	LPT--CFT	* JUMPER SEAL POT DRY/COLD FEED
.100E-01/HOUR	1.0	HOURS	LPTSPJTT	* JUMPER SEAL POT DRY
.300E-05/HOUR	6.0	MONTHS	LRV-281D	* RELAY 281 CONTACTS FAIL TO OPEN
.780E-04/HOUR	22.	HOURS	LSF7648F	* TRANSMITTER FIT-7648 INACTIVE
.120E-05/HOUR	6.0	MONTHS	LSV8773O	* BYPASS VENT VALVE SV-8773 FAILS OPEN
.100E-02/HOUR	1.0	HOURS	LSV8773X	* OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE
.300E-05/HOUR	6.0	MONTHS	LSW6852D	* SWITCH ASH-6852 FAILS TO CLOSE
.300E-05/HOUR	6.0	MONTHS	LSW6853D	* SWITCH ASH-6853 FAILS TO CLOSE
.300E-04/HOUR	1.0	HOURS	LSW7468D	* HIS-7468 FAILS TO OPEN
.100E-08/HOUR	22.	HOURS	LTG----I	LPPT STATIC CHARGE
.100E-03/HOUR	.50	MONTHS	LTKAUXTF	AUXILIARY PRECIPITATE TANK NOT PURGED
.100E-03/HOUR	22.	HOURS	LTKPRFTF	PRFT NOT PURGED
.100E-04/HOUR	22.	HOURS	LTR6852F	* TRANSMITTER AIT-6852 INACTIVE
.100E-04/HOUR	22.	HOURS	LTR6853F	* TRANSMITTER AIT-6853 INACTIVE
.340E-03/HOUR	.50	MONTHS	LUA6852F	* O2 ANALYZER 6852 INACTIVE
.100E-04/HOUR	22.	HOURS	LUA6852U	* BLOCK VALVES TO ANALYZER CLOSED (HUMAN ERROR)
.340E-04/HOUR	.50	MONTHS	LUA6853F	* O2 ANALYZER 6853 INACTIVE
.100E-04/HOUR	22.	HOURS	LUA6853U	* BLOCK VALVES TO ANALYZER CLOSED (HUMAN ERROR)
.140E-04/HOUR	22.	HOURS	LVA10F3X	LPPT PURGE MANUAL VALVES CLOSED ANY 1 OF 3
.830E-04/HOUR	22.	HOURS	LVBVCFO	BLOCK VALVE OPEN/COLD FEED
.830E-04/HOUR	22.	HOURS	LVBVPFO	BLOCK VALVE FAILS OPEN
.830E-04/HOUR	22.	HOURS	LVBSPJTO	BLOCK VALVE OPEN
.100E-04/HOUR	22.	HOURS	LVDSPTJX	DRAIN VALVE OPEN
.460E-06/HOUR	22.	HOURS	LVDSUPPX	DRAIN VALVE SUPPLEMENTAL LINE LEFT OPEN
.920E-05/HOUR	22.	HOURS	LVGM-28X	OPERATOR CLOSSES ANY 1 OF 2 MANUAL VALVES
.920E-05/HOUR	22.	HOURS	LVGM-34X	BRANCH A MANUAL VALVES CLOSED ANY 1 OF 2
.100E-03/HOUR	1.0	HOURS	LVGO-34X	* BRANCH B MANUAL VALVES CLOSED
.100E-01/HOUR	1.0	HOURS	LVGOPBRT	* OPERATOR FAILS TO VALVE BRANCH B WITHIN X MINU
.160E-04/HOUR	22.	HOURS	LV17834C	PRESSURE REGULATING VALVE 7834 FAILS CLOSED
.160E-04/HOUR	22.	HOURS	LV1M-35C	PCV 7172A FAILS CLOSED
.160E-05/HOUR	1.5	MONTHS	LV1O-35C	PCV 7172B FAILS CLOSED
.230E-04/HOUR	22.	HOURS	LVPVENTO	LPPT OVERFLOW VALVE FAILS OPEN
.120E-04/HOUR	22.	HOURS	LVS7469C	SV 7469 FAILS CLOSED
.150E-05/HOUR	6.0	MONTHS	LVS8772K	* MAIN VENT VALVE HCV-8772 FAILS TO CLOSE
.120E-04/HOUR	22.	HOURS	LVTSUPPC	SUPPLEMENTAL PURGE VALVE SV74 FAILS CLOSED
.120E-04/HOUR	22.	HOURS	LVTSVNSC	SV 74 FAILS CLOSED--NORMAL SUPPLY NEEDLE VALVE
.280E-06/HOUR	22.	HOURS	LVXLPN2P	LPPT PURGE CHECK VALVE PLUGGED
.200E-08/HOUR	22.	HOURS	LVY292AO	RELIEF VALVE PSV 292 FAILS OPEN
.200E-08/HOUR	1.5	MONTHS	LVY292BO	RELIEF VALVE PSV 292B FAILS OPEN
.100E-06/HOUR	22.	HOURS	NTK----U	SUPPLIER FAILURE- LOX SUPPLIED INTSTEAD OF LN2
.830E-05/HOUR	22.	HOURS	NVASUPPC	SUPPLEMENTAL PURGE VALVE FAILS TO OPEN
.160E-03/HOUR	22.	HOURS	NVK10F2C	BLOCK VALVE IN SUPPLEMENTAL PURGE LINE CLOSED
.690E-05/HOUR	22.	HOURS	NVPN2--F	VAPORIZER FAILS TO PROVIDE HEAT
.100E-04/HOUR	22.	HOURS	NVS7864C	SOLENOID VALVE SV 7864 FAILS CLOSED
.210E-05/HOUR	22.	HOURS	NVX10F4X	MANUAL VALVE CLOSED (ANY 1 OF 4)
.140E-07/HOUR	22.	HOURS	NVY10F3O	PRESSURE RELIEF VALVE FAILS OPEN (ANY 1 OF 7)
.620E-04/HOUR	22.	HOURS	NVZN2--O	Y-STRAINER VALVE OPEN
.230E-04/HOUR	22.	HOURS	OVA10F5X	MANUAL VALVE CLOSED (ANY 1 OF 5)
.320E-04/HOUR	22.	HOURS	OVA10F7X	VALVE IN H AREA STEAM LINE TO PRESS REDUCTION
.230E-04/HOUR	22.	HOURS	OVD10F5X	DRAIN VALVE OPEN (ANY 1 OF 5)
.220E-05/HOUR	22.	HOURS	OVL7538C	TEMPERATURE CONTROL VALVE TCV 7538 FAILS CLOSE
.230E-01/HOUR	1.0	HOURS	PUMPOUT-	* TIME PERIOD -- PUMPOUT 1 HR BENZENE CONC NORMA

.920E-05/HOUR	22.	HOURS	ZVA10F2X	MANUAL VALVE CLOSED (ANY 1 OF 2)
.920E-05/HOUR	22.	HOURS	ZVA7418X	MANUAL VALVE CLOSED (ANY 1 OF 2)
.920E-05/HOUR	22.	HOURS	ZVA7420X	MANUAL VALVE CLOSED (ANY 1 OF 2)
.160E-04/HOUR	22.	HOURS	ZV17418C	PRESSURE CONTROL VALVE 7418X FAILS CLOSED
.160E-04/HOUR	22.	HOURS	ZV1742-C	PRESSURE REGULATING VALVE 7420 FAILS CLOSED
.160E-04/HOUR	22.	HOURS	ZV17420C	PRESSURE CONTROL VALVE 7420X FAILS CLOSED
.200E-08/HOUR	22.	HOURS	ZVY72--O	PRESSURE RELIEF VALVE 72 FAILS OPEN
.620E-04/HOUR	22.	HOURS	ZVZN2--O	Y-STRAINER VALVE OPEN

1 *****
FIRE/EXPLOSION LPPT W/O REDUNDANT N2 SUPPLY *****

STEADY STATE SYSTEM CHARACTERISTICS

TOP EVENT RATE (PER HOUR) = .39109E-09 TOP EVENT RATE (PER YEAR) = .34259E-05

MEAN TIME TO SYSTEM FAILURE = .25570E+10 HOURS .29189E+06 YEARS

MEAN TIME TO SYSTEM REPAIR = 10.863 HOURS .45262 DAYS,

TOP EVENT PROBABILITY = .42483E-08

MISSION TIME	1.00	Y	30.0	Y
EXPECT NO OF SYSTEM FAIL	.343E-05		.103E-03	

1 *****
FIRE/EXPLOSION LPPT W/O REDUNDANT N2 SUPPLY *****

INITIATOR (BARLOW-PROSCHAN) MEASURE OF BASIC EVENT IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

TOP EVENT PROBABILITY = .42483E-08

MISSION TIME	1.00	Y	30.0	Y
EXPECT NO OF SYSTEM FAIL	.343E-05		.103E-03	

RANK	BASIC EVENT	IMPORTANCE	FAILURE RATE	MEAN FAULT DURATION	BASIC EVENT DESCRIPTION
1	LAG---I I	.494	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
2	LVM-35C I	.966E-01	.160E-04 HOURS	22.0 HOURS	PCV 7172A FAILS CLOSED
3	LVTSVNCS I	.725E-01	.120E-04 HOURS	22.0 HOURS	SV 74 FAILS CLOSED--NORMAL SUPPLY NEEDLE VALVE
3	LVS7469C I	.725E-01	.120E-04 HOURS	22.0 HOURS	SV 7469 FAILS CLOSED
4	LVGM-28X I	.554E-01	.920E-05 HOURS	22.0 HOURS	OPERATOR CLOSSES ANY 1 OF 2 MANUAL VALVES
4	LVGM-34X I	.554E-01	.920E-05 HOURS	22.0 HOURS	BRANCH A MANUAL VALVES CLOSED ANY 1 OF 2
5	LVPVENTO I	.366E-01	.230E-04 HOURS	22.0 HOURS	LPPT OVERFLOW VALVE FAILS OPEN
5	LFLVENTO I	.366E-01	.230E-04 HOURS	22.0 HOURS	AIR LEAK THROUGH VENT VALVE FLANGE
6	LHC1027L I	.334E-01	.210E-04 HOURS	22.0 HOURS	AIR LEAK THROUGH ANY 1 OF 27 HANFORD CONNECTOR
7	LHCN2LPL I	.155E-01	.260E-05 HOURS	22.0 HOURS	LPPT N2 JUMPERS LEAK ANY 1 OF 2 (FLOW DIVERSIO
8	LOPH20-T I	.122E-01	1.00 YEARS	1.00 HOURS	OPERATOR FAILS TO REPLENISH SUMP WATER
9	LFRBR-AP I	.589E-02	.100E-05 HOURS	22.0 HOURS	BRANCH A FILTER PLUGGED
10	LVDSUPPX I	.250E-02	.460E-06 HOURS	22.0 HOURS	DRAIN VALVE SUPPLEMENTAL LINE LEFT OPEN
11	LFLJETFL I	.203E-02	.130E-05 HOURS	22.0 HOURS	AIR LEAK THROUGH LPPT TRANSFER JET FLANGE
11	LFLSPARL I	.203E-02	.130E-05 HOURS	22.0 HOURS	AIR LEAK THROUGH SPARE FEED PUMP FLANGE
11	LFLPPFLL I	.203E-02	.130E-05 HOURS	22.0 HOURS	AIR LEAK THRU LPPT TRANSFER PUMP FLANGE
11	LFLLAGTL I	.203E-02	.130E-05 HOURS	22.0 HOURS	AIR LEAK THROUGH LPPT AGITATOR FLANGE
12	LHCN2LPL I	.193E-02	.130E-05 HOURS	22.0 HOURS	AIR LEAK THRU SUMP JET CONNECTOR
13	7CPDCS-F I	.425E-03	.200E-04 HOURS	22.0 HOURS	DCS INACTIVE
14	OVAIO20X I	.377E-03	.920E-04 HOURS	22.0 HOURS	ANY PAIR OF DRIP LEG BLOW DOWN VALVES OPEN (AN
14	ZVZN2--O I	.377E-03	.620E-04 HOURS	22.0 HOURS	Y-STRAINER VALVE OPEN
15	LDPDTLL I	.672E-04	.130E-05 HOURS	22.0 HOURS	LPPT INLET DIP TUBE LEAKS
16	LTKAUXTF I	.411E-05	.100E-03 HOURS	.500 MONTHS	AUXILIARY PRECIPITATE TANK NOT PURGED

I DENOTES INITIATING EVENT
1 *****
FIRE/EXPLOSION LPPT W/O REDUNDANT N2 SUPPLY *****

ENABLER (SEQUENTIAL CONTRIBUTORY) BASIC EVENT IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

TOP EVENT PROBABILITY = .42483E-08

MISSION TIME	1.00	Y	30.0	Y
EXPECT NO OF SYSTEM FAIL	.343E-05		.103E-03	

RANK	BASIC EVENT	IMPORTANCE	FAILURE RATE	MEAN FAULT DURATION		BASIC EVENT DESCRIPTION
1	LCBAG1TD	.759	.300E-02 HOURS	1.00	HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
2	BENZENEN	.752	1.00 HOURS	1.00	HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
3	FILLSTAN	.737	.980 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
4	LAG----I I	.506	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
5	LVS8772K	.391	.150E-05 HOURS	6.00	MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE
6	LSV8773O	.310	.120E-05 HOURS	6.00	MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
7	LC6H6UEL	.248	1.00 HOURS	1.00	HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
7	FILLSTAH	.248	.190 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
7	BENZENEH	.248	.330E-01 HOURS	1.00	HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
8	LUA6852F	.239	.340E-03 HOURS	.500	MONTHS	O2 ANALYZER 6852 INACTIVE
9	LUA6853F	.232	.340E-04 HOURS	.500	MONTHS	O2 ANALYZER 6853 INACTIVE
10	LVIM-35C I	.966E-01	.160E-04 HOURS	22.0	HOURS	PCV 7172A FAILS CLOSED
11	LVTSMVNSC I	.725E-01	.120E-04 HOURS	22.0	HOURS	SV 74 FAILS CLOSED--NORMAL SUPPLY NEEDLE VALVE
11	LVS7469C I	.725E-01	.120E-04 HOURS	22.0	HOURS	SV 7469 FAILS CLOSED
12	LSV8773X	.581E-01	.100E-02 HOURS	1.00	HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE
13	LVGM-34X I	.554E-01	.920E-05 HOURS	22.0	HOURS	BRANCH A MANUAL VALVES CLOSED ANY 1 OF 2
13	LVGM-28X I	.554E-01	.920E-05 HOURS	22.0	HOURS	OPERATOR CLOSSES ANY 1 OF 2 MANUAL VALVES
14	LFLVENTO I	.367E-01	.230E-04 HOURS	22.0	HOURS	AIR LEAK THROUGH VENT VALVE FLANGE
14	LVPVENTO I	.367E-01	.230E-04 HOURS	22.0	HOURS	LPPT OVERFLOW VALVE FAILS OPEN
15	LHC1027L I	.335E-01	.210E-04 HOURS	22.0	HOURS	AIR LEAK THROUGH ANY 1 OF 27 HANFORD CONNECTOR
16	LHCN2LPL I	.155E-01	.260E-05 HOURS	22.0	HOURS	LPPT N2 JUMPERS LEAK ANY 1 OF 2 (FLOW DIVERSIO
17	PUMPOUT-	.152E-01	.230E-01 HOURS	1.00	HOURS	TIME PERIOD -- PUMPOUT 1 HR BENZENE CONC NORMA
18	1SLSUMPF	.128E-01	.200E-03 HOURS	.500	MONTHS	SUMP PUMP BUBBLER INACTIVE
19	LFRBR-AP I	.589E-02	.100E-05 HOURS	22.0	HOURS	BRANCH A FILTER PLUGGED
20	LUA6853U	.386E-02	.100E-04 HOURS	22.0	HOURS	BLOCK VALVES TO ANALYZER CLOSED (HUMAN ERROR)
20	LTR6853F	.386E-02	.100E-04 HOURS	22.0	HOURS	TRANSMITTER AIT-6853 INACTIVE
21	LVDSUPPX I	.250E-02	.460E-06 HOURS	22.0	HOURS	DRAIN VALVE SUPPLEMENTAL LINE LEFT OPEN
22	LFLLAGTL I	.203E-02	.130E-05 HOURS	22.0	HOURS	AIR LEAK THROUGH LPPT AGITATOR FLANGE
22	LFLJETFL I	.203E-02	.130E-05 HOURS	22.0	HOURS	AIR LEAK THROUGH LPPT TRANSFER JET FLANGE
22	LFLPPFLL I	.203E-02	.130E-05 HOURS	22.0	HOURS	AIR LEAK THRU LPPT TRANSFER PUMP FLANGE
22	LFLSPARL I	.203E-02	.130E-05 HOURS	22.0	HOURS	AIR LEAK THROUGH SPARE FEED PUMP FLANGE
23	LHCSUMPL I	.193E-02	.130E-05 HOURS	22.0	HOURS	AIR LEAK THRU SUMP JET CONNECTOR
24	LRY-281D	.114E-02	.300E-05 HOURS	6.00	MONTHS	RELAY 281 CONTACTS FAIL TO OPEN
25	7CPDCS-F I	.851E-03	.200E-04 HOURS	22.0	HOURS	DCS INACTIVE
26	ZVZN2--O I	.754E-03	.620E-04 HOURS	22.0	HOURS	Y-STRAINER VALVE OPEN
26	OVA1020X I	.754E-03	.920E-04 HOURS	22.0	HOURS	ANY PAIR OF DRIP LEG BLOW DOWN VALVES OPEN (AN
27	LOPH20-T I	.556E-03	1.00 YEARS	1.00	HOURS	OPERATOR FAILS TO REPLENISH SUMP WATER
28	LTR6852F	.358E-03	.100E-04 HOURS	22.0	HOURS	TRANSMITTER AIT-6852 INACTIVE

I DENOTES INITIATING EVENT

1 *****

FIRE/EXPLOSION LPPT W/O REDUNDANT N2 SUPPLY

ENABLER (SEQUENTIAL CONTRIBUTORY) BASIC EVENT IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

TOP EVENT PROBABILITY = .42483E-08

MISSION TIME	1.00	Y	30.0	Y
EXPECT NO OF SYSTEM FAIL	.343E-05		.103E-03	

RANK	BASIC EVENT	IMPORTANCE	FAILURE RATE	MEAN FAULT DURATION		BASIC EVENT DESCRIPTION
28	LUA6852U	.358E-03	.100E-04 HOURS	22.0	HOURS	BLOCK VALVES TO ANALYZER CLOSED (HUMAN ERROR)
29	LSW6853D	.139E-03	.300E-05 HOURS	6.00	MONTHS	SWITCH ASH-6853 FAILS TO CLOSE
30	LTKAUXTF I	.134E-03	.100E-03 HOURS	.500	MONTHS	AUXILIARY PRECIPITATE TANK NOT PURGED
31	LDPDTLL I	.713E-04	.130E-05 HOURS	22.0	HOURS	LPPT INLET DIP TUBE LEAKS

I DENOTES INITIATING EVENT

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

GROUP RANK	CUMULATIVE IMPORTANCE	RESIDUAL IMPORTANCE
1	.096427	.904
2	.173570	.826
3	.318217	.682
4	.454885	.545
5	.517278	.483
6	.632997	.367
7	.743896	.256
8	.832616	.167

9	.848288	.152
10	.863169	.137
11	.875926	.124
12	.888463	.112
13	.910786	.892E-01
14	.927900	.721E-01
15	.933928	.661E-01
16	.938750	.612E-01
17	.958067	.419E-01
18	.960839	.392E-01
19	.963258	.367E-01
20	.965520	.345E-01
21	.967738	.323E-01
22	.969548	.305E-01
23	.972941	.271E-01
24	.975655	.243E-01
25	.978256	.217E-01
26	.983169	.168E-01
27	.984300	.157E-01
28	.986543	.135E-01
29	.988624	.114E-01
30	.989554	.104E-01
31	.991326	.867E-02
32	.992134	.787E-02
33	.993552	.645E-02
34	.994199	.580E-02
35	.994816	.518E-02
36	.995740	.426E-02
37	.996520	.348E-02
38	.996888	.311E-02
39	.997243	.276E-02
40	.997382	.262E-02
41	.997655	.234E-02
42	.997780	.222E-02
43	.998272	.173E-02
44	.998496	.150E-02
45	.999051	.949E-03
46	.999252	.748E-03
47	.999347	.653E-03
48	.999390	.610E-03

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FIRE/EXPLOSION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
 EXPECT NO OF SYSTEM FAIL .343E-05 .103E-03
 TOP EVENT PROBABILITY = .42483E-08

RANK IMPORTANCE

1 .964E-01 CUT SET 1 MEAN TIME TO OCCURRENCE=, .26517E+11 HOURS .30271E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .096427/ .904

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LVIM-35C I	.160E-04 HOURS	22.0 HOURS	PCV 7172A FAILS CLOSED
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

2 .771E-01 CUT SET 6 MEAN TIME TO OCCURRENCE=, .33146E+11 HOURS .37838E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .173570/ .826

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LSV8773O	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LVIM-35C I	.160E-04 HOURS	22.0 HOURS	PCV 7172A FAILS CLOSED

3 .723E-01 CUT SET 2 MEAN TIME TO OCCURRENCE=, .35355E+11 HOURS .40359E+07 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.318217/ .682

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LVS7469C I	.120E-04 HOURS	22.0 HOURS	SV 7469 FAILS CLOSED
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

3 .723E-01 CUT SET 3 MEAN TIME TO OCCURRENCE=, .35355E+11 HOURS .40359E+07 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.318217/ .682

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE
LVTSVNSC I	.120E-04 HOURS	22.0 HOURS	SV 74 FAILS CLOSED--NORMAL SUPPLY NEEDLE VALVE

I DENOTES INITIATING EVENT

1 *****

FIRE/EXPLOSION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
EXPECT NO OF SYSTEM FAIL .343E-05 .103E-03
TOP EVENT PROBABILITY = .42483E-08

RANK IMPORTANCE

4 .683E-01 CUT SET 35 MEAN TIME TO OCCURRENCE=, .37419E+11 HOURS .42715E+07 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.454885/ .545

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LAG----I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFLVENTO I	.230E-04 HOURS	22.0 HOURS	AIR LEAK THROUGH VENT VALVE FLANGE
LUA6852F	.340E-03 HOURS	.500 MONTHS	O2 ANALYZER 6852 INACTIVE
LUA6853F	.340E-04 HOURS	.500 MONTHS	O2 ANALYZER 6853 INACTIVE

4 .683E-01 CUT SET 36 MEAN TIME TO OCCURRENCE=, .37419E+11 HOURS .42715E+07 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.454885/ .545

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LAG----I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LUA6852F	.340E-03 HOURS	.500 MONTHS	O2 ANALYZER 6852 INACTIVE
LUA6853F	.340E-04 HOURS	.500 MONTHS	O2 ANALYZER 6853 INACTIVE
LVPVENTO I	.230E-04 HOURS	22.0 HOURS	LPPT OVERFLOW VALVE FAILS OPEN

5 .624E-01 CUT SET 37 MEAN TIME TO OCCURRENCE=, .40981E+11 HOURS .46782E+07 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.517278/ .483

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LAG----I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LHC1027L I	.210E-04 HOURS	22.0 HOURS	AIR LEAK THROUGH ANY 1 OF 27 HANFORD CONNECTOR
LUA6852F	.340E-03 HOURS	.500 MONTHS	O2 ANALYZER 6852 INACTIVE
LUA6853F	.340E-04 HOURS	.500 MONTHS	O2 ANALYZER 6853 INACTIVE

I DENOTES INITIATING EVENT
1 *****

FIRE/EXPLOSION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
EXPECT NO OF SYSTEM FAIL .343E-05 .103E-03
TOP EVENT PROBABILITY = .42483E-08

RANK IMPORTANCE

6 .579E-01 CUT SET 8 MEAN TIME TO OCCURRENCE=, .44193E+11 HOURS .50449E+07 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.632997/ .367

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LSV87730	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LVS7469C I	.120E-04 HOURS	22.0 HOURS	SV 7469 FAILS CLOSED

6 .579E-01 CUT SET 7 MEAN TIME TO OCCURRENCE=, .44193E+11 HOURS .50449E+07 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.632997/ .367

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LSV87730	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LVTSVNSC I	.120E-04 HOURS	22.0 HOURS	SV 74 FAILS CLOSED--NORMAL SUPPLY NEEDLE VALVE

7 .554E-01 CUT SET 4 MEAN TIME TO OCCURRENCE=, .46113E+11 HOURS .52641E+07 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.743896/ .256

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LVGM-34X I	.920E-05 HOURS	22.0 HOURS	BRANCH A MANUAL VALVES CLOSED ANY 1 OF 2
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

7 .554E-01 CUT SET 5 MEAN TIME TO OCCURRENCE=, .46113E+11 HOURS .52641E+07 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.743896/ .256

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LVGM-28X I	.920E-05 HOURS	22.0 HOURS	OPERATOR CLOSSES ANY 1 OF 2 MANUAL VALVES
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

I DENOTES INITIATING EVENT
1 *****

FIRE/EXPLOSION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
EXPECT NO OF SYSTEM FAIL .343E-05 .103E-03
TOP EVENT PROBABILITY = .42483E-08

RANK IMPORTANCE

8 .444E-01 CUT SET 9 MEAN TIME TO OCCURRENCE=, .57641E+11 HOURS .65801E+07 YEARS

GROUP RANK CUMULATIVE/RESIDUAL

.832616/ .167

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00	HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00	HOURS	AGITATOR MCC CONTACTS JI-7171 FAIL TO OPEN
LSV87730	.120E-05 HOURS	6.00	MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LVGH-2BX I	.920E-05 HOURS	22.0	HOURS	OPERATOR CLOSSES ANY 1 OF 2 MANUAL VALVES

8 .444E-01 CUT SET 10 MEAN TIME TO OCCURRENCE=, .57641E+11 HOURS .65801E+07 YEARS

GROUP RANK CUMULATIVE/RESIDUAL

.832616/ .167

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00	HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00	HOURS	AGITATOR MCC CONTACTS JI-7171 FAIL TO OPEN
LSV87730	.120E-05 HOURS	6.00	MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LVGH-34X I	.920E-05 HOURS	22.0	HOURS	BRANCH A MANUAL VALVES CLOSED ANY 1 OF 2

9 .157E-01 CUT SET 11 MEAN TIME TO OCCURRENCE=, .16316E+12 HOURS .18625E+08 YEARS

GROUP RANK CUMULATIVE/RESIDUAL

.848288/ .152

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00	HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00	HOURS	AGITATOR MCC CONTACTS JI-7171 FAIL TO OPEN
LHCN2LPL I	.260E-05 HOURS	22.0	HOURS	LPPT N2 JUMPERS LEAK ANY 1 OF 2 (FLOW DIVERSIO
LVS8772K	.150E-05 HOURS	6.00	MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

10 .149E-01 CUT SET 12 MEAN TIME TO OCCURRENCE=, .17183E+12 HOURS .19615E+08 YEARS

GROUP RANK CUMULATIVE/RESIDUAL

.863169/ .137

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00	HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00	HOURS	AGITATOR MCC CONTACTS JI-7171 FAIL TO OPEN
LSV8773X	.100E-02 HOURS	1.00	HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE
LVIM-35C I	.160E-04 HOURS	22.0	HOURS	PCV 7172A FAILS CLOSED

I DENOTES INITIATING EVENT

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FIRE/EXPLOSION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
 EXPECT NO OF SYSTEM FAIL .343E-05 .103E-03
 TOP EVENT PROBABILITY = .42483E-08

RANK IMPORTANCE

11 .128E-01 CUT SET 84 MEAN TIME TO OCCURRENCE=, .20043E+12 HOURS .22881E+08 YEARS

GROUP RANK CUMULATIVE/RESIDUAL

.875926/ .124

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
1SLSUMPF	.200E-03 HOURS	.500	MONTHS	SUMP PUMP BUBBLER INACTIVE
BENZENEN	.330E-01 HOURS	1.00	HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LAG----I I	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
LC6H6UEL	.100E+01 HOURS	1.00	HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LOPH20-T I	.100E+01 YEARS	1.00	HOURS	OPERATOR FAILS TO REPLENISH SUMP WATER
LUA6852F	.340E-03 HOURS	.500	MONTHS	O2 ANALYZER 6852 INACTIVE
LUA6853F	.340E-04 HOURS	.500	MONTHS	O2 ANALYZER 6853 INACTIVE

12 .125E-01 CUT SET 17 MEAN TIME TO OCCURRENCE=, .20395E+12 HOURS .23282E+08 YEARS

GROUP RANK CUMULATIVE/RESIDUAL

.888463/ .112

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS JI-7171 FAIL TO OPEN
LHCN2LPL I	.260E-05 HOURS	22.0 HOURS	LPPT N2 JUMPERS LEAK ANY 1 OF 2 (FLOW DIVERSIO
LSVB7730	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN

13 .112E-01 CUT SET 14 MEAN TIME TO OCCURRENCE=, .22909E+12 HOURS .26152E+08 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.910786/ .892E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS JI-7171 FAIL TO OPEN
LSVB773X	.100E-02 HOURS	1.00 HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE
LVSV7469C I	.120E-04 HOURS	22.0 HOURS	SV 7469 FAILS CLOSED

I DENOTES INITIATING EVENT

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FIRE/EXPLOSION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
EXPECT NO OF SYSTEM FAIL .343E-05 .103E-03
TOP EVENT PROBABILITY = .42483E-08

RANK IMPORTANCE

13 .112E-01 CUT SET 13 MEAN TIME TO OCCURRENCE=, .22909E+12 HOURS .26152E+08 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.910786/ .892E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS JI-7171 FAIL TO OPEN
LSVB773X	.100E-02 HOURS	1.00 HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE
LVTSVNSC I	.120E-04 HOURS	22.0 HOURS	SV 74 FAILS CLOSED--NORMAL SUPPLY NEEDLE VALVE

14 .856E-02 CUT SET 16 MEAN TIME TO OCCURRENCE=, .29881E+12 HOURS .34111E+08 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.927900/ .721E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS JI-7171 FAIL TO OPEN
LSVB773X	.100E-02 HOURS	1.00 HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE
LVGM-34X I	.920E-05 HOURS	22.0 HOURS	BRANCH A MANUAL VALVES CLOSED ANY 1 OF 2

14 .856E-02 CUT SET 15 MEAN TIME TO OCCURRENCE=, .29881E+12 HOURS .34111E+08 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.927900/ .721E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS JI-7171 FAIL TO OPEN
LSVB773X	.100E-02 HOURS	1.00 HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE
LVGM-28X I	.920E-05 HOURS	22.0 HOURS	OPERATOR CLOSES ANY 1 OF 2 MANUAL VALVES

15 .603E-02 CUT SET 18 MEAN TIME TO OCCURRENCE=, .42421E+12 HOURS .48425E+08 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.933928/ .661E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
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BENZENEN	.100E+01 HOURS	1.00	HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00	HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LFRBR-AP I	.100E-05 HOURS	22.0	HOURS	BRANCH A FILTER PLUGGED
LVS8772K	.150E-05 HOURS	6.00	MONTHS	MAIN VENT VALVE MCV-8772 FAILS TO CLOSE

I DENOTES INITIATING EVENT

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FIRE/EXPLOSION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
 EXPECT NO OF SYSTEM FAIL .343E-05 .103E-03
 TOP EVENT PROBABILITY = .42483E-08

RANK IMPORTANCE

16 .482E-02 CUT SET 23 MEAN TIME TO OCCURRENCE=, .53025E+12 HOURS .60531E+08 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .938750/ .612E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LFRBR-AP I	.100E-05 HOURS	22.0 HOURS	BRANCH A FILTER PLUGGED
LSV87730	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN

17 .386E-02 CUT SET 57 MEAN TIME TO OCCURRENCE=, .66186E+12 HOURS .75555E+08 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .958067/ .419E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LAG----I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LHCSUMPL I	.130E-05 HOURS	22.0 HOURS	AIR LEAK THRU SUMP JET CONNECTOR
LUA6852F	.340E-03 HOURS	.500 MONTHS	O2 ANALYZER 6852 INACTIVE
LUA6853F	.340E-04 HOURS	.500 MONTHS	O2 ANALYZER 6853 INACTIVE

17 .386E-02 CUT SET 39 MEAN TIME TO OCCURRENCE=, .66186E+12 HOURS .75555E+08 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .958067/ .419E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LAG----I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFLJETFL I	.130E-05 HOURS	22.0 HOURS	AIR LEAK THROUGH LPPT TRANSFER JET FLANGE
LUA6852F	.340E-03 HOURS	.500 MONTHS	O2 ANALYZER 6852 INACTIVE
LUA6853F	.340E-04 HOURS	.500 MONTHS	O2 ANALYZER 6853 INACTIVE

I DENOTES INITIATING EVENT

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FIRE/EXPLOSION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
 EXPECT NO OF SYSTEM FAIL .343E-05 .103E-03
 TOP EVENT PROBABILITY = .42483E-08

RANK IMPORTANCE

17 .386E-02 CUT SET 40 MEAN TIME TO OCCURRENCE=, .66186E+12 HOURS .75555E+08 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .958067/ .419E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
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BENZENEH	.330E-01 HOURS	1.00	HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LAG----I I	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
LC6H6UEL	.100E+01 HOURS	1.00	HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFLPPFLL I	.130E-05 HOURS	22.0	HOURS	AIR LEAK THRU LPPT TRANSFER PUMP FLANGE
LUA6852F	.340E-03 HOURS	.500	MONTHS	O2 ANALYZER 6852 INACTIVE
LUA6853F	.340E-04 HOURS	.500	MONTHS	O2 ANALYZER 6853 INACTIVE

17 .386E-02 CUT SET 41 MEAN TIME TO OCCURRENCE=, .66186E+12 HOURS .75555E+08 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.958067/ .419E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00	HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LAG----I I	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
LC6H6UEL	.100E+01 HOURS	1.00	HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFLLAGTL I	.130E-05 HOURS	22.0	HOURS	AIR LEAK THROUGH LPPT AGITATOR FLANGE
LUA6852F	.340E-03 HOURS	.500	MONTHS	O2 ANALYZER 6852 INACTIVE
LUA6853F	.340E-04 HOURS	.500	MONTHS	O2 ANALYZER 6853 INACTIVE

17 .386E-02 CUT SET 38 MEAN TIME TO OCCURRENCE=, .66186E+12 HOURS .75555E+08 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.958067/ .419E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00	HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LAG----I I	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
LC6H6UEL	.100E+01 HOURS	1.00	HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFLSPARL I	.130E-05 HOURS	22.0	HOURS	AIR LEAK THROUGH SPARE FEED PUMP FLANGE
LUA6852F	.340E-03 HOURS	.500	MONTHS	O2 ANALYZER 6852 INACTIVE
LUA6853F	.340E-04 HOURS	.500	MONTHS	O2 ANALYZER 6853 INACTIVE

I DENOTES INITIATING EVENT

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FIRE/EXPLOSION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAM) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME	.100E+01Y	.300E+02Y
EXPECT NO OF SYSTEM FAIL	.343E-05	.103E-03
TOP EVENT PROBABILITY =	.42483E-08	

RANK IMPORTANCE

18 .277E-02 CUT SET 20 MEAN TIME TO OCCURRENCE=, .92218E+12 HOURS .10527E+09 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.960839/ .392E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEH	.100E+01 HOURS	1.00	HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00	HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LVDSUPPX I	.460E-06 HOURS	22.0	HOURS	DRAIN VALVE SUPPLEMENTAL LINE LEFT OPEN
LVS8772K	.150E-05 HOURS	6.00	MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

19 .242E-02 CUT SET 24 MEAN TIME TO OCCURRENCE=, .10572E+13 HOURS .12069E+09 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.963258/ .367E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEH	.100E+01 HOURS	1.00	HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00	HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LHCN2LPL I	.260E-05 HOURS	22.0	HOURS	LPPT N2 JUMPERS LEAK ANY 1 OF 2 (FLOW DIVERSIO
LSV8773X	.100E-02 HOURS	1.00	HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE

20 .226E-02 CUT SET 19 MEAN TIME TO OCCURRENCE=, .11304E+13 HOURS .12904E+09 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.965520/ .345E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
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BENZENEN	.100E+01 HOURS	1.00	HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
LAG----I I	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00	HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LVIM-35C I	.160E-04 HOURS	22.0	HOURS	PCV 7172A FAILS CLOSED
LVS8772K	.150E-05 HOURS	6.00	MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE
PUMPOUT-	.230E-01 HOURS	1.00	HOURS	TIME PERIOD -- PUMPOUT 1 HR BENZENE CONC NORMA

21 .222E-02 CUT SET 28 MEAN TIME TO OCCURRENCE=, .11527E+13 HOURS .13159E+09 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.967738/ .323E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00	HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00	HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LSV8773O	.120E-05 HOURS	6.00	MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LVDSUPPX I	.460E-06 HOURS	22.0	HOURS	DRAIN VALVE SUPPLEMENTAL LINE LEFT OPEN

I DENOTES INITIATING EVENT

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FIRE/EXPLOSION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
EXPECT NO OF SYSTEM FAIL .343E-05 .103E-03
TOP EVENT PROBABILITY = .42483E-08

RANK IMPORTANCE

22 .181E-02 CUT SET 27 MEAN TIME TO OCCURRENCE=, .14130E+13 HOURS .16130E+09 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.969548/ .305E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00	HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
LAG----I I	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00	HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LSV8773O	.120E-05 HOURS	6.00	MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LVIM-35C I	.160E-04 HOURS	22.0	HOURS	PCV 7172A FAILS CLOSED
PUMPOUT-	.230E-01 HOURS	1.00	HOURS	TIME PERIOD -- PUMPOUT 1 HR BENZENE CONC NORMA

23 .170E-02 CUT SET 22 MEAN TIME TO OCCURRENCE=, .15072E+13 HOURS .17205E+09 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.972941/ .271E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00	HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
LAG----I I	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00	HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LVS8772K	.150E-05 HOURS	6.00	MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE
LVTSVNSC I	.120E-04 HOURS	22.0	HOURS	SV 74 FAILS CLOSED--NORMAL SUPPLY NEEDLE VALVE
PUMPOUT-	.230E-01 HOURS	1.00	HOURS	TIME PERIOD -- PUMPOUT 1 HR BENZENE CONC NORMA

23 .170E-02 CUT SET 21 MEAN TIME TO OCCURRENCE=, .15072E+13 HOURS .17205E+09 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.972941/ .271E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00	HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
LAG----I I	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00	HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LVS7469C I	.120E-04 HOURS	22.0	HOURS	SV 7469 FAILS CLOSED
LVS8772K	.150E-05 HOURS	6.00	MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE
PUMPOUT-	.230E-01 HOURS	1.00	HOURS	TIME PERIOD -- PUMPOUT 1 HR BENZENE CONC NORMA

24 .136E-02 CUT SET 29 MEAN TIME TO OCCURRENCE=, .18839E+13 HOURS .21506E+09 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.975655/ .243E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00	HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
LAG----I I	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00	HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN

LSV87730	.120E-05 HOURS	6.00	MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LVS7469C I	.120E-04 HOURS	22.0	HOURS	SV 7469 FAILS CLOSED
PUMPOUT-	.230E-01 HOURS	1.00	HOURS	TIME PERIOD -- PUMPOUT 1 HR BENZENE CONC NORMA

I DENOTES INITIATING EVENT

1 *****

FIRE/EXPLOSION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
 EXPECT NO OF SYSTEM FAIL .343E-05 .103E-03
 TOP EVENT PROBABILITY = .42483E-08

RANK IMPORTANCE

24 .136E-02 CUT SET 30 MEAN TIME TO OCCURRENCE=, .18839E+13 HOURS .21506E+09 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL

.975655/ .243E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
LAG---I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS JI-7171 FAIL TO OPEN
LSV87730	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LVTSVNSC I	.120E-04 HOURS	22.0 HOURS	SV 74 FAILS CLOSED--NORMAL SUPPLY NEEDLE VALVE
PUMPOUT-	.230E-01 HOURS	1.00 HOURS	TIME PERIOD -- PUMPOUT 1 HR BENZENE CONC NORMA

25 .130E-02 CUT SET 25 MEAN TIME TO OCCURRENCE=, .19659E+13 HOURS .22442E+09 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL

.978256/ .217E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
LAG---I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS JI-7171 FAIL TO OPEN
LVGH-34X I	.920E-05 HOURS	22.0 HOURS	BRANCH A MANUAL VALVES CLOSED ANY 1 OF 2
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE
PUMPOUT-	.230E-01 HOURS	1.00 HOURS	TIME PERIOD -- PUMPOUT 1 HR BENZENE CONC NORMA

25 .130E-02 CUT SET 26 MEAN TIME TO OCCURRENCE=, .19659E+13 HOURS .22442E+09 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL

.978256/ .217E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
LAG---I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS JI-7171 FAIL TO OPEN
LVGH-28X I	.920E-05 HOURS	22.0 HOURS	OPERATOR CLOSSES ANY 1 OF 2 MANUAL VALVES
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE
PUMPOUT-	.230E-01 HOURS	1.00 HOURS	TIME PERIOD -- PUMPOUT 1 HR BENZENE CONC NORMA

I DENOTES INITIATING EVENT

1 *****

FIRE/EXPLOSION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
 EXPECT NO OF SYSTEM FAIL .343E-05 .103E-03
 TOP EVENT PROBABILITY = .42483E-08

RANK IMPORTANCE

26 .123E-02 CUT SET 45 MEAN TIME TO OCCURRENCE=, .20818E+13 HOURS .23765E+09 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL

.983169/ .168E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LAG---I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS

LFLVENTO I	.230E-04 HOURS	22.0	HOURS	AIR LEAK THROUGH VENT VALVE FLANGE
LTR6853F	.100E-04 HOURS	22.0	HOURS	TRANSMITTER AIT-6853 INACTIVE
LUA6852F	.340E-03 HOURS	.500	MONTHS	O2 ANALYZER 6852 INACTIVE

26 .123E-02 CUT SET 43 MEAN TIME TO OCCURRENCE=, .20818E+13 HOURS .23765E+09 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.983169/ .168E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00	HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LAG----I I	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
LC6H6UEL	.100E+01 HOURS	1.00	HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LUA6852F	.340E-03 HOURS	.500	MONTHS	O2 ANALYZER 6852 INACTIVE
LUA6853U	.100E-04 HOURS	22.0	HOURS	BLOCK VALVES TO ANALYZER CLOSED (HUMAN ERROR)
LVPVENTO I	.230E-04 HOURS	22.0	HOURS	LPPT OVERFLOW VALVE FAILS OPEN

26 .123E-02 CUT SET 44 MEAN TIME TO OCCURRENCE=, .20818E+13 HOURS .23765E+09 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.983169/ .168E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00	HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LAG----I I	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
LC6H6UEL	.100E+01 HOURS	1.00	HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LTR6853F	.100E-04 HOURS	22.0	HOURS	TRANSMITTER AIT-6853 INACTIVE
LUA6852F	.340E-03 HOURS	.500	MONTHS	O2 ANALYZER 6852 INACTIVE
LVPVENTO I	.230E-04 HOURS	22.0	HOURS	LPPT OVERFLOW VALVE FAILS OPEN

I DENOTES INITIATING EVENT

1 *****

FIRE/EXPLOSION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
EXPECT NO OF SYSTEM FAIL .343E-05 .103E-03
TOP EVENT PROBABILITY = .42483E-08

RANK IMPORTANCE

26 .123E-02 CUT SET 42 MEAN TIME TO OCCURRENCE=, .20818E+13 HOURS .23765E+09 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.983169/ .168E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00	HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LAG----I I	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
LC6H6UEL	.100E+01 HOURS	1.00	HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFLVENTO I	.230E-04 HOURS	22.0	HOURS	AIR LEAK THROUGH VENT VALVE FLANGE
LUA6852F	.340E-03 HOURS	.500	MONTHS	O2 ANALYZER 6852 INACTIVE
LUA6853U	.100E-04 HOURS	22.0	HOURS	BLOCK VALVES TO ANALYZER CLOSED (HUMAN ERROR)

27 .113E-02 CUT SET 80 MEAN TIME TO OCCURRENCE=, .22618E+13 HOURS .25819E+09 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.984300/ .157E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
OVA1020X I	.920E-04 HOURS	22.0	HOURS	ANY PAIR OF DRIP LEG BLOW DOWN VALVES OPEN (AN
BENZENEH	.100E+01 HOURS	1.00	HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAH	.980E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LAG----I I	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00	HOURS	AGITATOR MCC CONTACTS JI-7171 FAIL TO OPEN
LVS8772K	.150E-05 HOURS	6.00	MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE
ZV2N2--O I	.620E-04 HOURS	22.0	HOURS	Y-STRAINER VALVE OPEN

28 .112E-02 CUT SET 47 MEAN TIME TO OCCURRENCE=, .22800E+13 HOURS .26028E+09 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.986543/ .135E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00	HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE

LAG---I I	.300E-02 HOURS	22.0	HOURS	AGITATOR IGNITION SOURCE
LC6H6UEL	.100E+01 HOURS	1.00	HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LHC1027L I	.210E-04 HOURS	22.0	HOURS	AIR LEAK THROUGH ANY 1 OF 27 HANFORD CONNECTOR
LUA6852F	.340E-03 HOURS	.500	MONTHS	O2 ANALYZER 6852 INACTIVE
LUA6853U	.100E-04 HOURS	22.0	HOURS	BLOCK VALVES TO ANALYZER CLOSED (HUMAN ERROR)

I DENOTES INITIATING EVENT

1 *****

FIRE/EXPLOSION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
 EXPECT NO OF SYSTEM FAIL .343E-05 .103E-03
 TOP EVENT PROBABILITY = .42483E-08

RANK IMPORTANCE

28 .112E-02 CUT SET 46 MEAN TIME TO OCCURRENCE=, .22800E+13 HOURS .26028E+09 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .986543/ .135E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LAG---I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LHC1027L I	.210E-04 HOURS	22.0 HOURS	AIR LEAK THROUGH ANY 1 OF 27 HANFORD CONNECTOR
LTR6853F	.100E-04 HOURS	22.0 HOURS	TRANSMITTER AIT-6853 INACTIVE
LUA6852F	.340E-03 HOURS	.500 MONTHS	O2 ANALYZER 6852 INACTIVE

29 .104E-02 CUT SET 33 MEAN TIME TO OCCURRENCE=, .24573E+13 HOURS .28051E+09 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .988624/ .114E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
LAG---I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LSV87730	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LVGM-34X I	.920E-05 HOURS	22.0 HOURS	BRANCH A MANUAL VALVES CLOSED ANY 1 OF 2
PUMPOUT-	.230E-01 HOURS	1.00 HOURS	TIME PERIOD -- PUMPOUT 1 HR BENZENE CONC NORMA

29 .104E-02 CUT SET 32 MEAN TIME TO OCCURRENCE=, .24573E+13 HOURS .28051E+09 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .988624/ .114E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
LAG---I I	.300E-02 HOURS	22.0 HOURS	AGITATOR IGNITION SOURCE
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LSV87730	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LVGM-28X I	.920E-05 HOURS	22.0 HOURS	OPERATOR CLOSSES ANY 1 OF 2 MANUAL VALVES
PUMPOUT-	.230E-01 HOURS	1.00 HOURS	TIME PERIOD -- PUMPOUT 1 HR BENZENE CONC NORMA

I DENOTES INITIATING EVENT

1 *****

FIRE/EXPLOSION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE
 FOR CUT SETS OF RANK 30 AND HIGHER

STEADY STATE CALCULATIONS

TOP EVENT PROBABILITY = .42483E-08

MISSION TIME 1.00 Y 30.0 Y
 EXPECT NO OF SYSTEM FAIL .343E-05 .103E-03

RANK	CUT SET NO	IMPORTANCE*	RANK	CUT SET NO	IMPORTANCE*	RANK	CUT SET NO	IMPORTANCE*	RANK	CUT SET NO	IMPORTANCE*
30	31	.930E-03*	37	55	.390E-03*	43	62	.123E-03*	45	72	.694E-04*

31	48	.886E-03*	37	54	.390E-03*	43	64	.123E-03*	45	73	.694E-04*
31	49	.886E-03*	38	34	.368E-03*	44	65	.112E-03*	46	78	.501E-04*
32	50	.809E-03*	39	56	.356E-03*	44	66	.112E-03*	46	75	.501E-04*
33	52	.709E-03*	40	83	.138E-03*	45	70	.694E-04*	46	76	.501E-04*
33	51	.709E-03*	41	59	.137E-03*	45	71	.694E-04*	46	77	.501E-04*
34	53	.647E-03*	41	58	.137E-03*	45	67	.694E-04*	47	86	.475E-04*
35	79	.616E-03*	42	60	.125E-03*	45	68	.694E-04*	47	85	.475E-04*
36	81	.462E-03*	43	63	.123E-03*	45	69	.694E-04*	48	87	.434E-04*
36	82	.462E-03*	43	61	.123E-03*	45	74	.694E-04*			

1 REFERENCE TABLE FOR MIN CUT SETS

ORDER	1	2	3	4	5	6	7	8
NO. OF MIN CUT SETS	0	0	0	0	0	34	48	5

NO. OF MIN CUT SETS = 87

CUT SET NO. ORDER BASIC EVENTS

1	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LVIM-35C	LVS8772K	
2	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LVS7469C	LVS8772K	
3	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LVS8772K	LVTSVNSC	
4	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LVGM-34X	LVS8772K	
5	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LVGM-28X	LVS8772K	
6	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LSV87730	LVIM-35C	
7	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LSV87730	LVTSVNSC	
8	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LSV87730	LVS7469C	
9	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LSV87730	LVGM-28X	
10	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LSV87730	LVGM-34X	
11	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LHCN2LPL	LVS8772K	
12	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LSV8773X	LVIM-35C	
13	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LSV8773X	LVTSVNSC	
14	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LSV8773X	LVS7469C	
15	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LSV8773X	LVGM-28X	
16	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LSV8773X	LVGM-34X	
17	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LHCN2LPL	LSV87730	
18	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LFRBR-AP	LVS8772K	
19	6	BENZENEN	LAG----	LCBAGITD	LVIM-35C	LVS8772K	PUMPOUT-	
20	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LVDSUPPX	LVS8772K	
21	6	BENZENEN	LAG----	LCBAGITD	LVS7469C	LVS8772K	PUMPOUT-	
22	6	BENZENEN	LAG----	LCBAGITD	LVS8772K	LVTSVNSC	PUMPOUT-	
23	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LFRBR-AP	LSV87730	
24	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LHCN2LPL	LSV8773X	
25	6	BENZENEN	LAG----	LCBAGITD	LVGM-34X	LVS8772K	PUMPOUT-	
26	6	BENZENEN	LAG----	LCBAGITD	LVGM-28X	LVS8772K	PUMPOUT-	
27	6	BENZENEN	LAG----	LCBAGITD	LSV87730	LVIM-35C	PUMPOUT-	
28	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LSV87730	LVDSUPPX	
29	6	BENZENEN	LAG----	LCBAGITD	LSV87730	LVS7469C	PUMPOUT-	
30	6	BENZENEN	LAG----	LCBAGITD	LSV87730	LVTSVNSC	PUMPOUT-	
31	6	BENZENEN	FILLSTAN	LAG----	LCBAGITD	LFRBR-AP	LSV8773X	
32	6	BENZENEN	LAG----	LCBAGITD	LSV87730	LVGM-28X	PUMPOUT-	
33	6	BENZENEN	LAG----	LCBAGITD	LSV87730	LVGM-34X	PUMPOUT-	
34	6	BENZENEN	LAG----	LCBAGITD	LHCN2LPL	LVS8772K	PUMPOUT-	
35	7	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LFLVENTO	LUA6852F	LUA6853F
36	7	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LUA6852F	LUA6853F	LVPVENTO
37	7	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LHC1027L	LUA6852F	LUA6853F
38	7	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LFLSPARL	LUA6852F	LUA6853F
39	7	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LFLJETFL	LUA6852F	LUA6853F
40	7	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LFLPPFLL	LUA6852F	LUA6853F
41	7	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LFLLAGTL	LUA6852F	LUA6853F
42	7	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LFLVENTO	LUA6852F	LUA6853U
43	7	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LUA6852F	LUA6853U	LVPVENTO
44	7	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LTR6853F	LUA6852F	LVPVENTO
45	7	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LFLVENTO	LTR6853F	LUA6852F
46	7	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LHC1027L	LTR6853F	LUA6852F
47	7	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LHC1027L	LUA6852F	LUA6853U
48	7	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LCBAGITD	LFLVENTO	LVS8772K
49	7	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LCBAGITD	LVPVENTO	LVS8772K
50	7	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LCBAGITD	LHC1027L	LVS8772K
51	7	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LCBAGITD	LFLVENTO	LSV87730
52	7	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LCBAGITD	LSV87730	LVPVENTO
53	7	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LCBAGITD	LHC1027L	LSV87730
54	7	7CPDCS-F	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LFLVENTO	LRV-281D
55	7	7CPDCS-F	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LRV-281D	LVPVENTO
56	7	7CPDCS-F	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LHC1027L	LRV-281D
57	7	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LHC5LMP	LUA6852F	LUA6853F
58	7	BENZENEH	FILLSTAH	LAG----	LC6H6UEL	LCBAGITD	LSV8773X	LVPVENTO

59	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LCBAGITD	LFLVENTO	LSV8773X	
60	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LCBAGITD	LHC1027L	LSV8773X	
61	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LTR6852F	LUA6853F	LVPVENTO	
62	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LFLVENTO	LTR6852F	LUA6853F	
63	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LUA6852U	LUA6853F	LVPVENTO	
64	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LFLVENTO	LUA6852U	LUA6853F	
65	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LHC1027L	LTR6852F	LUA6853F	
66	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LHC1027L	LUA6852U	LUA6853F	
67	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LFLJETFL	LUA6852F	LUA6853U	
68	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LFLPPFLL	LUA6852F	LUA6853U	
69	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LFLLAGTL	LUA6852F	LUA6853U	
70	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LFLSPARL	LUA6852F	LUA6853U	
71	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LFLJETFL	LTR6853F	LUA6852F	
72	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LFLPPFLL	LTR6853F	LUA6852F	
73	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LFLLAGTL	LTR6853F	LUA6852F	
74	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LFLSPARL	LTR6853F	LUA6852F	
75	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LCBAGITD	LFLJETFL	LVS8772K	
76	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LCBAGITD	LFLPPFLL	LVS8772K	
77	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LCBAGITD	LFLLAGTL	LVS8772K	
78	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LCBAGITD	LFLSPARL	LVS8772K	
79	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LCBAGITD	LVIM-35C	LVS8772K	
80	7	OVAIO20X	BENZENEH	FILLSTAH	LAG----I	LCBAGITD	LVS8772K	ZVZN2--D	
81	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LCBAGITD	LVS7469C	LVS8772K	
82	7	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LCBAGITD	LVS8772K	LVTSVNSC	
83	8	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LDPDTLL	LYKAUXTF	LUA6852F	LUA6853F
84	8	1SLSUMPF	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LOPH20-Y	LUA6852F	LUA6853F
85	8	7CPDCS-F	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LSW6853D	LUA6852F	LVPVENTO
86	8	7CPDCS-F	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LFLVENTO	LSW6853D	LUA6852F
87	8	7CPDCS-F	BENZENEH	FILLSTAH	LAG----I	LC6H6UEL	LHC1027L	LSW6853D	LUA6852F

APPENDIX C

IMPORTANCE OUTPUT

EXPLOSIVE CONCENTRATION WITHIN THE

LOW POINT PRECIPITATE TANK

WITHOUT REDUNDANT N₂ PURGE SUPPLY

** TIME AND DATE OF RUN -- 00:51:36 MAY 20, 1992
INPUT FILE NAME : LPWOEC .II

EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

INPUT DATA OPTION 1
FAILURE RATE AND MEAN FAULT DURATION GIVEN IN TERMS OF REAL TIME

STEADY STATE CALCULATIONS

EXPECTED NUMBER OF FAILURES CALCULATED FOR TIME = , 1.00Y 30.00Y

** BASIC EVENT OPTIONS USED **

	CRITICALITY	UPGRADING FUNCTION	FUSSELL-VESELY	INITIATOR (BARLOW-PROSCHAN)	ENABLER (CONTRIBUTORY)	STRUCTURAL
BIRNBAUM	NO	NO	NO	YES	YES	NO

** MIN CUT SET OPTIONS USED **

INITIATOR (BARLOW-PROSCHAN)	FUSSELL-VESELY
YES	NO

INFORMATION ON DETAILED CUT SET OUTPUT -- NM =100 AND FACTOR = .100E-01

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EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

** BASIC EVENT DATA **

FAILURE RATE	MEAN FAULT DURATION	NAME	ENABLER	DESCRIPTION
.200E+00/YEAR	22. HOURS	OH-AREAF		H AREA STEAM SUPPLY FAILS
.200E+00/YEAR	22. HOURS	OSPRDSYF		STEAM PRESSURE REDUCTION SYSTEM FAILS
.920E-04/HOUR	22. HOURS	OVAIO20X		ANY PAIR OF DRIP LEG BLOW DOWN VALVES OPEN (AM
.160E-04/HOUR	22. HOURS	OVI4004C		PRESSURE CONTROL VALVE PCV 4004 FAILS CLOSED
.200E-03/HOUR	.50 MONTHS	1SLSUMP	*	SUMP PUMP BUBBLER INACTIVE
.200E-04/HOUR	22. HOURS	7CPDCS-F		DCS INACTIVE
.100E-02/HOUR	1.0 HOURS	7ITSUMPU	*	LOW SUMP LEVEL (BUBBLER) INTERLOCK BYPASSED
.300E-05/HOUR	3.0 MONTHS	7RYBUBLD	*	LOW SUMP LEVEL (BUBBLER) RELAY FAILS TO OPEN
.330E-01/HOUR	1.0 HOURS	BENZENEH	*	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
.100E+01/HOUR	1.0 HOURS	BENZENEN	*	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
.190E+00/HOUR	1.0 HOURS	FILLSTAH	*	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
.980E+00/HOUR	1.0 HOURS	FILLSTAN	*	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
.300E-02/HOUR	22. HOURS	LAG----	I	AGITATOR IGNITION SOURCE
.100E+01/HOUR	1.0 HOURS	LC6H6UEL	*	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
.300E-02/HOUR	1.0 HOURS	LCBAGITD	*	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
.300E-02/HOUR	1.0 HOURS	LCBTRPPD	*	TRANSFER PUMP MCC CONTACTS J1-7162 FAIL TO OPE
.130E-05/HOUR	22. HOURS	LDPDTLL		LPPT INLET DIP TUBE LEAKS
.130E-05/HOUR	22. HOURS	LDPPRFTL		PRFT LEVEL DIP TUBE LEAKS
.130E-05/HOUR	22. HOURS	LFLBFCFO		BLIND FLANGE OPEN/COLD FEED
.130E-05/HOUR	22. HOURS	LFLJETFL		AIR LEAK THROUGH LPPT TRANSFER JET FLANGE
.130E-05/HOUR	22. HOURS	LFLLAGTL		AIR LEAK THROUGH LPPT AGITATOR FLANGE
.130E-05/HOUR	22. HOURS	LFLPPFLL		AIR LEAK THRU LPPT TRANSFER PUMP FLANGE
.130E-05/HOUR	22. HOURS	LFLSPARL		AIR LEAK THROUGH SPARE FEED PUMP FLANGE
.230E-04/HOUR	22. HOURS	LFLVENTO		AIR LEAK THROUGH VENT VALVE FLANGE

.100E-05/HOUR	22.	HOURS	LFRBR-AP	BRANCH A FILTER PLUGGED
.160E-05/HOUR	1.5	MONTHS	LFRBR-BP	BRANCH B FILTER PLUGGED
.210E-04/HOUR	22.	HOURS	LWC1027L	AIR LEAK THROUGH ANY 1 OF 27 HANFORD CONNECTOR
.260E-05/HOUR	22.	HOURS	LHCN2LPL	LPPT N2 JUMPERS LEAK ANY 1 OF 2 (FLOW DIVERSIO
.130E-05/HOUR	22.	HOURS	LHCSUMPL	AIR LEAK THRU SUMP JET CONNECTOR
.100E-02/HOUR	1.0	HOURS	LIT---1U	INTERLOCK 1 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT---2U	INTERLOCK 1 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT---3U	INTERLOCK 1 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT---4U	INTERLOCK 4 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT---5U	INTERLOCK 5 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT---6U	INTERLOCK 6 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT---7U	INTERLOCK 7 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT---8U	INTERLOCK 8 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT---9U	INTERLOCK 9 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT--10U	INTERLOCK 10 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT--11U	INTERLOCK 11 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT--12U	INTERLOCK 12 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT--13U	INTERLOCK 13 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT--14U	INTERLOCK 14 BYPASSED
.100E-02/HOUR	1.0	HOURS	LIT--15U	INTERLOCK 15 BYPASSED
.100E+01/YEAR	1.0	HOURS	LOPH20-T	OPERATOR FAILS TO REPLENISH SUMP WATER
.100E-01/HOUR	1.0	HOURS	LOPOLWT	OPERATOR FAILS TO RESPOND TO LOW LEVEL ALARM
.520E-05/HOUR	22.	HOURS	LP-BUBBL	BUBBLER JUMP LEAK ANY 1 OF 4 (FLOW DIVERSION)
.520E-05/HOUR	22.	HOURS	LPBUBBL	BUBBLER JUMPER LEAK ANY 1 OF 4 (FLOW DIVERSION)
.300E-02/HOUR	22.	HOURS	LPPTRANI	TRANSFER PUMP IGNITION SOURCE
.100E-01/HOUR	1.0	HOURS	LPT--CFT	JUMPER SEAL POT DRY/COLD FEED
.100E-01/HOUR	1.0	HOURS	LPTSPJTT	JUMPER SEAL POT DRY
.300E-05/HOUR	6.0	MONTHS	LRV-281D	RELAY 281 CONTACTS FAIL TO OPEN
.780E-04/HOUR	22.	HOURS	LSF7648F	TRANSMITTER FIT-7648 INACTIVE
.120E-05/HOUR	6.0	MONTHS	LSVB7730	BYPASS VENT VALVE SV-8773 FAILS OPEN
.100E-02/HOUR	1.0	HOURS	LSVB773X	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE
.300E-05/HOUR	6.0	MONTHS	LSW6852D	SWITCH ASH-6852 FAILS TO CLOSE
.300E-05/HOUR	6.0	MONTHS	LSW6853D	SWITCH ASH-6853 FAILS TO CLOSE
.300E-04/HOUR	1.0	HOURS	LSW7468D	HIS-7468 FAILS TO OPEN
.100E-08/HOUR	22.	HOURS	LTK----I	LPPT STATIC CHARGE
.100E-03/HOUR	.50	MONTHS	LTKAUXTF	AUXILIARY PRECIPITATE TANK NOT PURGED
.100E-03/HOUR	22.	HOURS	LTKPRFTF	PRFT NOT PURGED
.100E-04/HOUR	22.	HOURS	LTR6852F	TRANSMITTER AIT-6852 INACTIVE
.100E-04/HOUR	22.	HOURS	LTR6853F	TRANSMITTER AIT-6853 INACTIVE
.340E-03/HOUR	.50	MONTHS	LUA6852F	O2 ANALYZER 6852 INACTIVE
.100E-04/HOUR	22.	HOURS	LUA6852U	BLOCK VALVES TO ANALYZER CLOSED (HUMAN ERROR)
.340E-04/HOUR	.50	MONTHS	LUA6853F	O2 ANALYZER 6853 INACTIVE
.100E-04/HOUR	22.	HOURS	LUA6853U	BLOCK VALVES TO ANALYZER CLOSED (HUMAN ERROR)
.140E-04/HOUR	22.	HOURS	LVA10F3X	LPPT PURGE MANUAL VALVES CLOSED ANY 1 OF 3
.830E-04/HOUR	22.	HOURS	LVBVVCFO	BLOCK VALVE OPEN/COLD FEED
.830E-04/HOUR	22.	HOURS	LVBVVPFO	BLOCK VALVE FAILS OPEN
.830E-04/HOUR	22.	HOURS	LVBSPJTO	BLOCK VALVE OPEN
.100E-04/HOUR	22.	HOURS	LVDSPJTX	DRAIN VALVE OPEN
.460E-06/HOUR	22.	HOURS	LVDSUPPX	DRAIN VALVE SUPPLEMENTAL LINE LEFT OPEN
.920E-05/HOUR	22.	HOURS	LVGM-28X	OPERATOR CLOSES ANY 1 OF 2 MANUAL VALVES
.920E-05/HOUR	22.	HOURS	LVGM-34X	BRANCH A MANUAL VALVES CLOSED ANY 1 OF 2
.100E-03/HOUR	1.0	HOURS	LVGO-34X	BRANCH B MANUAL VALVES CLOSED
.100E-01/HOUR	1.0	HOURS	LVGOPBRT	OPERATOR FAILS TO VALVE BRANCH B WITHIN X MINU
.160E-04/HOUR	22.	HOURS	LV17834C	PRESSURE REGULATING VALVE 7834 FAILS CLOSED
.160E-04/HOUR	22.	HOURS	LVIM-35C	PCV 7172A FAILS CLOSED
.160E-05/HOUR	1.5	MONTHS	LV10-35C	PCV 7172B FAILS CLOSED
.230E-04/HOUR	22.	HOURS	LVPVENTO	LPPT OVERFLOW VALVE FAILS OPEN
.120E-04/HOUR	22.	HOURS	LVS7469C	SV 7469 FAILS CLOSED
.150E-05/HOUR	6.0	MONTHS	LVS8772K	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE
.120E-04/HOUR	22.	HOURS	LVTSUPPC	SUPPLEMENTAL PURGE VALVE SV74 FAILS CLOSED
.120E-04/HOUR	22.	HOURS	LVTSVNSC	SV 74 FAILS CLOSED--NORMAL SUPPLY NEEDLE VALVE
.280E-06/HOUR	22.	HOURS	LVXLPN2P	LPPT PURGE CHECK VALVE PLUGGED
.200E-08/HOUR	22.	HOURS	LVY292AO	RELIEF VALVE PSV 292 FAILS OPEN
.200E-08/HOUR	1.5	MONTHS	LVY292BO	RELIEF VALVE PSV 292B FAILS OPEN
.100E-06/HOUR	22.	HOURS	NTK----U	SUPPLIER FAILURE- LOX SUPPLIED INTSTEAD OF LN2
.830E-05/HOUR	22.	HOURS	NVASUPPC	SUPPLEMENTAL PURGE VALVE FAILS TO OPEN
.160E-03/HOUR	22.	HOURS	NVK10F2C	BLOCK VALVE IN SUPPLEMENTAL PURGE LINE CLOSED
.690E-05/HOUR	22.	HOURS	NVPN2--F	VAPORIZER FAILS TO PROVIDE HEAT
.100E-04/HOUR	22.	HOURS	NVS7864C	SOLENOID VALVE SV 7864 FAILS CLOSED
.210E-05/HOUR	22.	HOURS	NVX10F4X	MANUAL VALVE CLOSED (ANY 1 OF 4)
.140E-07/HOUR	22.	HOURS	NVY10F3O	PRESSURE RELIEF VALVE FAILS OPEN (ANY 1 OF 7)
.620E-04/HOUR	22.	HOURS	NVZN2--O	Y-STRAINER VALVE OPEN
.230E-04/HOUR	22.	HOURS	OVA10F5X	MANUAL VALVE CLOSED (ANY 1 OF 5)
.320E-04/HOUR	22.	HOURS	OVA10F7X	VALVE IN H AREA STEAM LINE TO PRESS REDUCTION
.230E-04/HOUR	22.	HOURS	OVD10F5X	DRAIN VALVE OPEN (ANY 1 OF 5)
.220E-05/HOUR	22.	HOURS	OVL7538C	TEMPERATURE CONTROL VALVE TCV 7538 FAILS CLOSE
.230E-01/HOUR	1.0	HOURS	PUMPOUT-	TIME PERIOD -- PUMPOUT 1 HR BENZENE CONC NORMA

.920E-05/HOUR	22.	HOURS	ZVA10F2X	MANUAL VALVE CLOSED (ANY 1 OF 2)
.920E-05/HOUR	22.	HOURS	ZVA7418X	MANUAL VALVE CLOSED (ANY 1 OF 2)
.920E-05/HOUR	22.	HOURS	ZVA7420X	MANUAL VALVE CLOSED (ANY 1 OF 2)
.160E-04/HOUR	22.	HOURS	ZV17418C	PRESSURE CONTROL VALVE 7418X FAILS CLOSED
.160E-04/HOUR	22.	HOURS	ZV1742-C	PRESSURE REGULATING VALVE 7420 FAILS CLOSED
.160E-04/HOUR	22.	HOURS	ZV17420C	PRESSURE CONTROL VALVE 7420X FAILS CLOSED
.200E-08/HOUR	22.	HOURS	ZVY72--O	PRESSURE RELIEF VALVE 72 FAILS OPEN
.620E-04/HOUR	22.	HOURS	ZVZN2--O	Y-STRAINER VALVE OPEN

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EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY *****

STEADY STATE SYSTEM CHARACTERISTICS

TOP EVENT RATE (PER HOUR) = .15368E-07 TOP EVENT RATE (PER YEAR) = .13463E-03

MEAN TIME TO SYSTEM FAILURE = .65069E+08 HOURS 7428.0 YEARS

MEAN TIME TO SYSTEM REPAIR = 20.656 HOURS .86066 DAYS,

TOP EVENT PROBABILITY = .31745E-06

MISSION TIME 1.00 Y 30.0 Y
EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02

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EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY *****

INITIATOR (BARLOW-PROSCHAN) MEASURE OF BASIC EVENT IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

TOP EVENT PROBABILITY = .31745E-06

MISSION TIME 1.00 Y 30.0 Y
EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02

RANK	BASIC EVENT	IMPORTANCE	FAILURE RATE	MEAN FAULT DURATION	BASIC EVENT DESCRIPTION
1	LFLVENTO I	.133	.230E-04 HOURS	22.0 HOURS	AIR LEAK THROUGH VENT VALVE FLANGE
1	LVPVENTO I	.133	.230E-04 HOURS	22.0 HOURS	LPPT OVERFLOW VALVE FAILS OPEN
2	LVIM-35C I	.122	.160E-04 HOURS	22.0 HOURS	PCV 7172A FAILS CLOSED
3	LHC1027L I	.122	.210E-04 HOURS	22.0 HOURS	AIR LEAK THROUGH ANY 1 OF 27 HANFORD CONNECTOR
4	LVTSVNSC I	.918E-01	.120E-04 HOURS	22.0 HOURS	SV 74 FAILS CLOSED--NORMAL SUPPLY NEEDLE VALVE
4	LVS7469C I	.918E-01	.120E-04 HOURS	22.0 HOURS	SV 7469 FAILS CLOSED
5	LVGM-34X I	.704E-01	.920E-05 HOURS	22.0 HOURS	BRANCH A MANUAL VALVES CLOSED ANY 1 OF 2
5	LVGM-28X I	.704E-01	.920E-05 HOURS	22.0 HOURS	OPERATOR CLOSSES ANY 1 OF 2 MANUAL VALVES
6	LOPH20-T I	.587E-01	1.00 YEARS	1.00 HOURS	OPERATOR FAILS TO REPLENISH SUMP WATER
7	LP-BUBBL I	.269E-01	.520E-05 HOURS	22.0 HOURS	BUBBLER JUMP LEAK ANY 1 OF 4 (FLOW DIVERSION)
8	LHCN2LPL I	.199E-01	.260E-05 HOURS	22.0 HOURS	LPPT N2 JUMPERS LEAK ANY 1 OF 2 (FLOW DIVERSIO
9	LFRBR-AP I	.764E-02	.100E-05 HOURS	22.0 HOURS	BRANCH A FILTER PLUGGED
10	LFLPPFLL I	.755E-02	.130E-05 HOURS	22.0 HOURS	AIR LEAK THRU LPPT TRANSFER PUMP FLANGE
10	LFLLAGTL I	.755E-02	.130E-05 HOURS	22.0 HOURS	AIR LEAK THROUGH LPPT AGITATOR FLANGE
10	LFLSPARL I	.755E-02	.130E-05 HOURS	22.0 HOURS	AIR LEAK THROUGH SPARE FEED PUMP FLANGE
10	LFLJETFL I	.755E-02	.130E-05 HOURS	22.0 HOURS	AIR LEAK THROUGH LPPT TRANSFER JET FLANGE
11	LHCSUMPL I	.754E-02	.130E-05 HOURS	22.0 HOURS	AIR LEAK THRU SUMP JET CONNECTOR
12	LVDSUPPX I	.351E-02	.460E-06 HOURS	22.0 HOURS	DRAIN VALVE SUPPLEMENTAL LINE LEFT OPEN
13	ZVZN2--O I	.347E-02	.620E-04 HOURS	22.0 HOURS	Y-STRAINER VALVE OPEN
14	OVA1020X I	.133E-02	.920E-04 HOURS	22.0 HOURS	ANY PAIR OF DRIP LEG BLOW DOWN VALVES OPEN (AN
15	MVZN2--O I	.876E-03	.620E-04 HOURS	22.0 HOURS	Y-STRAINER VALVE OPEN
16	ZV1742-C I	.743E-03	.160E-04 HOURS	22.0 HOURS	PRESSURE REGULATING VALVE 7420 FAILS CLOSED
17	7CPDCS-F I	.595E-03	.200E-04 HOURS	22.0 HOURS	DCS INACTIVE
18	OVA10F7X I	.437E-03	.320E-04 HOURS	22.0 HOURS	VALVE IN H AREA STEAM LINE TO PRESS REDUCTION
19	ZVA10F2X I	.325E-03	.920E-05 HOURS	22.0 HOURS	MANUAL VALVE CLOSED (ANY 1 OF 2)
20	OVD10F5X I	.292E-03	.230E-04 HOURS	22.0 HOURS	DRAIN VALVE OPEN (ANY 1 OF 5)
20	OVA10F5X I	.292E-03	.230E-04 HOURS	22.0 HOURS	MANUAL VALVE CLOSED (ANY 1 OF 5)
21	OSPRDSYF I	.290E-03	.200 YEARS	22.0 HOURS	STEAM PRESSURE REDUCTION SYSTEM FAILS
21	OH-AREAF I	.290E-03	.200 YEARS	22.0 HOURS	H AREA STEAM SUPPLY FAILS
22	LDPDTLL I	.262E-03	.130E-05 HOURS	22.0 HOURS	LPPT INLET DIP TUBE LEAKS
23	OVI4004C I	.197E-03	.160E-04 HOURS	22.0 HOURS	PRESSURE CONTROL VALVE PCV 4004 FAILS CLOSED
23	LV17834C I	.197E-03	.160E-04 HOURS	22.0 HOURS	PRESSURE REGULATING VALVE 7834 FAILS CLOSED
24	LVA10F3X I	.162E-03	.140E-04 HOURS	22.0 HOURS	LPPT PURGE MANUAL VALVES CLOSED ANY 1 OF 3
25	MVS7864C I	.965E-04	.100E-04 HOURS	22.0 HOURS	SOLENOID VALVE SV 7864 FAILS CLOSED
26	MVPN2--F I	.628E-04	.690E-05 HOURS	22.0 HOURS	VAPORIZER FAILS TO PROVIDE HEAT
27	LTKAUXTF I	.160E-04	.100E-03 HOURS	.500 MONTHS	AUXILIARY PRECIPITATE TANK NOT PURGED
28	OVL7538C I	.792E-05	.220E-05 HOURS	22.0 HOURS	TEMPERATURE CONTROL VALVE TCV 7538 FAILS CLOSE

29 NVX10F4X I .756E-05 .210E-05 HOURS 22.0 HOURS MANUAL VALVE CLOSED (ANY 1 OF 4)

I DENOTES INITIATING EVENT

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EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF BASIC EVENT IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

TOP EVENT PROBABILITY = .31745E-06

MISSION TIME 1.00 Y 30.0 Y
EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02

RANK	BASIC EVENT	IMPORTANCE	FAILURE RATE	MEAN FAULT DURATION	BASIC EVENT DESCRIPTION
30	LFLBFCFO I	.113E-06	.130E-05 HOURS	22.0 HOURS	BLIND FLANGE OPEN/COLD FEED
30	LVBVCFO I	.113E-06	.830E-04 HOURS	22.0 HOURS	BLOCK VALVE OPEN/COLD FEED

I DENOTES INITIATING EVENT

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EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

ENABLER (SEQUENTIAL CONTRIBUTORY) BASIC EVENT IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

TOP EVENT PROBABILITY = .31745E-06

MISSION TIME 1.00 Y 30.0 Y
EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02

RANK	BASIC EVENT	IMPORTANCE	FAILURE RATE	MEAN FAULT DURATION	BASIC EVENT DESCRIPTION
1	LC6H6UEL	.842	1.00 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
1	FILLSTAH	.842	.190 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
1	BENZENEH	.841	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
2	LVS8772K	.484	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE
3	LSV8773O	.387	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
4	BENZENEN	.158	1.00 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
5	LCBAGITD	.157	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
6	FILLSTAN	.154	.980 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
7	LSV8773X	.744E-01	.100E-02 HOURS	1.00 HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE
8	LUA6852F	.530E-01	.340E-03 HOURS	.500 MONTHS	O2 ANALYZER 6852 INACTIVE
9	LUA6853F	.514E-01	.340E-04 HOURS	.500 MONTHS	O2 ANALYZER 6853 INACTIVE
10	1SLSUMPF	.475E-01	.200E-03 HOURS	.500 MONTHS	SUMP PUMP BUBBLER INACTIVE
11	LOPLOWLT	.659E-02	.100E-01 HOURS	1.00 HOURS	OPERATOR FAILS TO RESPOND TO LOW LEVEL ALARM
12	7RYBUBLD	.427E-02	.300E-05 HOURS	3.00 MONTHS	LOW SUMP LEVEL (BUBBLER) RELAY FAILS TO OPEN
13	PUMPOUT-	.354E-02	.230E-01 HOURS	1.00 HOURS	TIME PERIOD -- PUMPOUT 1 HR BENZENE CONC NORMA
14	ZVZN2--O I	.347E-02	.620E-04 HOURS	22.0 HOURS	Y-STRAINER VALVE OPEN
15	OVA1020X I	.133E-02	.920E-04 HOURS	22.0 HOURS	ANY PAIR OF DRIP LEG BLOW DOWN VALVES OPEN (AN
16	LRY-281D	.119E-02	.300E-05 HOURS	6.00 MONTHS	RELAY 281 CONTACTS FAIL TO OPEN
17	NVZN2--O I	.876E-03	.620E-04 HOURS	22.0 HOURS	Y-STRAINER VALVE OPEN
18	LTR6853F	.810E-03	.100E-04 HOURS	22.0 HOURS	TRANSMITTER AIT-6853 INACTIVE
18	LUA6853U	.810E-03	.100E-04 HOURS	22.0 HOURS	BLOCK VALVES TO ANALYZER CLOSED (HUMAN ERROR)
19	ZV1742-C I	.743E-03	.160E-04 HOURS	22.0 HOURS	PRESSURE REGULATING VALVE 7420 FAILS CLOSED
20	7CPDCS-F I	.595E-03	.200E-04 HOURS	22.0 HOURS	DCS INACTIVE
21	OVA10F7X I	.437E-03	.320E-04 HOURS	22.0 HOURS	VALVE IN H AREA STEAM LINE TO PRESS REDUCTION
22	ZVA10F2X I	.325E-03	.920E-05 HOURS	22.0 HOURS	MANUAL VALVE CLOSED (ANY 1 OF 2)
23	7ITSUMPU	.302E-03	.100E-02 HOURS	1.00 HOURS	LOW SUMP LEVEL (BUBBLER) INTERLOCK BYPASSED
24	OVD10F5X I	.292E-03	.230E-04 HOURS	22.0 HOURS	DRAIN VALVE OPEN (ANY 1 OF 5)
24	OVA10F5X I	.292E-03	.230E-04 HOURS	22.0 HOURS	MANUAL VALVE CLOSED (ANY 1 OF 5)
25	OH-AREAF I	.290E-03	.200 YEARS	22.0 HOURS	H AREA STEAM SUPPLY FAILS
25	OSPRDSYF I	.290E-03	.200 YEARS	22.0 HOURS	STEAM PRESSURE REDUCTION SYSTEM FAILS
26	LTKAUXTF I	.262E-03	.100E-03 HOURS	.500 MONTHS	AUXILIARY PRECIPITATE TANK NOT PURGED
27	LV17834C I	.197E-03	.160E-04 HOURS	22.0 HOURS	PRESSURE REGULATING VALVE 7834 FAILS CLOSED
27	OVI4004C I	.197E-03	.160E-04 HOURS	22.0 HOURS	PRESSURE CONTROL VALVE PCV 4004 FAILS CLOSED
28	LVA10F3X I	.162E-03	.140E-04 HOURS	22.0 HOURS	LPPT PURGE MANUAL VALVES CLOSED ANY 1 OF 3
29	LSF7648F	.123E-03	.780E-04 HOURS	22.0 HOURS	TRANSMITTER FIT-7648 INACTIVE
30	LVIH-35C I	.105E-03	.160E-04 HOURS	22.0 HOURS	PCV 7172A FAILS CLOSED
31	LIT--11U	.968E-04	.100E-02 HOURS	1.00 HOURS	INTERLOCK 11 BYPASSED
32	NVS7864C I	.965E-04	.100E-04 HOURS	22.0 HOURS	SOLENOID VALVE SV 7864 FAILS CLOSED

I DENOTES INITIATING EVENT

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EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

ENABLER (SEQUENTIAL CONTRIBUTORY) BASIC EVENT IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

TOP EVENT PROBABILITY = .31745E-06

MISSION TIME 1.00 Y 30.0 Y
EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02

RANK	BASIC EVENT	IMPORTANCE	FAILURE RATE	MEAN FAULT DURATION		BASIC EVENT DESCRIPTION
33	LSW6853D	.918E-04	.300E-05 HOURS	6.00	MONTHS	SWITCH ASH-6853 FAILS TO CLOSE
34	LTR6852F	.819E-04	.100E-04 HOURS	22.0	HOURS	TRANSMITTER AIT-6852 INACTIVE
34	LUA6852U	.819E-04	.100E-04 HOURS	22.0	HOURS	BLOCK VALVES TO ANALYZER CLOSED (HUMAN ERROR)
35	LVS7469C I	.787E-04	.120E-04 HOURS	22.0	HOURS	SV 7469 FAILS CLOSED
35	LVTSVNSC I	.787E-04	.120E-04 HOURS	22.0	HOURS	SV 74 FAILS CLOSED--NORMAL SUPPLY NEEDLE VALVE
36	NVPN2--F I	.628E-04	.690E-05 HOURS	22.0	HOURS	VAPORIZER FAILS TO PROVIDE HEAT
37	LFLVENTO I	.618E-04	.230E-04 HOURS	22.0	HOURS	AIR LEAK THROUGH VENT VALVE FLANGE
37	LVPVENTO I	.618E-04	.230E-04 HOURS	22.0	HOURS	LPPT OVERFLOW VALVE FAILS OPEN
38	LVGM-34X I	.604E-04	.920E-05 HOURS	22.0	HOURS	BRANCH A MANUAL VALVES CLOSED ANY 1 OF 2
38	LVGM-28X I	.604E-04	.920E-05 HOURS	22.0	HOURS	OPERATOR CLOSES ANY 1 OF 2 MANUAL VALVES
39	LHC1027L I	.565E-04	.210E-04 HOURS	22.0	HOURS	AIR LEAK THROUGH ANY 1 OF 27 HANFORD CONNECTOR
40	LIT---1U	.244E-04	.100E-02 HOURS	1.00	HOURS	INTERLOCK 1 BYPASSED
41	LDPDTLL I	.160E-04	.130E-05 HOURS	22.0	HOURS	LPPT INLET DIP TUBE LEAKS
42	LSW6852D	.122E-04	.300E-05 HOURS	6.00	MONTHS	SWITCH ASH-6852 FAILS TO CLOSE
43	LP-BUBBL I	.121E-04	.520E-05 HOURS	22.0	HOURS	BUBBLER JUMP LEAK ANY 1 OF 4 (FLOW DIVERSION)
44	LIT---2U	.990E-05	.100E-02 HOURS	1.00	HOURS	INTERLOCK 1 BYPASSED
45	LIT--10U	.867E-05	.100E-02 HOURS	1.00	HOURS	INTERLOCK 10 BYPASSED
46	OVL7538C I	.792E-05	.220E-05 HOURS	22.0	HOURS	TEMPERATURE CONTROL VALVE TCV 7538 FAILS CLOSE
47	NVX10F4X I	.756E-05	.210E-05 HOURS	22.0	HOURS	MANUAL VALVE CLOSED (ANY 1 OF 4)
48	LIT---5U	.629E-05	.100E-02 HOURS	1.00	HOURS	INTERLOCK 5 BYPASSED
49	LHCN2LPL I	.605E-05	.260E-05 HOURS	22.0	HOURS	LPPT W2 JUMPERS LEAK ANY 1 OF 2 (FLOW DIVERSIO
50	LFLPPFL I	.339E-05	.130E-05 HOURS	22.0	HOURS	AIR LEAK THRU LPPT TRANSFER PUMP FLANGE
50	LFLLAGTL I	.339E-05	.130E-05 HOURS	22.0	HOURS	AIR LEAK THROUGH LPPT AGITATOR FLANGE
50	LFLJETFL I	.339E-05	.130E-05 HOURS	22.0	HOURS	AIR LEAK THROUGH LPPT TRANSFER JET FLANGE
50	LFLSPARL I	.339E-05	.130E-05 HOURS	22.0	HOURS	AIR LEAK THROUGH SPARE FEED PUMP FLANGE
51	LPT--CFT	.226E-06	.100E-01 HOURS	1.00	HOURS	JUMPER SEAL POT DRY/COLD FEED
52	LFLBFCFO I	.113E-06	.130E-05 HOURS	22.0	HOURS	BLIND FLANGE OPEN/COLD FEED
52	LVBVCFIO I	.113E-06	.830E-04 HOURS	22.0	HOURS	BLOCK VALVE OPEN/COLD FEED

I DENOTES INITIATING EVENT

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

GROUP RANK	CUMULATIVE IMPORTANCE	RESIDUAL IMPORTANCE
1	.121229	.879
2	.176572	.823
3	.273555	.726
4	.317829	.682
5	.359996	.640
6	.393729	.606
7	.456978	.543
8	.507578	.492
9	.556069	.444
10	.577727	.422
11	.597533	.402
12	.636326	.364
13	.653653	.346
14	.669498	.331
15	.699206	.301
16	.727276	.273
17	.740980	.259
18	.753794	.246
19	.777561	.222
20	.800338	.200
21	.811301	.189
22	.830009	.170
23	.848230	.152
24	.856771	.143
25	.863623	.136
26	.870130	.130
27	.875612	.124
28	.880626	.119

29	.890387	.110
30	.897870	.102
31	.915000	.850E-01
32	.918343	.817E-01
33	.921561	.784E-01
34	.924618	.754E-01
35	.927626	.724E-01
36	.941330	.587E-01
37	.943965	.560E-01
38	.946540	.535E-01
39	.948946	.511E-01
40	.953531	.465E-01
41	.955646	.444E-01
42	.957754	.422E-01
43	.959703	.403E-01
44	.963218	.368E-01
45	.964778	.352E-01
46	.966016	.340E-01
47	.967228	.328E-01
48	.968285	.317E-01
49	.969275	.307E-01
50	.970245	.298E-01
51	.974212	.258E-01
52	.974908	.251E-01
53	.975565	.244E-01
54	.976135	.239E-01
55	.978778	.212E-01
56	.979304	.207E-01
57	.979801	.202E-01
58	.980729	.193E-01
59	.981185	.188E-01
60	.981636	.184E-01
61	.982079	.179E-01
62	.982486	.175E-01
63	.982857	.171E-01
64	.983212	.168E-01
65	.983908	.161E-01
66	.984217	.158E-01
67	.984819	.152E-01
68	.985376	.146E-01
69	.985910	.141E-01
70	.986919	.131E-01
71	.987166	.128E-01
72	.987626	.124E-01
73	.987855	.121E-01
74	.988282	.117E-01
75	.988490	.115E-01
76	.988681	.113E-01
77	.988868	.111E-01
78	.989051	.109E-01
79	.989221	.108E-01
80	.989388	.106E-01
81	.989716	.103E-01
82	.990043	.996E-02
83	.990179	.982E-02
84	.990442	.956E-02
85	.990703	.930E-02
86	.990829	.917E-02
87	.991172	.883E-02
88	.991280	.872E-02
89	.991492	.851E-02
90	.991593	.841E-02
91	.991694	.831E-02
92	.991794	.821E-02
93	.991892	.811E-02
94	.991989	.801E-02
95	.992263	.774E-02
96	.992351	.765E-02
97	.992437	.756E-02
98	.992517	.748E-02
99	.992597	.740E-02
100	.992675	.732E-02
101	.992830	.717E-02
102	.992983	.702E-02
103	.993058	.694E-02
104	.993133	.687E-02
105	.993207	.679E-02

106	.993279	.672E-02
107	.993350	.665E-02
108	.993419	.658E-02
109	.993485	.652E-02
110	.993548	.645E-02
111	.993672	.633E-02
112	.993795	.621E-02
113	.993855	.614E-02
114	.993915	.608E-02
115	.993974	.603E-02
116	.994031	.597E-02
117	.994144	.586E-02
118	.994254	.575E-02
119	.994523	.548E-02
120	.994576	.542E-02
121	.994625	.537E-02
122	.994673	.533E-02
123	.994720	.528E-02
124	.994767	.523E-02
125	.994813	.519E-02
126	.994903	.510E-02
127	.995033	.497E-02
128	.995118	.488E-02
129	.995288	.471E-02
130	.995373	.463E-02
131	.995455	.455E-02
132	.995494	.451E-02
133	.995532	.447E-02
134	.995569	.443E-02
135	.995604	.440E-02
136	.995673	.433E-02
137	.995775	.423E-02
138	.995842	.416E-02
139	.995876	.412E-02
140	.995908	.409E-02
141	.995939	.406E-02
142	.995998	.400E-02
143	.996028	.397E-02
144	.996057	.394E-02
145	.996084	.392E-02
146	.996112	.389E-02
147	.996138	.386E-02
148	.996164	.384E-02
149	.996214	.379E-02
150	.996315	.368E-02
151	.996366	.363E-02
152	.996415	.359E-02
153	.996463	.354E-02
154	.996487	.351E-02
155	.996534	.347E-02
156	.996558	.344E-02
157	.996581	.342E-02
158	.996627	.337E-02
159	.996667	.333E-02
160	.996706	.329E-02
161	.996726	.327E-02
162	.996744	.326E-02
163	.996762	.324E-02
164	.996797	.320E-02
165	.996848	.315E-02
166	.996865	.313E-02
167	.996882	.312E-02
168	.996898	.310E-02
169	.996913	.309E-02
170	.996929	.307E-02
171	.996944	.306E-02
172	.996959	.304E-02
173	.997033	.297E-02
174	.997176	.282E-02
175	.997203	.280E-02
176	.997216	.278E-02
177	.997242	.276E-02
178	.997280	.272E-02
179	.997305	.269E-02
180	.997317	.268E-02
181	.997329	.267E-02
182	.997341	.266E-02

183	.997352	.265E-02
184	.997362	.264E-02
185	.997372	.263E-02
186	.997402	.260E-02
187	.997421	.258E-02
188	.997436	.256E-02
189	.997460	.254E-02
190	.997466	.253E-02
191	.997477	.252E-02
192	.997480	.252E-02
193	.997482	.252E-02
194	.997484	.252E-02
195	.997486	.251E-02
196	.997488	.251E-02
197	.997490	.251E-02
198	.997491	.251E-02
199	.997493	.251E-02
200	.997494	.251E-02
201	.997500	.250E-02
202	.997503	.250E-02
203	.997504	.250E-02
204	.997508	.249E-02
205	.997510	.249E-02
206	.997510	.249E-02
207	.997510	.249E-02

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EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
 EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02
 TOP EVENT PROBABILITY = .31745E-06

RANK IMPORTANCE

1 .606E-01 CUT SET 1 MEAN TIME TO OCCURRENCE=, .10735E+10 HOURS .12254E+06 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .121229/ .879

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LVPVENTO I	.230E-04 HOURS	22.0 HOURS	LPPT OVERFLOW VALVE FAILS OPEN
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

1 .606E-01 CUT SET 2 MEAN TIME TO OCCURRENCE=, .10735E+10 HOURS .12254E+06 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .121229/ .879

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFLVENTO I	.230E-04 HOURS	22.0 HOURS	AIR LEAK THROUGH VENT VALVE FLANGE
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

2 .553E-01 CUT SET 3 MEAN TIME TO OCCURRENCE=, .11757E+10 HOURS .13422E+06 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .176572/ .823

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LHC1027L I	.210E-04 HOURS	22.0 HOURS	AIR LEAK THROUGH ANY 1 OF 27 HANFORD CONNECTOR
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

3 .485E-01 CUT SET 5 MEAN TIME TO OCCURRENCE=, .13419E+10 HOURS .15318E+06 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .273555/ .726

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS

FILLSTAH	.190E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00	HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LSV87730	.120E-05 HOURS	6.00	MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LVPVENTO I	.230E-04 HOURS	22.0	HOURS	LPPT OVERFLOW VALVE FAILS OPEN

I DENOTES INITIATING EVENT

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EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
 EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02
 TOP EVENT PROBABILITY = .31745E-06

RANK IMPORTANCE

3 .485E-01 CUT SET 4 MEAN TIME TO OCCURRENCE=, .13419E+10 HOURS .15318E+06 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .273555/ .726

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFVVENTO I	.230E-04 HOURS	22.0 HOURS	AIR LEAK THROUGH VENT VALVE FLANGE
LSV87730	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN

4 .443E-01 CUT SET 6 MEAN TIME TO OCCURRENCE=, .14697E+10 HOURS .16777E+06 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .317829/ .682

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LHC1027L I	.210E-04 HOURS	22.0 HOURS	AIR LEAK THROUGH ANY 1 OF 27 HANFORD CONNECTOR
LSV87730	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN

5 .422E-01 CUT SET 14 MEAN TIME TO OCCURRENCE=, .15431E+10 HOURS .17616E+06 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .359996/ .640

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LVIM-35C I	.160E-04 HOURS	22.0 HOURS	PCV 7172A FAILS CLOSED
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

6 .337E-01 CUT SET 23 MEAN TIME TO OCCURRENCE=, .19289E+10 HOURS .22020E+06 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .393729/ .606

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LSV87730	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LVIM-35C I	.160E-04 HOURS	22.0 HOURS	PCV 7172A FAILS CLOSED

I DENOTES INITIATING EVENT

1 *****

EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
 EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02
 TOP EVENT PROBABILITY = .31745E-06

RANK IMPORTANCE

7 .316E-01 CUT SET 16 MEAN TIME TO OCCURRENCE=, .20575E+10 HOURS .23488E+06 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.456978/ .543

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE
LVTSVNSC I	.120E-04 HOURS	22.0 HOURS	SV 74 FAILS CLOSED--NORMAL SUPPLY NEEDLE VALVE

7 .316E-01 CUT SET 15 MEAN TIME TO OCCURRENCE=, .20575E+10 HOURS .23488E+06 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.456978/ .543

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LVS7469C I	.120E-04 HOURS	22.0 HOURS	SV 7469 FAILS CLOSED
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

8 .253E-01 CUT SET 26 MEAN TIME TO OCCURRENCE=, .25719E+10 HOURS .29360E+06 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.507578/ .492

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LSV87730	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LVTSVNSC I	.120E-04 HOURS	22.0 HOURS	SV 74 FAILS CLOSED--NORMAL SUPPLY NEEDLE VALVE

8 .253E-01 CUT SET 27 MEAN TIME TO OCCURRENCE=, .25719E+10 HOURS .29360E+06 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.507578/ .492

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LSV87730	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LSV7469C I	.120E-04 HOURS	22.0 HOURS	SV 7469 FAILS CLOSED

I DENOTES INITIATING EVENT

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EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT M2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02
TOP EVENT PROBABILITY = .31745E-06

RANK IMPORTANCE

9 .242E-01 CUT SET 17 MEAN TIME TO OCCURRENCE=, .26837E+10 HOURS .30636E+06 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.556069/ .444

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LVGM-34X I	.920E-05 HOURS	22.0 HOURS	BRANCH A MANUAL VALVES CLOSED ANY 1 OF 2
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

9 .242E-01 CUT SET 18 MEAN TIME TO OCCURRENCE=, .26837E+10 HOURS .30636E+06 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.556069/ .444

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS

LVGM-28X I .920E-05 HOURS 22.0 HOURS OPERATOR CLOSSES ANY 1 OF 2 MANUAL VALVES
 LVS8772K .150E-05 HOURS 6.00 MONTHS MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

10 .217E-01 CUT SET 112 MEAN TIME TO OCCURRENCE=, .30043E+10 HOURS .34296E+06 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .577727/ .422

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
1SLSUMPF	.200E-03 HOURS	.500 MONTHS	SUMP PUMP BUBBLER INACTIVE
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LOPH20-T I	.100E+01 YEARS	1.00 HOURS	OPERATOR FAILS TO REPLENISH SUMP WATER
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

11 .198E-01 CUT SET 24 MEAN TIME TO OCCURRENCE=, .32853E+10 HOURS .37504E+06 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .597533/ .402

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAH	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LCBAG1TD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LVIM-35C I	.160E-04 HOURS	22.0 HOURS	PCV 7172A FAILS CLOSED
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

I DENOTES INITIATING EVENT

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EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
 EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02
 TOP EVENT PROBABILITY = .31745E-06

RANK IMPORTANCE

12 .194E-01 CUT SET 31 MEAN TIME TO OCCURRENCE=, .33547E+10 HOURS .38295E+06 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .636326/ .364

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LSV87730	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LVGM-28X I	.920E-05 HOURS	22.0 HOURS	OPERATOR CLOSSES ANY 1 OF 2 MANUAL VALVES

12 .194E-01 CUT SET 30 MEAN TIME TO OCCURRENCE=, .33547E+10 HOURS .38295E+06 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .636326/ .364

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LSV87730	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LVGM-34X I	.920E-05 HOURS	22.0 HOURS	BRANCH A MANUAL VALVES CLOSED ANY 1 OF 2

13 .173E-01 CUT SET 124 MEAN TIME TO OCCURRENCE=, .37554E+10 HOURS .42870E+06 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .653653/ .346

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
1SLSUMPF	.200E-03 HOURS	.500 MONTHS	SUMP PUMP BUBBLER INACTIVE
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LOPH20-T I	.100E+01 YEARS	1.00 HOURS	OPERATOR FAILS TO REPLENISH SUMP WATER
LSV87730	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN

14 .158E-01 CUT SET 40 MEAN TIME TO OCCURRENCE=, .41067E+10 HOURS .46880E+06 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .669498/ .331

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS JI-7171 FAIL TO OPEN
LSV8773O	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LVIM-35C I	.160E-04 HOURS	22.0 HOURS	PCV 7172A FAILS CLOSED

I DENOTES INITIATING EVENT

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EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
 EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02
 TOP EVENT PROBABILITY = .31745E-06

RANK IMPORTANCE

15 .149E-01 CUT SET 28 MEAN TIME TO OCCURRENCE=, .43805E+10 HOURS .50005E+06 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .699206/ .301

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS JI-7171 FAIL TO OPEN
LVS7469C I	.120E-04 HOURS	22.0 HOURS	SV 7469 FAILS CLOSED
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

15 .149E-01 CUT SET 29 MEAN TIME TO OCCURRENCE=, .43805E+10 HOURS .50005E+06 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .699206/ .301

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS JI-7171 FAIL TO OPEN
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE
LVTSVNSC I	.120E-04 HOURS	22.0 HOURS	SV 74 FAILS CLOSED--NORMAL SUPPLY NEEDLE VALVE

16 .140E-01 CUT SET 99 MEAN TIME TO OCCURRENCE=, .46362E+10 HOURS .52925E+06 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .727276/ .273

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LUA6852F	.340E-03 HOURS	.500 MONTHS	O2 ANALYZER 6852 INACTIVE
LUA6853F	.340E-04 HOURS	.500 MONTHS	O2 ANALYZER 6853 INACTIVE
LVPVENTO I	.230E-04 HOURS	22.0 HOURS	LPPT OVERFLOW VALVE FAILS OPEN

16 .140E-01 CUT SET 98 MEAN TIME TO OCCURRENCE=, .46362E+10 HOURS .52925E+06 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .727276/ .273

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFLVENTO I	.230E-04 HOURS	22.0 HOURS	AIR LEAK THROUGH VENT VALVE FLANGE
LUA6852F	.340E-03 HOURS	.500 MONTHS	O2 ANALYZER 6852 INACTIVE
LUA6853F	.340E-04 HOURS	.500 MONTHS	O2 ANALYZER 6853 INACTIVE

I DENOTES INITIATING EVENT

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EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
 EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02

TOP EVENT PROBABILITY = .31745E-06

RANK IMPORTANCE

17 .137E-01 CUT SET 25 MEAN TIME TO OCCURRENCE=, .47482E+10 HOURS .54203E+06 YEARS

GROUP RANK CUMULATIVE/RESIDUAL

.740980/ .259

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LP-BUBBL I	.520E-05 HOURS	22.0 HOURS	BUBBLER JUMP LEAK ANY 1 OF 4 (FLOW DIVERSION)
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

18 .128E-01 CUT SET 100 MEAN TIME TO OCCURRENCE=, .50778E+10 HOURS .57966E+06 YEARS

GROUP RANK CUMULATIVE/RESIDUAL

.753794/ .246

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LHC1027L I	.210E-04 HOURS	22.0 HOURS	AIR LEAK THROUGH ANY 1 OF 27 HANFORD CONNECTOR
LUA6852F	.340E-03 HOURS	.500 MONTHS	O2 ANALYZER 6852 INACTIVE
LUA6853F	.340E-04 HOURS	.500 MONTHS	O2 ANALYZER 6853 INACTIVE

19 .119E-01 CUT SET 45 MEAN TIME TO OCCURRENCE=, .54756E+10 HOURS .62507E+06 YEARS

GROUP RANK CUMULATIVE/RESIDUAL

.777561/ .222

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LSV8773O	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LVTSVNSC I	.120E-04 HOURS	22.0 HOURS	SV 74 FAILS CLOSED--NORMAL SUPPLY NEEDLE VALVE

19 .119E-01 CUT SET 44 MEAN TIME TO OCCURRENCE=, .54756E+10 HOURS .62507E+06 YEARS

GROUP RANK CUMULATIVE/RESIDUAL

.777561/ .222

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LSV8773O	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LVS7469C I	.120E-04 HOURS	22.0 HOURS	SV 7469 FAILS CLOSED

I DENOTES INITIATING EVENT

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EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y

EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02

TOP EVENT PROBABILITY = .31745E-06

RANK IMPORTANCE

20 .114E-01 CUT SET 36 MEAN TIME TO OCCURRENCE=, .57137E+10 HOURS .65225E+06 YEARS

GROUP RANK CUMULATIVE/RESIDUAL

.800338/ .200

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LVGM-28X I	.920E-05 HOURS	22.0 HOURS	OPERATOR CLOSES ANY 1 OF 2 MANUAL VALVES
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

20 .114E-01 CUT SET 37 MEAN TIME TO OCCURRENCE=, .57137E+10 HOURS .65225E+06 YEARS

GROUP RANK CUMULATIVE/RESIDUAL

.800338/ .200

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00	HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LCBAGITD	.300E-02 HOURS	1.00	HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LVGM-34X I	.920E-05 HOURS	22.0	HOURS	BRANCH A MANUAL VALVES CLOSED ANY 1 OF 2
LVS8772K	.150E-05 HOURS	6.00	MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

21 .110E-01 CUT SET 41 MEAN TIME TO OCCURRENCE=, .59352E+10 HOURS .67754E+06 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.811301/ .189

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00	HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00	HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LP-BUBBL I	.520E-05 HOURS	22.0	HOURS	BUBBLER JUMP LEAK ANY 1 OF 4 (FLOW DIVERSION)
LSV8773O	.120E-05 HOURS	6.00	MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN

22 .935E-02 CUT SET 7 MEAN TIME TO OCCURRENCE=, .69563E+10 HOURS .79410E+06 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.830009/ .170

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00	HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00	HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LSV8773X	.100E-02 HOURS	1.00	HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE
LVPVENTO I	.230E-04 HOURS	22.0	HOURS	LPPT OVERFLOW VALVE FAILS OPEN

I DENOTES INITIATING EVENT

1 *****

EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02
TOP EVENT PROBABILITY = .31745E-06

RANK IMPORTANCE

22 .935E-02 CUT SET 8 MEAN TIME TO OCCURRENCE=, .69563E+10 HOURS .79410E+06 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.830009/ .170

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00	HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00	HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFLVENTO I	.230E-04 HOURS	22.0	HOURS	AIR LEAK THROUGH VENT VALVE FLANGE
LSV8773X	.100E-02 HOURS	1.00	HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE

23 .911E-02 CUT SET 49 MEAN TIME TO OCCURRENCE=, .71421E+10 HOURS .81531E+06 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.848230/ .152

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00	HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LCBAGITD	.300E-02 HOURS	1.00	HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LSV8773O	.120E-05 HOURS	6.00	MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LVGM-28X I	.920E-05 HOURS	22.0	HOURS	OPERATOR CLOSSES ANY 1 OF 2 MANUAL VALVES

23 .911E-02 CUT SET 50 MEAN TIME TO OCCURRENCE=, .71421E+10 HOURS .81531E+06 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.848230/ .152

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00	HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LCBAGITD	.300E-02 HOURS	1.00	HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LSV8773O	.120E-05 HOURS	6.00	MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LVGM-34X I	.920E-05 HOURS	22.0	HOURS	BRANCH A MANUAL VALVES CLOSED ANY 1 OF 2

24 .854E-02 CUT SET 9 MEAN TIME TO OCCURRENCE=, .76188E+10 HOURS .86973E+06 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .856771/ .143

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LHC1027L I	.210E-04 HOURS	22.0 HOURS	AIR LEAK THROUGH ANY 1 OF 27 HANFORD CONNECTOR
LSV8773X	.100E-02 HOURS	1.00 HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE

I DENOTES INITIATING EVENT

1 *****

EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
 EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02
 TOP EVENT PROBABILITY = .31745E-06

RANK IMPORTANCE

25 .685E-02 CUT SET 38 MEAN TIME TO OCCURRENCE=, .94963E+10 HOURS .10841E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .863623/ .136

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LHCN2LPL I	.260E-05 HOURS	22.0 HOURS	LPPT N2 JUMPERS LEAK ANY 1 OF 2 (FLOW DIVERSIO
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

26 .651E-02 CUT SET 39 MEAN TIME TO OCCURRENCE=, .99997E+10 HOURS .11415E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .870130/ .130

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LSV8773X	.100E-02 HOURS	1.00 HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE
LVIM-35C I	.160E-04 HOURS	22.0 HOURS	PCV 7172A FAILS CLOSED

27 .548E-02 CUT SET 51 MEAN TIME TO OCCURRENCE=, .11870E+11 HOURS .13551E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .875612/ .124

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LHCN2LPL I	.260E-05 HOURS	22.0 HOURS	LPPT N2 JUMPERS LEAK ANY 1 OF 2 (FLOW DIVERSIO
LSV8773O	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN

28 .501E-02 CUT SET 304 MEAN TIME TO OCCURRENCE=, .12975E+11 HOURS .14812E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .880626/ .119

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
1SLSUMPF	.200E-03 HOURS	.500 MONTHS	SUMP PUMP BUBBLER INACTIVE
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LOPH20-T I	.100E+01 YEARS	1.00 HOURS	OPERATOR FAILS TO REPLENISH SUMP WATER
LUA6852F	.340E-03 HOURS	.500 MONTHS	O2 ANALYZER 6852 INACTIVE
LUA6853F	.340E-04 HOURS	.500 MONTHS	O2 ANALYZER 6853 INACTIVE

I DENOTES INITIATING EVENT

1 *****

EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
 EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02
 TOP EVENT PROBABILITY = .31745E-06

RANK IMPORTANCE

29 .488E-02 CUT SET 43 MEAN TIME TO OCCURRENCE=, .13333E+11 HOURS .15220E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .890387/ .110

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LSV8773X	.100E-02 HOURS	1.00 HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE
LVTSVNSC I	.120E-04 HOURS	22.0 HOURS	SV 74 FAILS CLOSED--NORMAL SUPPLY NEEDLE VALVE

29 .488E-02 CUT SET 42 MEAN TIME TO OCCURRENCE=, .13333E+11 HOURS .15220E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .890387/ .110

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LSV8773X	.100E-02 HOURS	1.00 HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE
LVS7469C I	.120E-04 HOURS	22.0 HOURS	SV 7469 FAILS CLOSED

30 .374E-02 CUT SET 46 MEAN TIME TO OCCURRENCE=, .17391E+11 HOURS .19853E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .897870/ .102

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LSV8773X	.100E-02 HOURS	1.00 HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE
LVGM-34X I	.920E-05 HOURS	22.0 HOURS	BRANCH A MANUAL VALVES CLOSED ANY 1 OF 2

30 .374E-02 CUT SET 47 MEAN TIME TO OCCURRENCE=, .17391E+11 HOURS .19853E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .897870/ .102

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LSV8773X	.100E-02 HOURS	1.00 HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE
LVGM-28X I	.920E-05 HOURS	22.0 HOURS	OPERATOR CLOSSES ANY 1 OF 2 MANUAL VALVES

I DENOTES INITIATING EVENT

1 *****

EXPLOSIVE CONCENTRATION LPPT W/D REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
 EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02
 TOP EVENT PROBABILITY = .31745E-06

RANK IMPORTANCE

31 .343E-02 CUT SET 11 MEAN TIME TO OCCURRENCE=, .18993E+11 HOURS .21681E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .915000/ .850E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFLSPARL I	.130E-05 HOURS	22.0 HOURS	AIR LEAK THROUGH SPARE FEED PUMP FLANGE
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

31 .343E-02 CUT SET 13 MEAN TIME TO OCCURRENCE=, .18993E+11 HOURS .21681E+07 YEARS

GROUP RANK CUMULATIVE/RESIDUAL
.915000/ .850E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFLPPFLL I	.130E-05 HOURS	22.0 HOURS	AIR LEAK THRU LPPT TRANSFER PUMP FLANGE
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

31 .343E-02 CUT SET 10 MEAN TIME TO OCCURRENCE=, .18993E+11 HOURS .21681E+07 YEARS

GROUP RANK CUMULATIVE/RESIDUAL
.915000/ .850E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFLJETFL I	.130E-05 HOURS	22.0 HOURS	AIR LEAK THROUGH LPPT TRANSFER JET FLANGE
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

31 .343E-02 CUT SET 48 MEAN TIME TO OCCURRENCE=, .18993E+11 HOURS .21681E+07 YEARS

GROUP RANK CUMULATIVE/RESIDUAL
.915000/ .850E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LHCSUMPL I	.130E-05 HOURS	22.0 HOURS	AIR LEAK THRU SUMP JET CONNECTOR
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

I DENOTES INITIATING EVENT

1 *****

EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02
TOP EVENT PROBABILITY = .31745E-06

RANK IMPORTANCE

31 .343E-02 CUT SET 12 MEAN TIME TO OCCURRENCE=, .18993E+11 HOURS .21681E+07 YEARS

GROUP RANK CUMULATIVE/RESIDUAL
.915000/ .850E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFLLAGTL I	.130E-05 HOURS	22.0 HOURS	AIR LEAK THROUGH LPPT AGITATOR FLANGE
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

32 .334E-02 CUT SET 136 MEAN TIME TO OCCURRENCE=, .19468E+11 HOURS .22224E+07 YEARS

GROUP RANK CUMULATIVE/RESIDUAL
.918343/ .817E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
1SLSUMP	.200E-03 HOURS	.500 MONTHS	SUMP PUMP BUBBLER INACTIVE
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LOPH20-T I	.100E+01 YEARS	1.00 HOURS	OPERATOR FAILS TO REPLENISH SUMP WATER
LSV8773X	.100E-02 HOURS	1.00 HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE

33 .322E-02 CUT SET 53 MEAN TIME TO OCCURRENCE=, .20218E+11 HOURS .23080E+07 YEARS

GROUP RANK CUMULATIVE/RESIDUAL
.921561/ .784E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAH	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS JI-7171 FAIL TO OPEN

LHCN2LPL I	.260E-05 HOURS	22.0	HOURS	LPPT N2 JUMPERS LEAK ANY 1 OF 2 (FLOW DIVERSIO
LVS8772K	.150E-05 HOURS	6.00	MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

34 .306E-02 CUT SET 54 MEAN TIME TO OCCURRENCE=, .21289E+11 HOURS .24302E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .924618/ .754E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEH	.100E+01 HOURS	1.00	HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LCBAGITD	.300E-02 HOURS	1.00	HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LSV8773X	.100E-02 HOURS	1.00	HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE
LVIN-35C I	.160E-04 HOURS	22.0	HOURS	PCV 7172A FAILS CLOSED

I DENOTES INITIATING EVENT
 1 *****
 EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY *****

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
 EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02
 TOP EVENT PROBABILITY = .31745E-06

RANK IMPORTANCE

35 .301E-02 CUT SET 138 MEAN TIME TO OCCURRENCE=, .21631E+11 HOURS .24693E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .927626/ .724E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00	HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00	HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LOPH20-T I	.100E+01 YEARS	1.00	HOURS	OPERATOR FAILS TO REPLENISH SUMP WATER
LOPLWLT	.100E-01 HOURS	1.00	HOURS	OPERATOR FAILS TO RESPOND TO LOW LEVEL ALARM
LVS8772K	.150E-05 HOURS	6.00	MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

36 .274E-02 CUT SET 21 MEAN TIME TO OCCURRENCE=, .23741E+11 HOURS .27101E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .941330/ .587E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00	HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00	HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFLJETFL I	.130E-05 HOURS	22.0	HOURS	AIR LEAK THROUGH LPPT TRANSFER JET FLANGE
LSV87730	.120E-05 HOURS	6.00	MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN

36 .274E-02 CUT SET 20 MEAN TIME TO OCCURRENCE=, .23741E+11 HOURS .27101E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .941330/ .587E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00	HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00	HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFLSPARL I	.130E-05 HOURS	22.0	HOURS	AIR LEAK THROUGH SPARE FEED PUMP FLANGE
LSV87730	.120E-05 HOURS	6.00	MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN

36 .274E-02 CUT SET 22 MEAN TIME TO OCCURRENCE=, .23741E+11 HOURS .27101E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .941330/ .587E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00	HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00	HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFLPPFLL I	.130E-05 HOURS	22.0	HOURS	AIR LEAK THRU LPPT TRANSFER PUMP FLANGE
LSV87730	.120E-05 HOURS	6.00	MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN

I DENOTES INITIATING EVENT
 1 *****
 EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY *****

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
 EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02
 TOP EVENT PROBABILITY = .31745E-06

RANK IMPORTANCE

36 .274E-02 CUT SET 19 MEAN TIME TO OCCURRENCE=, .23741E+11 HOURS .27101E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .941330/ .587E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFLLAGTL I	.130E-05 HOURS	22.0 HOURS	AIR LEAK THROUGH LPPT AGITATOR FLANGE
LSV87730	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN

36 .274E-02 CUT SET 58 MEAN TIME TO OCCURRENCE=, .23741E+11 HOURS .27101E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .941330/ .587E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LHCSUMPL I	.130E-05 HOURS	22.0 HOURS	AIR LEAK THRU SUMP JET CONNECTOR
LSV87730	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN

37 .264E-02 CUT SET 52 MEAN TIME TO OCCURRENCE=, .24690E+11 HOURS .28185E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .943965/ .560E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFRBR-AP I	.100E-05 HOURS	22.0 HOURS	BRANCH A FILTER PLUGGED
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

38 .257E-02 CUT SET 64 MEAN TIME TO OCCURRENCE=, .25272E+11 HOURS .28849E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .946540/ .535E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LHCN2LPL I	.260E-05 HOURS	22.0 HOURS	LPPT N2 JUMPERS LEAK ANY 1 OF 2 (FLOW DIVERSIO
LSV87730	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN

I DENOTES INITIATING EVENT

1 *****

EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
 EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02
 TOP EVENT PROBABILITY = .31745E-06

RANK IMPORTANCE

39 .241E-02 CUT SET 152 MEAN TIME TO OCCURRENCE=, .27039E+11 HOURS .30866E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .948946/ .511E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LOPN20-T I	.100E+01 YEARS	1.00 HOURS	OPERATOR FAILS TO REPLENISH SUMP WATER
LOPLOWLT	.100E-01 HOURS	1.00 HOURS	OPERATOR FAILS TO RESPOND TO LOW LEVEL ALARM

LSV87730 .120E-05 HOURS 6.00 MONTHS BYPASS VENT VALVE SV-8773 FAILS OPEN

40 .229E-02 CUT SET 57 MEAN TIME TO OCCURRENCE=, .28385E+11 HOURS .32403E+07 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.953531/ .465E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
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BENZENEH	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LSV8773X	.100E-02 HOURS	1.00 HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE
LVS7469C I	.120E-04 HOURS	22.0 HOURS	SV 7469 FAILS CLOSED

40 .229E-02 CUT SET 56 MEAN TIME TO OCCURRENCE=, .28385E+11 HOURS .32403E+07 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.953531/ .465E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
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BENZENEH	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LSV8773X	.100E-02 HOURS	1.00 HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE
LVTSVNSC I	.120E-04 HOURS	22.0 HOURS	SV 74 FAILS CLOSED--NORMAL SUPPLY NEEDLE VALVE

41 .211E-02 CUT SET 55 MEAN TIME TO OCCURRENCE=, .30768E+11 HOURS .35124E+07 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.955646/ .444E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
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BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LP-BUBBL I	.520E-05 HOURS	22.0 HOURS	BUBBLER JUMP LEAK ANY 1 OF 4 (FLOW DIVERSION)
LSV8773X	.100E-02 HOURS	1.00 HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE

I DENOTES INITIATING EVENT

1 *****

EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02
TOP EVENT PROBABILITY = .31745E-06

RANK IMPORTANCE

42 .211E-02 CUT SET 62 MEAN TIME TO OCCURRENCE=, .30863E+11 HOURS .35232E+07 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.957754/ .422E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
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BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFRBR-AP I	.100E-05 HOURS	22.0 HOURS	BRANCH A FILTER PLUGGED
LSV87730	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN

43 .195E-02 CUT SET 142 MEAN TIME TO OCCURRENCE=, .33381E+11 HOURS .38106E+07 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.959703/ .403E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
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7RYBUBLD	.300E-05 HOURS	3.00 MONTHS	LOW SUMP LEVEL (BUBBLER) RELAY FAILS TO OPEN
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LOPH20-T I	.100E+01 YEARS	1.00 HOURS	OPERATOR FAILS TO REPLENISH SUMP WATER
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

44 .176E-02 CUT SET 59 MEAN TIME TO OCCURRENCE=, .37025E+11 HOURS .42265E+07 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.963218/ .368E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
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1 *****

EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
 EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02
 TOP EVENT PROBABILITY = .31745E-06

RANK IMPORTANCE

49 .990E-03 CUT SET 73 MEAN TIME TO OCCURRENCE=, .65708E+11 HOURS .75009E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .969275/ .307E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LFRBR-AP I	.100E-05 HOURS	22.0 HOURS	BRANCH A FILTER PLUGGED
LSV87730	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN

50 .970E-03 CUT SET 68 MEAN TIME TO OCCURRENCE=, .67094E+11 HOURS .76591E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .970245/ .298E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LSV87730	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN
LVDSUPPX I	.460E-06 HOURS	22.0 HOURS	DRAIN VALVE SUPPLEMENTAL LINE LEFT OPEN

51 .793E-03 CUT SET 102 MEAN TIME TO OCCURRENCE=, .82026E+11 HOURS .93637E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .974212/ .258E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFLJETFL I	.130E-05 HOURS	22.0 HOURS	AIR LEAK THROUGH LPPT TRANSFER JET FLANGE
LUA6852F	.340E-03 HOURS	.500 MONTHS	O2 ANALYZER 6852 INACTIVE
LUA6853F	.340E-04 HOURS	.500 MONTHS	O2 ANALYZER 6853 INACTIVE

51 .793E-03 CUT SET 101 MEAN TIME TO OCCURRENCE=, .82026E+11 HOURS .93637E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .974212/ .258E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFLSPARL I	.130E-05 HOURS	22.0 HOURS	AIR LEAK THROUGH SPARE FEED PUMP FLANGE
LUA6852F	.340E-03 HOURS	.500 MONTHS	O2 ANALYZER 6852 INACTIVE
LUA6853F	.340E-04 HOURS	.500 MONTHS	O2 ANALYZER 6853 INACTIVE

I DENOTES INITIATING EVENT

1 *****

EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
 EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02
 TOP EVENT PROBABILITY = .31745E-06

RANK IMPORTANCE

51 .793E-03 CUT SET 117 MEAN TIME TO OCCURRENCE=, .82026E+11 HOURS .93637E+07 YEARS
 GROUP RANK CUMULATIVE/RESIDUAL
 .974212/ .258E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
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BENZENEN	.100E+01 HOURS	1.00	HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LCBAGITD	.300E-02 HOURS	1.00	HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LSV8773X	.100E-02 HOURS	1.00	HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE
LVGM-28X I	.920E-05 HOURS	22.0	HOURS	OPERATOR CLOSSES ANY 1 OF 2 MANUAL VALVES

44 .176E-02 CUT SET 60 MEAN TIME TO OCCURRENCE=, .37025E+11 HOURS .42265E+07 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.963218/ .368E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LSV8773X	.100E-02 HOURS	1.00 HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE
LVGM-34X I	.920E-05 HOURS	22.0 HOURS	BRANCH A MANUAL VALVES CLOSED ANY 1 OF 2

I DENOTES INITIATING EVENT
1 *****

EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02
TOP EVENT PROBABILITY = .31745E-06

RANK IMPORTANCE

45 .156E-02 CUT SET 166 MEAN TIME TO OCCURRENCE=, .41727E+11 HOURS .47633E+07 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.964778/ .352E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
7RYBUBLD	.300E-05 HOURS	3.00 MONTHS	LOW SUMP LEVEL (BUBBLER) RELAY FAILS TO OPEN
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LOPH20-T I	.100E+01 YEARS	1.00 HOURS	OPERATOR FAILS TO REPLENISH SUMP WATER
LSV87730	.120E-05 HOURS	6.00 MONTHS	BYPASS VENT VALVE SV-8773 FAILS OPEN

46 .124E-02 CUT SET 65 MEAN TIME TO OCCURRENCE=, .52566E+11 HOURS .60007E+07 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.966016/ .340E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEN	.100E+01 HOURS	1.00 HOURS	BATCH BENZENE CONC NORMAL -- 29/30 TRANSFERS
FILLSTAN	.980E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY, 43 HRS -- BENZENE CO
LCBAGITD	.300E-02 HOURS	1.00 HOURS	AGITATOR MCC CONTACTS J1-7171 FAIL TO OPEN
LFRBR-AP I	.100E-05 HOURS	22.0 HOURS	BRANCH A FILTER PLUGGED
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

47 .121E-02 CUT SET 61 MEAN TIME TO OCCURRENCE=, .53675E+11 HOURS .61273E+07 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.967228/ .328E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LVDSUPPX I	.460E-06 HOURS	22.0 HOURS	DRAIN VALVE SUPPLEMENTAL LINE LEFT OPEN
LVS8772K	.150E-05 HOURS	6.00 MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE

48 .106E-02 CUT SET 63 MEAN TIME TO OCCURRENCE=, .61537E+11 HOURS .70248E+07 YEARS
GROUP RANK CUMULATIVE/RESIDUAL
.968285/ .317E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION	BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00 HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAN	.190E+00 HOURS	1.00 HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00 HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LHCN2LPL I	.260E-05 HOURS	22.0 HOURS	LPPT N2 JUMPERS LEAK ANY 1 OF 2 (FLOW DIVERSIO
LSV8773X	.100E-02 HOURS	1.00 HOURS	OPERATOR OPENS SV-8773 AND FAILS TO RECLOSE

I DENOTES INITIATING EVENT

TOP EVENT PROBABILITY = .31745E-06

MISSION TIME 1.00 Y 30.0 Y
EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02

RANK	CUT	SET NO	IMPORTANCE*	RANK	CUT	SET NO	IMPORTANCE*	RANK	CUT	SET NO	IMPORTANCE*	RANK	CUT	SET NO	IMPORTANCE*
54	69		.569E-03*	78	160		.183E-03*	105	164		.738E-04*	129	198		.424E-04*
55	35		.529E-03*	79	145		.170E-03*	106	86		.717E-04*	129	197		.424E-04*
55	66		.529E-03*	80	173		.167E-03*	107	163		.715E-04*	130	199		.421E-04*
55	34		.529E-03*	81	143		.164E-03*	108	165		.684E-04*	130	200		.421E-04*
55	33		.529E-03*	81	144		.164E-03*	109	172		.658E-04*	131	90		.412E-04*
55	32		.529E-03*	82	147		.163E-03*	110	243		.639E-04*	131	91		.412E-04*
56	137		.526E-03*	82	146		.163E-03*	111	238		.618E-04*	132	246		.395E-04*
57	74		.497E-03*	83	171		.136E-03*	111	239		.618E-04*	133	281		.376E-04*
58	67		.464E-03*	84	168		.132E-03*	112	241		.614E-04*	134	287		.368E-04*
58	204		.464E-03*	84	167		.132E-03*	112	242		.614E-04*	135	209		.353E-04*
59	79		.456E-03*	85	169		.131E-03*	113	92		.604E-04*	136	290		.345E-04*
60	315		.451E-03*	85	170		.131E-03*	114	245		.600E-04*	136	289		.345E-04*
61	127		.443E-03*	86	111		.126E-03*	115	174		.591E-04*	137	254		.340E-04*
62	70		.407E-03*	87	149		.114E-03*	116	217		.572E-04*	137	253		.340E-04*
63	77		.371E-03*	87	150		.114E-03*	117	203		.562E-04*	137	212		.340E-04*
64	141		.354E-03*	87	151		.114E-03*	117	202		.562E-04*	138	256		.337E-04*
65	72		.348E-03*	88	162		.107E-03*	118	181		.554E-04*	138	255		.337E-04*
65	71		.348E-03*	89	113		.106E-03*	118	180		.554E-04*	139	231		.336E-04*
66	140		.309E-03*	89	114		.106E-03*	119	205		.538E-04*	140	232		.322E-04*
67	223		.301E-03*	90	154		.101E-03*	119	88		.537E-04*	141	244		.309E-04*
67	224		.301E-03*	91	115		.101E-03*	119	89		.537E-04*	142	219		.295E-04*
68	81		.279E-03*	92	153		.100E-03*	119	206		.537E-04*	142	218		.295E-04*
68	80		.279E-03*	93	159		.976E-04*	119	207		.537E-04*	143	297		.292E-04*
69	75		.267E-03*	94	116		.968E-04*	120	222		.527E-04*	144	93		.290E-04*
69	76		.267E-03*	95	184		.915E-04*	121	183		.493E-04*	145	247		.278E-04*
70	108		.252E-03*	95	185		.915E-04*	122	211		.477E-04*	146	286		.272E-04*
70	106		.252E-03*	95	186		.915E-04*	123	237		.473E-04*	147	230		.262E-04*
70	107		.252E-03*	96	87		.879E-04*	124	210		.470E-04*	148	227		.258E-04*
70	105		.252E-03*	97	214		.860E-04*	125	213		.459E-04*	149	226		.254E-04*
71	161		.247E-03*	98	201		.801E-04*	126	260		.450E-04*	149	225		.254E-04*
72	109		.230E-03*	99	179		.798E-04*	126	259		.450E-04*	150	120		.252E-04*
72	110		.230E-03*	100	208		.782E-04*	127	215		.431E-04*	150	119		.252E-04*
73	139		.229E-03*	101	176		.772E-04*	127	216		.431E-04*	150	121		.252E-04*
74	83		.214E-03*	101	175		.772E-04*	127	263		.431E-04*	150	118		.252E-04*
74	84		.214E-03*	102	177		.767E-04*	128	264		.430E-04*	151	229		.252E-04*
75	148		.208E-03*	102	178		.767E-04*	128	262		.430E-04*	151	228		.252E-04*
76	82		.191E-03*	103	85		.754E-04*	129	195		.425E-04*	152	234		.244E-04*
77	78		.187E-03*	104	182		.750E-04*	129	196		.425E-04*	152	233		.244E-04*

EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE
FOR CUT SETS OF RANK 54 AND HIGHER

STEADY STATE CALCULATIONS

TOP EVENT PROBABILITY = .31745E-06

MISSION TIME 1.00 Y 30.0 Y
EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02

RANK	CUT	SET NO	IMPORTANCE*	RANK	CUT	SET NO	IMPORTANCE*	RANK	CUT	SET NO	IMPORTANCE*	RANK	CUT	SET NO	IMPORTANCE*
153	236		.242E-04*	173	298		.149E-04*	187	339		.962E-05*	199	345		.996E-06*
153	235		.242E-04*	173	299		.149E-04*	187	340		.962E-05*	199	346		.996E-06*
154	240		.240E-04*	174	128		.143E-04*	188	349		.732E-05*	200	347		.909E-06*
155	294		.236E-04*	174	221		.143E-04*	188	348		.732E-05*	201	325		.840E-06*
155	293		.236E-04*	174	130		.143E-04*	189	155		.599E-05*	201	326		.840E-06*
156	95		.232E-04*	174	129		.143E-04*	189	156		.599E-05*	201	328		.840E-06*
157	252		.232E-04*	174	131		.143E-04*	189	157		.599E-05*	201	327		.840E-06*
158	122		.230E-04*	174	220		.143E-04*	189	158		.599E-05*	201	323		.840E-06*
158	123		.230E-04*	174	135		.143E-04*	190	311		.149E-05*	201	324		.840E-06*
159	278		.200E-04*	174	133		.143E-04*	190	312		.149E-05*	201	321		.840E-06*

BENZENEH	.330E-01 HOURS	1.00	HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00	HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LHC5UPL I	.130E-05 HOURS	22.0	HOURS	AIR LEAK THRU SUMP JET CONNECTOR
LUA6852F	.340E-03 HOURS	.500	MONTHS	O2 ANALYZER 6852 INACTIVE
LUA6853F	.340E-04 HOURS	.500	MONTHS	O2 ANALYZER 6853 INACTIVE

51 .793E-03 CUT SET 103 MEAN TIME TO OCCURRENCE=, .82026E+11 HOURS .93637E+07 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.974212/ .258E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00	HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00	HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFLLAGTL I	.130E-05 HOURS	22.0	HOURS	AIR LEAK THROUGH LPPT AGITATOR FLANGE
LUA6852F	.340E-03 HOURS	.500	MONTHS	O2 ANALYZER 6852 INACTIVE
LUA6853F	.340E-04 HOURS	.500	MONTHS	O2 ANALYZER 6853 INACTIVE

51 .793E-03 CUT SET 104 MEAN TIME TO OCCURRENCE=, .82026E+11 HOURS .93637E+07 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.974212/ .258E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00	HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00	HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LFLPPFLL I	.130E-05 HOURS	22.0	HOURS	AIR LEAK THRU LPPT TRANSFER PUMP FLANGE
LUA6852F	.340E-03 HOURS	.500	MONTHS	O2 ANALYZER 6852 INACTIVE
LUA6853F	.340E-04 HOURS	.500	MONTHS	O2 ANALYZER 6853 INACTIVE

I DENOTES INITIATING EVENT

1 *****

EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE (MEASURE OF INTERVAL RELIABILITY)

STEADY STATE CALCULATIONS

MISSION TIME .100E+01Y .300E+02Y
EXPECT NO OF SYSTEM FAIL .135E-03 .404E-02
TOP EVENT PROBABILITY = .31745E-06

RANK IMPORTANCE

52 .697E-03 CUT SET 308 MEAN TIME TO OCCURRENCE=, .93421E+11 HOURS .10665E+08 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.974908/ .251E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
BENZENEH	.330E-01 HOURS	1.00	HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00	HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LOPH20-T I	.100E+01 YEARS	1.00	HOURS	OPERATOR FAILS TO REPLENISH SUMP WATER
LOPLOWLT	.100E-01 HOURS	1.00	HOURS	OPERATOR FAILS TO RESPOND TO LOW LEVEL ALARM
LUA6852F	.340E-03 HOURS	.500	MONTHS	O2 ANALYZER 6852 INACTIVE
LUA6853F	.340E-04 HOURS	.500	MONTHS	O2 ANALYZER 6853 INACTIVE

53 .657E-03 CUT SET 125 MEAN TIME TO OCCURRENCE=, .99015E+11 HOURS .11303E+08 YEARS
GROUP RANK CUMULATIVE/RESIDUAL

.975565/ .244E-01

BASIC EVENT	FAILURE RATE	MEAN FAUL DURATION		BASIC EVENT DESCRIPTION
OVAIO20X I	.920E-04 HOURS	22.0	HOURS	ANY PAIR OF DRIP LEG BLOW DOWN VALVES OPEN (AN
BENZENEH	.330E-01 HOURS	1.00	HOURS	BATCH BENZENE CONC HIGH -- 1/30 TRANSFERS
FILLSTAH	.190E+00 HOURS	1.00	HOURS	TIME PERIOD FILL/STANDBY FIRST 8 HOURS BENZENE
LC6H6UEL	.100E+01 HOURS	1.00	HOURS	BENZENE CONC IN LPPT BETWEEN LEL & UEL LIMITS
LVS8772K	.150E-05 HOURS	6.00	MONTHS	MAIN VENT VALVE HCV-8772 FAILS TO CLOSE
ZVZN2--O I	.620E-04 HOURS	22.0	HOURS	Y-STRAINER VALVE OPEN

I DENOTES INITIATING EVENT

1 *****

EXPLOSIVE CONCENTRATION LPPT W/O REDUNDANT N2 SUPPLY

INITIATOR (BARLOW-PROSCHAN) MEASURE OF CUT SET IMPORTANCE
FOR CUT SETS OF RANK 54 AND HIGHER

STEADY STATE CALCULATIONS

159	277	.200E-04*	174	134	.143E-04*	190	309	.149E-05*	201	322	.840E-06*
160	280	.198E-04*	174	132	.143E-04*	190	310	.149E-05*	202	354	.730E-06*
160	279	.198E-04*	175	303	.136E-04*	191	190	.143E-05*	202	355	.730E-06*
161	126	.195E-04*	175	302	.136E-04*	191	191	.143E-05*	202	356	.730E-06*
162	248	.185E-04*	176	94	.133E-04*	191	192	.143E-05*	202	357	.730E-06*
163	249	.177E-04*	177	306	.129E-04*	191	193	.143E-05*	203	344	.526E-06*
164	250	.177E-04*	177	305	.129E-04*	191	187	.143E-05*	203	343	.526E-06*
164	251	.177E-04*	178	288	.127E-04*	191	189	.143E-05*	204	267	.453E-06*
165	257	.170E-04*	178	341	.127E-04*	191	194	.143E-05*	204	273	.453E-06*
165	258	.170E-04*	178	342	.127E-04*	191	188	.143E-05*	204	271	.453E-06*
165	331	.170E-04*	179	329	.125E-04*	192	333	.137E-05*	204	269	.453E-06*
166	320	.167E-04*	179	330	.125E-04*	192	332	.137E-05*	204	268	.453E-06*
167	291	.166E-04*	180	292	.120E-04*	193	314	.136E-05*	204	274	.453E-06*
168	295	.160E-04*	181	307	.118E-04*	193	313	.136E-05*	204	270	.453E-06*
169	261	.157E-04*	182	96	.116E-04*	194	336	.126E-05*	204	272	.453E-06*
170	265	.155E-04*	183	296	.110E-04*	195	334	.122E-05*	205	282	.414E-06*
171	276	.151E-04*	184	97	.107E-04*	195	335	.122E-05*	205	283	.414E-06*
172	266	.150E-04*	185	350	.990E-05*	196	316	.115E-05*	205	284	.414E-06*
173	275	.149E-04*	186	353	.976E-05*	196	317	.115E-05*	205	285	.414E-06*
173	301	.149E-04*	186	352	.976E-05*	197	337	.111E-05*	206	318	.125E-06*
173	300	.149E-04*	186	338	.975E-05*	198	319	.105E-05*	207	351	.999E-07*

1 REFERENCE TABLE FOR MIN CUT SETS

ORDER	1	2	3	4	5	6	7
NO. OF MIN CUT SETS	0	0	0	0	97	199	61

NO. OF MIN CUT SETS = 357

CUT SET NO. ORDER BASIC EVENTS

1	5	BENZENEH	FILLSTAH	LC6H6UEL	LVPVENTO	LVS8772K
2	5	BENZENEH	FILLSTAH	LC6H6UEL	LFLVENTO	LVS8772K
3	5	BENZENEH	FILLSTAH	LC6H6UEL	LHC1027L	LVS8772K
4	5	BENZENEH	FILLSTAH	LC6H6UEL	LFLVENTO	LSV87730
5	5	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	LVPVENTO
6	5	BENZENEH	FILLSTAH	LC6H6UEL	LHC1027L	LSV87730
7	5	BENZENEH	FILLSTAH	LC6H6UEL	LSV8773X	LVPVENTO
8	5	BENZENEH	FILLSTAH	LC6H6UEL	LFLVENTO	LSV8773X
9	5	BENZENEH	FILLSTAH	LC6H6UEL	LHC1027L	LSV8773X
10	5	BENZENEH	FILLSTAH	LC6H6UEL	LFLJETFL	LVS8772K
11	5	BENZENEH	FILLSTAH	LC6H6UEL	LFLSPARL	LVS8772K
12	5	BENZENEH	FILLSTAH	LC6H6UEL	LFLLAGTL	LVS8772K
13	5	BENZENEH	FILLSTAH	LC6H6UEL	LFLPPFLL	LVS8772K
14	5	BENZENEH	FILLSTAH	LC6H6UEL	LVIM-35C	LVS8772K
15	5	BENZENEH	FILLSTAH	LC6H6UEL	LVS7469C	LVS8772K
16	5	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	LVTSVNSC
17	5	BENZENEH	FILLSTAH	LC6H6UEL	LVGM-34X	LVS8772K
18	5	BENZENEH	FILLSTAH	LC6H6UEL	LVGM-28X	LVS8772K
19	5	BENZENEH	FILLSTAH	LC6H6UEL	LFLLAGTL	LSV87730
20	5	BENZENEH	FILLSTAH	LC6H6UEL	LFLSPARL	LSV87730
21	5	BENZENEH	FILLSTAH	LC6H6UEL	LFLJETFL	LSV87730
22	5	BENZENEH	FILLSTAH	LC6H6UEL	LFLPPFLL	LSV87730
23	5	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	LVIM-35C
24	5	BENZENEH	FILLSTAH	LCBAGITD	LVIM-35C	LVS8772K
25	5	BENZENEH	FILLSTAH	LC6H6UEL	LP-BUBBL	LVS8772K
26	5	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	LVTSVNSC
27	5	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	LVS7469C
28	5	BENZENEH	FILLSTAH	LCBAGITD	LVS7469C	LVS8772K
29	5	BENZENEH	FILLSTAH	LCBAGITD	LVS8772K	LVTSVNSC
30	5	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	LVGM-34X
31	5	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	LVGM-28X
32	5	BENZENEH	FILLSTAH	LC6H6UEL	LFLSPARL	LSV8773X
33	5	BENZENEH	FILLSTAH	LC6H6UEL	LFLPPFLL	LSV8773X
34	5	BENZENEH	FILLSTAH	LC6H6UEL	LFLLAGTL	LSV8773X
35	5	BENZENEH	FILLSTAH	LC6H6UEL	LFLJETFL	LSV8773X
36	5	BENZENEH	FILLSTAH	LCBAGITD	LVGM-28X	LVS8772K
37	5	BENZENEH	FILLSTAH	LCBAGITD	LVGM-34X	LVS8772K
38	5	BENZENEH	FILLSTAH	LC6H6UEL	LHCN2LPL	LVS8772K
39	5	BENZENEH	FILLSTAH	LC6H6UEL	LSV8773X	LVIM-35C
40	5	BENZENEH	FILLSTAH	LCBAGITD	LSV87730	LVIM-35C
41	5	BENZENEH	FILLSTAH	LC6H6UEL	LP-BUBBL	LSV87730
42	5	BENZENEH	FILLSTAH	LC6H6UEL	LSV8773X	LVS7469C
43	5	BENZENEH	FILLSTAH	LC6H6UEL	LSV8773X	LVTSVNSC
44	5	BENZENEH	FILLSTAH	LCBAGITD	LSV87730	LVS7469C
45	5	BENZENEH	FILLSTAH	LCBAGITD	LSV87730	LVTSVNSC
46	5	BENZENEH	FILLSTAH	LC6H6UEL	LSV8773X	LVGM-34X

47	5	BENZENEH	FILLSTAH	LC6H6UEL	LSV8773X	LVGM-28X
48	5	BENZENEH	FILLSTAH	LC6H6UEL	LHCSUMPL	LVS8772K
49	5	BENZENEH	FILLSTAH	LCBAGITD	LSV87730	LVGM-28X
50	5	BENZENEH	FILLSTAH	LCBAGITD	LSV87730	LVGM-34X
51	5	BENZENEH	FILLSTAH	LC6H6UEL	LHCN2LPL	LSV87730
52	5	BENZENEH	FILLSTAH	LC6H6UEL	LFRBR-AP	LVS8772K
53	5	BENZENEH	FILLSTAH	LCBAGITD	LHCN2LPL	LVS8772K
54	5	BENZENEH	FILLSTAH	LCBAGITD	LSV8773X	LVIM-35C
55	5	BENZENEH	FILLSTAH	LC6H6UEL	LP-BUBBL	LSV8773X
56	5	BENZENEH	FILLSTAH	LCBAGITD	LSV8773X	LVTSVNSC
57	5	BENZENEH	FILLSTAH	LCBAGITD	LSV8773X	LVS7469C
58	5	BENZENEH	FILLSTAH	LC6H6UEL	LHCSUMPL	LSV87730
59	5	BENZENEH	FILLSTAH	LCBAGITD	LSV8773X	LVGM-28X
60	5	BENZENEH	FILLSTAH	LCBAGITD	LSV8773X	LVGM-34X
61	5	BENZENEH	FILLSTAH	LC6H6UEL	LVDSUPPX	LVS8772K
62	5	BENZENEH	FILLSTAH	LC6H6UEL	LFRBR-AP	LSV87730
63	5	BENZENEH	FILLSTAH	LC6H6UEL	LHCN2LPL	LSV8773X
64	5	BENZENEH	FILLSTAH	LCBAGITD	LHCN2LPL	LSV87730
65	5	BENZENEH	FILLSTAH	LCBAGITD	LFRBR-AP	LVS8772K
66	5	BENZENEH	FILLSTAH	LC6H6UEL	LHCSUMPL	LSV8773X
67	5	BENZENEH	LCBAGITD	LVIM-35C	LVS8772K	PUMPOUT-
68	5	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	LVDSUPPX
69	5	BENZENEH	FILLSTAH	LCBAGITD	LVDSUPPX	LVS8772K
70	5	BENZENEH	FILLSTAH	LC6H6UEL	LFRBR-AP	LSV8773X
71	5	BENZENEH	LCBAGITD	LVS7469C	LVS8772K	PUMPOUT-
72	5	BENZENEH	LCBAGITD	LVS8772K	LVTSVNSC	PUMPOUT-
73	5	BENZENEH	FILLSTAH	LCBAGITD	LFRBR-AP	LSV87730
74	5	BENZENEH	FILLSTAH	LCBAGITD	LHCN2LPL	LSV8773X
75	5	BENZENEH	LCBAGITD	LVGM-34X	LVS8772K	PUMPOUT-
76	5	BENZENEH	LCBAGITD	LVGM-28X	LVS8772K	PUMPOUT-
77	5	BENZENEH	LCBAGITD	LSV87730	LVIM-35C	PUMPOUT-
78	5	BENZENEH	FILLSTAH	LC6H6UEL	LSV8773X	LVDSUPPX
79	5	BENZENEH	FILLSTAH	LCBAGITD	LSV87730	LVDSUPPX
80	5	BENZENEH	LCBAGITD	LSV87730	LVTSVNSC	PUMPOUT-
81	5	BENZENEH	LCBAGITD	LSV87730	LVS7469C	PUMPOUT-
82	5	BENZENEH	FILLSTAH	LCBAGITD	LFRBR-AP	LSV8773X
83	5	BENZENEH	LCBAGITD	LSV87730	LVGM-28X	PUMPOUT-
84	5	BENZENEH	LCBAGITD	LSV87730	LVGM-34X	PUMPOUT-
85	5	BENZENEH	LCBAGITD	LHCN2LPL	LVS8772K	PUMPOUT-
86	5	BENZENEH	LCBAGITD	LSV8773X	LVIM-35C	PUMPOUT-
87	5	BENZENEH	FILLSTAH	LCBAGITD	LSV8773X	LVDSUPPX
88	5	BENZENEH	LCBAGITD	LSV8773X	LVS7469C	PUMPOUT-
89	5	BENZENEH	LCBAGITD	LSV8773X	LVTSVNSC	PUMPOUT-
90	5	BENZENEH	LCBAGITD	LSV8773X	LVGM-28X	PUMPOUT-
91	5	BENZENEH	LCBAGITD	LSV8773X	LVGM-34X	PUMPOUT-
92	5	BENZENEH	LCBAGITD	LHCN2LPL	LSV87730	PUMPOUT-
93	5	BENZENEH	LCBAGITD	LFRBR-AP	LVS8772K	PUMPOUT-
94	5	BENZENEH	LCBAGITD	LVDSUPPX	LVS8772K	PUMPOUT-
95	5	BENZENEH	LCBAGITD	LFRBR-AP	LSV87730	PUMPOUT-
96	5	BENZENEH	LCBAGITD	LHCN2LPL	LSV8773X	PUMPOUT-
97	5	BENZENEH	LCBAGITD	LSV87730	LVDSUPPX	PUMPOUT-
98	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLVENTO	LUA6852F
99	6	BENZENEH	FILLSTAH	LC6H6UEL	LUA6852F	LUA6853F
100	6	BENZENEH	FILLSTAH	LC6H6UEL	LHC1027L	LUA6852F
101	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLSPARL	LUA6852F
102	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLJETFL	LUA6852F
103	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLLAGTL	LUA6852F
104	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLPPFLL	LUA6852F
105	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLVENTO	LUA6852F
106	6	BENZENEH	FILLSTAH	LC6H6UEL	LTR6853F	LUA6852F
107	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLVENTO	LTR6853F
108	6	BENZENEH	FILLSTAH	LC6H6UEL	LUA6852F	LUA6853U
109	6	BENZENEH	FILLSTAH	LC6H6UEL	LHC1027L	LTR6853F
110	6	BENZENEH	FILLSTAH	LC6H6UEL	LHC1027L	LUA6852F
111	6	BENZENEH	FILLSTAH	LC6H6UEL	LDPDTLL	LTKAUXTF
112	6	1SLSUMPF	BENZENEH	FILLSTAH	LC6H6UEL	LPH20-T
113	6	7CPDCS-F	BENZENEH	FILLSTAH	LC6H6UEL	LRV-281D
114	6	7CPDCS-F	BENZENEH	FILLSTAH	LC6H6UEL	LFLVENTO
115	6	BENZENEH	FILLSTAH	LC6H6UEL	LDPDTLL	LSV87730
116	6	7CPDCS-F	BENZENEH	FILLSTAH	LC6H6UEL	LHC1027L
117	6	BENZENEH	FILLSTAH	LC6H6UEL	LHCSUMPL	LUA6852F
118	6	BENZENEH	FILLSTAH	LC6H6UEL	LUA6852U	LUA6853F
119	6	BENZENEH	FILLSTAH	LC6H6UEL	LTR6852F	LUA6853F
120	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLVENTO	LUA6852U
121	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLVENTO	LTR6852F
122	6	BENZENEH	FILLSTAH	LC6H6UEL	LHC1027L	LUA6852U
123	6	BENZENEH	FILLSTAH	LC6H6UEL	LHC1027L	LTR6852F

201	6	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	LVA10F3X	ZVZN2--O
202	6	7CPDCS-F	BENZENEH	FILLSTAN	LRY-281D	LVS7469C	LVS8772K
203	6	7CPDCS-F	BENZENEH	FILLSTAN	LRY-281D	LVS8772K	LVTSVNSC
204	6	BENZENEH	FILLSTAH	LC6H6UEL	LOPH20-T	LOPLLOWLT	LSV8773X
205	6	BENZENEH	FILLSTAN	LCBAGITD	LVS8772K	HVZN2--O	ZV1742-C
206	6	BENZENEH	FILLSTAN	LCBAGITD	LVI7834C	LVS8772K	ZVZN2--O
207	6	OVI4004C	BENZENEH	FILLSTAN	LCBAGITD	LVS8772K	ZVZN2--O
208	6	OVA1020X	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	ZVA10F2X
209	6	BENZENEH	FILLSTAH	LC6H6UEL	LSV8773X	OVA10F7X	ZVZN2--O
210	6	BENZENEH	FILLSTAN	LCBAGITD	LVA10F3X	LVS8772K	ZVZN2--O
211	6	OVA1020X	BENZENEH	FILLSTAN	LCBAGITD	LSV8773X	ZVZN2--O
212	6	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	OVA10F7X	ZVA10F2X
213	6	OVA1020X	BENZENEH	FILLSTAN	LCBAGITD	LVS8772K	ZVA10F2X
214	6	BENZENEH	FILLSTAN	LCBAGITD	LSV87730	OVA10F7X	ZVZN2--O
215	6	7CPDCS-F	BENZENEH	FILLSTAN	LRY-281D	LVGM-28X	LVS8772K
216	6	7CPDCS-F	BENZENEH	FILLSTAN	LRY-281D	LVGM-34X	LVS8772K
217	6	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	HVS7864C	ZVZN2--O
218	6	BENZENEH	FILLSTAH	LC6H6UEL	LVI7834C	LVS8772K	ZV1742-C
219	6	OVI4004C	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	ZV1742-C
220	6	BENZENEH	FILLSTAH	LC6H6UEL	LHCSUMPL	LUA6852F	LUA6853U
221	6	BENZENEH	FILLSTAH	LC6H6UEL	LHCSUMPL	LTR6853F	LUA6852F
222	6	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	HVZN2--O	ZVA10F2X
223	6	7ITSUMPU	BENZENEH	FILLSTAH	LC6H6UEL	LOPH20-T	LVS8772K
224	6	7RYBUBLD	BENZENEH	FILLSTAH	LC6H6UEL	LOPH20-T	LSV8773X
225	6	BENZENEH	FILLSTAH	LC6H6UEL	LSV8773X	OVA10F5X	ZVZN2--O
226	6	BENZENEH	FILLSTAH	LC6H6UEL	LSV8773X	OVD10F5X	ZVZN2--O
227	6	BENZENEH	FILLSTAH	LC6H6UEL	LVA10F3X	LVS8772K	ZV1742-C
228	6	OSPRDSYF	BENZENEH	FILLSTAH	LC6H6UEL	LSV8773X	ZVZN2--O
229	6	OH-AREAF	BENZENEH	FILLSTAH	LC6H6UEL	LSV8773X	ZVZN2--O
230	6	OVA1020X	BENZENEH	FILLSTAH	LC6H6UEL	LSV8773X	ZV1742-C
231	6	BENZENEH	FILLSTAN	LCBAGITD	LVS8772K	HVS7864C	ZVZN2--O
232	6	BENZENEH	FILLSTAN	LCBAGITD	LSV8773X	HVZN2--O	ZVZN2--O
233	6	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	OVA10F5X	ZVA10F2X
234	6	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	OVD10F5X	ZVA10F2X
235	6	OSPRDSYF	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	ZVA10F2X
236	6	OH-AREAF	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	ZVA10F2X
237	6	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	OVA10F7X	ZV1742-C
238	6	BENZENEH	FILLSTAN	LCBAGITD	LSV87730	OVA10F5X	ZVZN2--O
239	6	BENZENEH	FILLSTAN	LCBAGITD	LSV87730	OVD10F5X	ZVZN2--O
240	6	7CPDCS-F	BENZENEH	FILLSTAH	LC6H6UEL	LP-BUBBL	LRY-281D
241	6	OSPRDSYF	BENZENEH	FILLSTAN	LCBAGITD	LSV87730	ZVZN2--O
242	6	OH-AREAF	BENZENEH	FILLSTAN	LCBAGITD	LSV87730	ZVZN2--O
243	6	OVA1020X	BENZENEH	FILLSTAN	LCBAGITD	LSV87730	ZV1742-C
244	6	BENZENEH	FILLSTAN	LCBAGITD	LVS8772K	HVZN2--O	ZVA10F2X
245	6	7CPDCS-F	BENZENEH	FILLSTAN	LRY-281D	LSV87730	LVIM-35C
246	6	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	HVPN2--F	ZVZN2--O
247	6	BENZENEH	FILLSTAN	LCBAGITD	LVS8772K	OVA10F7X	ZV1742-C
248	6	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	HVS7864C	ZV1742-C
249	6	BENZENEH	FILLSTAH	LC6H6UEL	LSV8773X	HVZN2--O	ZV1742-C
250	6	BENZENEH	FILLSTAH	LC6H6UEL	LSV8773X	LVI7834C	ZVZN2--O
251	6	OVI4004C	BENZENEH	FILLSTAH	LC6H6UEL	LSV8773X	ZVZN2--O
252	6	BENZENEH	FILLSTAN	LCBAGITD	LVS8772K	HVPN2--F	ZVZN2--O
253	6	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	OVA10F5X	ZV1742-C
254	6	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	OVD10F5X	ZV1742-C
255	6	OH-AREAF	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	ZV1742-C
256	6	OSPRDSYF	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	ZV1742-C
257	6	BENZENEH	FILLSTAH	LC6H6UEL	LVI7834C	LVS8772K	ZVA10F2X
258	6	OVI4004C	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	ZVA10F2X
259	6	7CPDCS-F	BENZENEH	FILLSTAN	LRY-281D	LSV87730	LVS7469C
260	6	7CPDCS-F	BENZENEH	FILLSTAN	LRY-281D	LSV87730	LVTSVNSC
261	6	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	OVL7538C	ZVZN2--O
262	6	OVI4004C	BENZENEH	FILLSTAN	LCBAGITD	LSV87730	ZVZN2--O
263	6	BENZENEH	FILLSTAN	LCBAGITD	LSV87730	HVZN2--O	ZV1742-C
264	6	BENZENEH	FILLSTAN	LCBAGITD	LSV87730	LVI7834C	ZVZN2--O
265	6	BENZENEH	FILLSTAH	LC6H6UEL	LSV8773X	LVA10F3X	ZVZN2--O
266	6	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	HVX10F4X	ZVZN2--O
267	6	BENZENEH	FILLSTAH	LC6H6UEL	LTR6852F	LTR6853F	LVPVENTO
268	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLVENTO	LTR6852F	LTR6853F
269	6	BENZENEH	FILLSTAH	LC6H6UEL	LUA6852U	LUA6853U	LVPVENTO
270	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLVENTO	LUA6852U	LUA6853U
271	6	BENZENEH	FILLSTAH	LC6H6UEL	LTR6852F	LUA6853U	LVPVENTO
272	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLVENTO	LTR6852F	LUA6853U
273	6	BENZENEH	FILLSTAH	LC6H6UEL	LTR6853F	LUA6852U	LVPVENTO
274	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLVENTO	LTR6853F	LUA6852U
275	6	BENZENEH	FILLSTAH	LC6H6UEL	LVA10F3X	LVS8772K	ZVA10F2X
276	6	OVA1020X	BENZENEH	FILLSTAH	LC6H6UEL	LSV8773X	ZVA10F2X
277	6	BENZENEH	FILLSTAN	LCBAGITD	LVS8772K	OVA10F5X	ZV1742-C

124	6	1SLSUMP	BENZENEH	FILLSTAH	LC6H6UEL	LOPH20-T	LSV87730
125	6	OVA1020X	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	ZVZN2--O
126	6	BENZENEH	FILLSTAH	LC6H6UEL	LDPDTYLL	LSV8773X	LYKAUXTF
127	6	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	NVZN2--O	ZVZN2--O
128	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLLAGTL	LTR6853F	LUA6852F
129	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLSPARL	LTR6853F	LUA6852F
130	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLPPFLL	LUA6852F	LUA6853U
131	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLLAGTL	LUA6852F	LUA6853U
132	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLSPARL	LUA6852F	LUA6853U
133	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLJETFL	LTR6853F	LUA6852F
134	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLPPFLL	LTR6853F	LUA6852F
135	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLJETFL	LUA6852F	LUA6853U
136	6	1SLSUMP	BENZENEH	FILLSTAH	LC6H6UEL	LOPH20-T	LSV8773X
137	6	OVA1020X	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	ZVZN2--O
138	6	BENZENEH	FILLSTAH	LC6H6UEL	LOPH20-T	LOPLOWLT	LVS8772K
139	6	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	OVA10F7X	ZVZN2--O
140	6	OVA1020X	BENZENEH	FILLSTAH	LCBAGITD	LVS8772K	ZVZN2--O
141	6	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	NVZN2--O	ZVZN2--O
142	6	7RYBUBLD	BENZENEH	FILLSTAH	LC6H6UEL	LOPH20-T	LVS8772K
143	6	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	OVD10F5X	ZVZN2--O
144	6	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	OVA10F5X	ZVZN2--O
145	6	OVA1020X	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	ZV1742-C
146	6	OSPRDSYF	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	ZVZN2--O
147	6	OH-AREAF	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	ZVZN2--O
148	6	BENZENEH	FILLSTAH	LCBAGITD	LVS8772K	NVZN2--O	ZVZN2--O
149	6	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	NVZN2--O	ZV1742-C
150	6	BENZENEH	FILLSTAH	LC6H6UEL	LV17834C	LVS8772K	ZVZN2--O
151	6	OVI4004C	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	ZVZN2--O
152	6	BENZENEH	FILLSTAH	LC6H6UEL	LOPH20-T	LOPLOWLT	LSV87730
153	6	BENZENEH	FILLSTAH	LC6H6UEL	LVA10F3X	LVS8772K	ZVZN2--O
154	6	OVA1020X	BENZENEH	FILLSTAH	LC6H6UEL	LSV8773X	ZVZN2--O
155	6	7CPDCS-F	BENZENEH	FILLSTAH	LC6H6UEL	LFLJETFL	LY-281D
156	6	7CPDCS-F	BENZENEH	FILLSTAH	LC6H6UEL	LFLPPFLL	LY-281D
157	6	7CPDCS-F	BENZENEH	FILLSTAH	LC6H6UEL	LFLLAGTL	LY-281D
158	6	7CPDCS-F	BENZENEH	FILLSTAH	LC6H6UEL	LFLSPARL	LY-281D
159	6	OVA1020X	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	ZVA10F2X
160	6	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	OVA10F7X	ZVZN2--O
161	6	OVA1020X	BENZENEH	FILLSTAH	LCBAGITD	LSV87730	ZVZN2--O
162	6	BENZENEH	FILLSTAH	LCBAGITD	LVS8772K	OVA10F7X	ZVZN2--O
163	6	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	NVS7864C	ZVZN2--O
164	6	7CPDCS-F	BENZENEH	FILLSTAH	LC6H6UEL	LY-281D	LVIM-35C
165	6	BENZENEH	FILLSTAH	LC6H6UEL	LSV8773X	NVZN2--O	ZVZN2--O
166	6	7RYBUBLD	BENZENEH	FILLSTAH	LC6H6UEL	LOPH20-T	LSV87730
167	6	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	OVA10F5X	ZVZN2--O
168	6	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	OVD10F5X	ZVZN2--O
169	6	OSPRDSYF	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	ZVZN2--O
170	6	OH-AREAF	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	ZVZN2--O
171	6	OVA1020X	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	ZV1742-C
172	6	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	NVZN2--O	ZVA10F2X
173	6	BENZENEH	FILLSTAH	LCBAGITD	LSV87730	NVZN2--O	ZVZN2--O
174	6	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	OVA10F7X	ZV1742-C
175	6	BENZENEH	FILLSTAH	LCBAGITD	LVS8772K	OVA10F5X	ZVZN2--O
176	6	BENZENEH	FILLSTAH	LCBAGITD	LVS8772K	OVD10F5X	ZVZN2--O
177	6	OSPRDSYF	BENZENEH	FILLSTAH	LCBAGITD	LVS8772K	ZVZN2--O
178	6	OH-AREAF	BENZENEH	FILLSTAH	LCBAGITD	LVS8772K	ZVZN2--O
179	6	OVA1020X	BENZENEH	FILLSTAH	LCBAGITD	LVS8772K	ZV1742-C
180	6	7CPDCS-F	BENZENEH	FILLSTAH	LC6H6UEL	LY-281D	LVS7469C
181	6	7CPDCS-F	BENZENEH	FILLSTAH	LC6H6UEL	LY-281D	LVTSVHSC
182	6	7CPDCS-F	BENZENEH	FILLSTAH	LY-281D	LVIM-35C	LVS8772K
183	6	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	NVZN2--O	ZVZN2--O
184	6	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	NVZN2--O	ZV1742-C
185	6	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	LV17834C	ZVZN2--O
186	6	OVI4004C	BENZENEH	FILLSTAH	LC6H6UEL	LSV87730	ZVZN2--O
187	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLJETFL	LUA6852U	LUA6853F
188	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLJETFL	LTR6852F	LUA6853F
189	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLPPFLL	LTR6852F	LUA6853F
190	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLLAGTL	LTR6852F	LUA6853F
191	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLSPARL	LTR6852F	LUA6853F
192	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLPPFLL	LUA6852U	LUA6853F
193	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLLAGTL	LUA6852U	LUA6853F
194	6	BENZENEH	FILLSTAH	LC6H6UEL	LFLSPARL	LUA6852U	LUA6853F
195	6	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	OVD10F5X	ZV1742-C
196	6	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	OVA10F5X	ZV1742-C
197	6	7CPDCS-F	BENZENEH	FILLSTAH	LC6H6UEL	LY-281D	LVGM-28X
198	6	7CPDCS-F	BENZENEH	FILLSTAH	LC6H6UEL	LY-281D	LVGM-34X
199	6	OH-AREAF	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	ZV1742-C
200	6	OSPRDSYF	BENZENEH	FILLSTAH	LC6H6UEL	LVS8772K	ZV1742-C

Supplemental Notes

APPT/LPPT

FAULT TREE ANALYSIS

PRESENTATION

APPT/LPPT FAULT TREE ANALYSIS

Howard Lambert
March 31, 1992

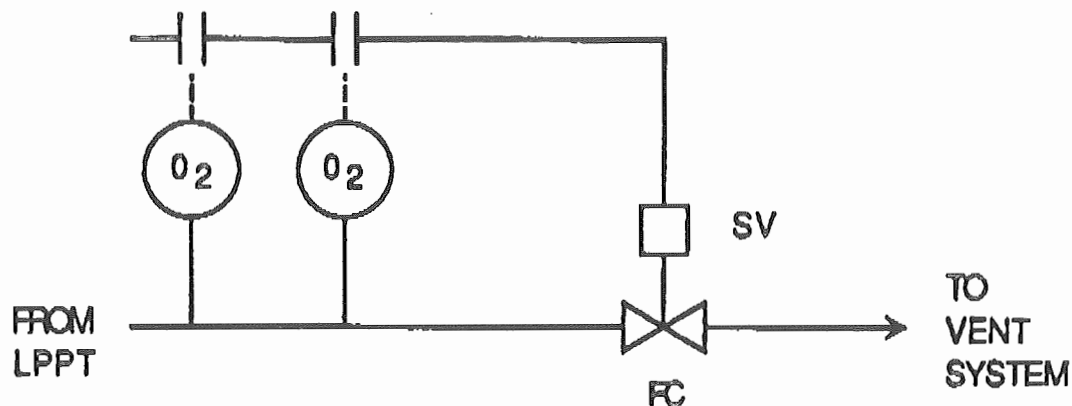
- **1991 FTA**
 - 1) INTERLOCKS CONSIDERED**
 - 2) RESULTS**
 - 3) FAULT TREE CONSTRUCTION
PROCEDURE**

- **1992 FTA**
 - 1) ASSUMPTIONS**
 - 2) INTERLOCKS**

- **CURRENT DESIGN CHANGES**

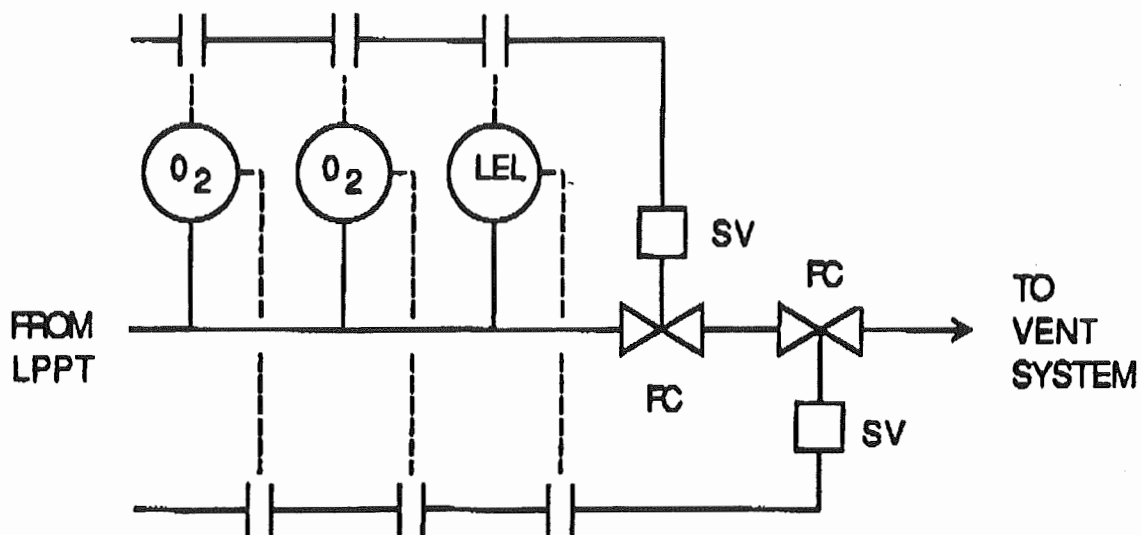
DESIGN A

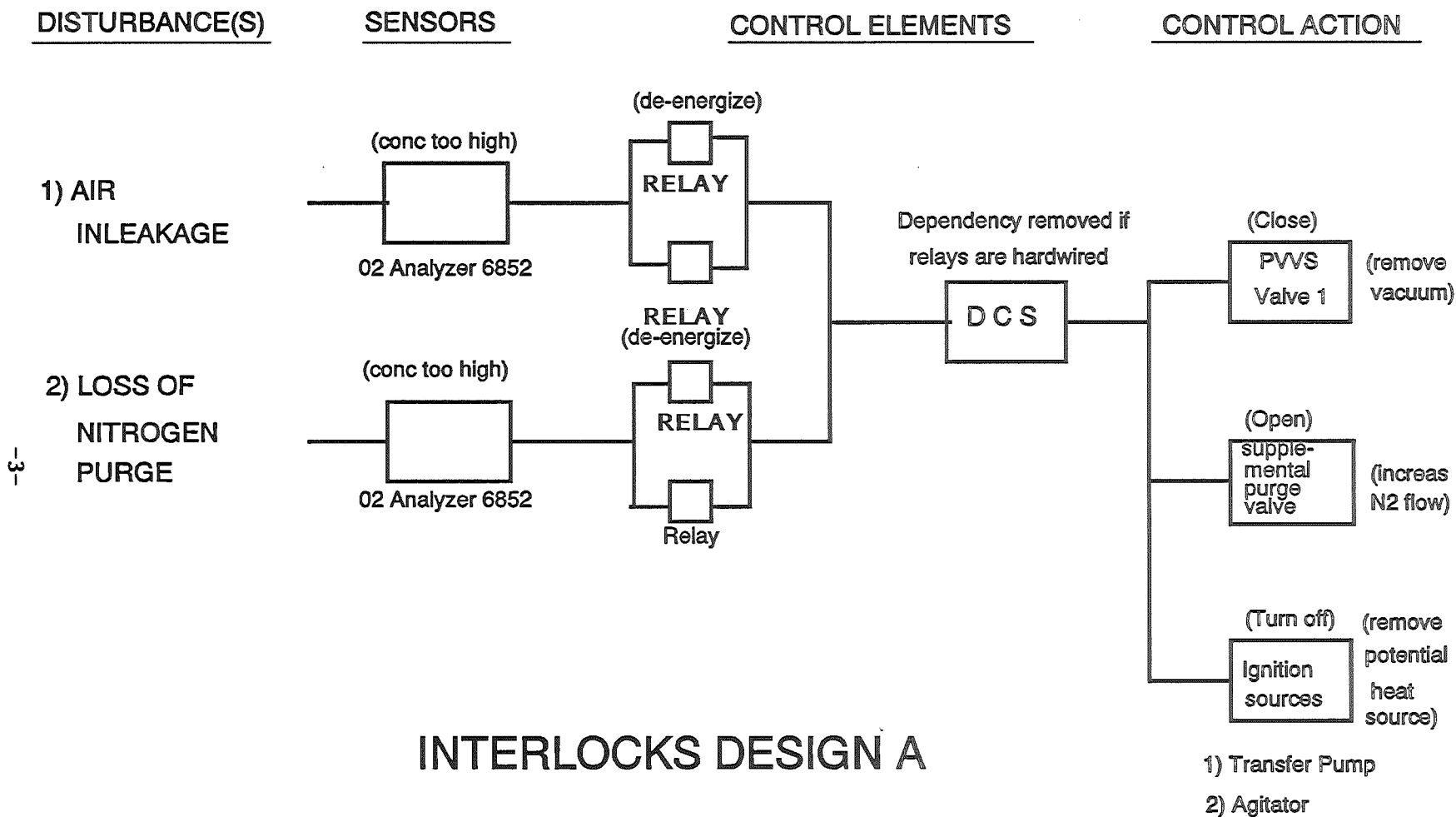
CURRENT BASIS: High O₂ reading by either analyser will open circuit to SV, allowing SV to close.

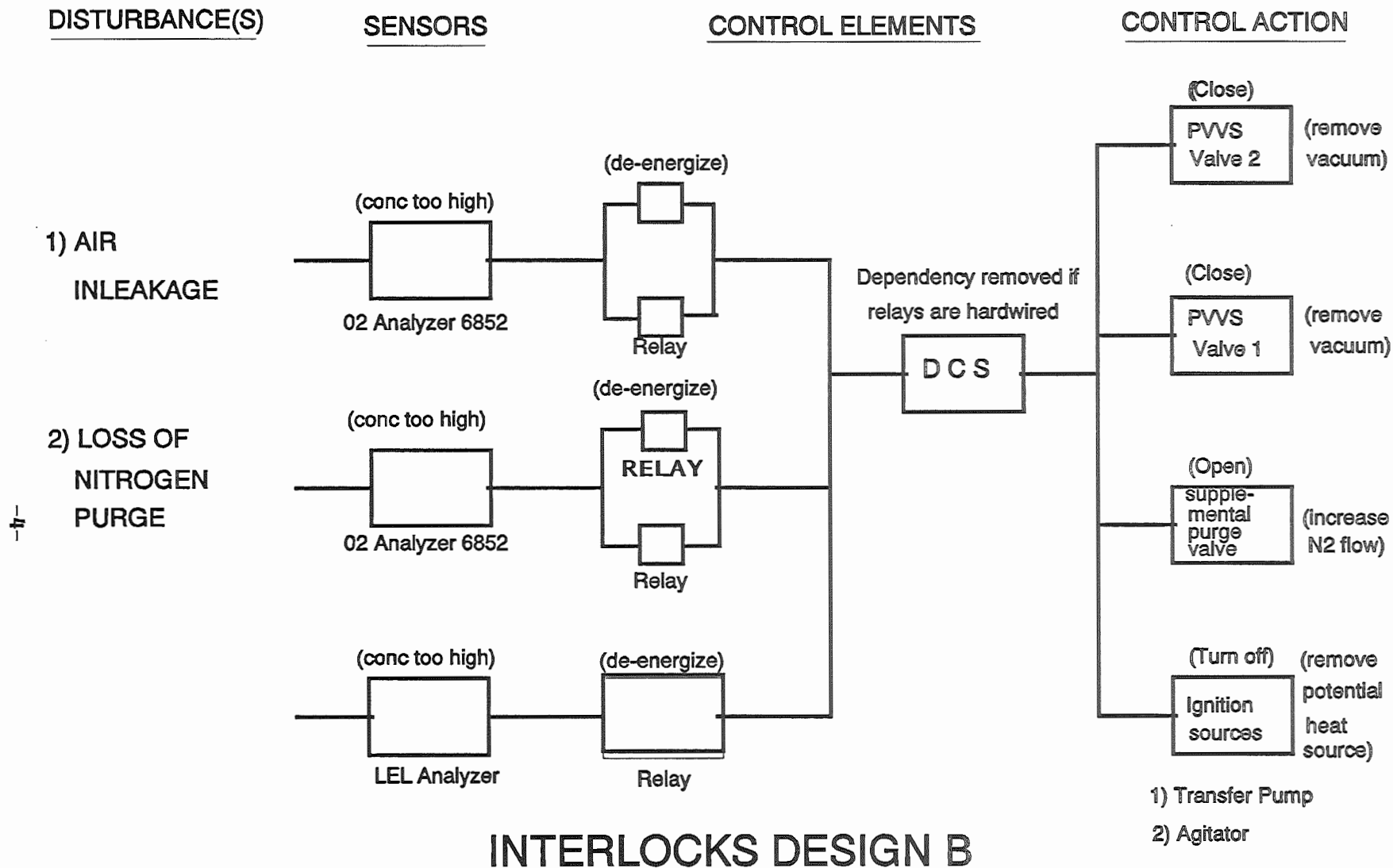


DESIGN B

PROPOSED CHANGE: Add an LEL and a series block valve to improve improve reliability of isolating LPPT from vent system.







DESIGN B

PUMP PIT DESIGN MODIFICATIONS

CHANGE DESCRIPTION	COMMENTS
Add PVV Block Valve No. 1	Spring Return Fail Closed Valve, N2 Operated (3" Plug Valves)
Add PVV Block Valve No. 2	Spring Return Fail Closed Valve, N2 Operated
Add Hardwired Interlocks to O2 Analyzer 1	Ensure that no single device failure can compromise design (relay, etc.)
Add Hardwired Interlocks to O2 Analyzer 2	Ensure that no single device failure can compromise design (relay, etc.)
Add LEL Analyzer to PVV System	Ensure that no single device failure can compromise design (relay, etc.)
Add Isolation Valve on Sump Inlet to Precipitate Tank	Valve to be located as near as practical to tank nozzle to minimize potential leaks (isolating discharge line of pump jet)
Change Nitrogen Purge Valve from Air Operated to N2 Operated (Leakage in Diaphragm)	Not Part of Hardwired Circuit Requirements
Change Sump Jet Gas from Air to N2	
Add Hardwired Interlocks from Both O2 Analyzers and LEL Analyzer to Close Both PVV Block Valves and Stop Operation of the Agitator and Transfer Pumps	Fault Signal Every Transfer Circuit Test
Add New Transfer Pump for Backup Transfer in Place of Steam Jet Transfer of Tank Contents	Recommendation Derived from Interarea Pipeline Design Temperature of 70°C Maximum

JANUARY 1991

SUMMARY OF RESULTS

TOP EVENT OCCURRENCE FREQUENCY

	<u>DESIGN A</u>	<u>DESIGN B</u>	
		2 BLOCK VALVES 3 ANALYZERS MOV TO ISOLATE SUMP JET	NO MOV TO ISOLATE SUMP JET
CASE 1 -- WITH SUPPLEMENTAL PURGE MITIGATION AND DCS DEPENDENCY	$3.0 \times 10^{-3}/\text{yr}$	$2.6 \times 10^{-3}/\text{yr}$	$5.3 \times 10^{-3}/\text{yr}$
CASE 1A --			
CASE 1 WITH NO PVVS BLOCK VALVE	$6.7 \times 10^{-2}/\text{yr}$		
CASE 2 -- WITH NO DCS DEPENDENCY AND WITH SUPPLEMENTAL PURGE MITIGATION	$3.3 \times 10^{-4}/\text{yr}$	$3.6 \times 10^{-5}/\text{yr}$	$3.7 \times 10^{-5}/\text{yr}$
CASE 2A --			
CASE 2 WITH NO PVVS BLOCK VALVE	$6.4 \times 10^{-2}/\text{yr}$		
CASE 3 -- WITHOUT SUPPLEMENTAL PURGE AND WITH NO DCS DEPENDENCY	$5.4 \times 10^{-4}/\text{yr}$	$3.7 \times 10^{-5}/\text{yr}$	$3.8 \times 10^{-5}/\text{yr}$
CASE 3A --			
CASE 3 WITH NO PVVS BLOCK VALVE (I.E., ORIGINAL DESIGN)	$.14/\text{yr}$		

FAULT TREE ANALYSIS STEPS

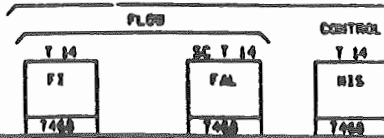
- Step 1 -- Top Event Definition**
- Step 2 -- System Understanding**
- Step 3 -- Fault Tree Construction**
- Step 4 -- Qualitative Analysis**
- Step 5 -- Reliability Data**
- Step 6 -- Probabilistic Analysis**
- Step 7 -- Importance Analysis**
- Step 8 -- Conclusions,
Recommendations and Results**

STEP 3 --

FAULT TREE CONSTRUCTION

- **Top Level Fault Tree**
- **Control System Failure Modes
Dependent on Top Events**
- **Generation of AND Gates**
 - 1) **Conditions for Fire/Explosion**
 - 2) **Redundancy**
 - 3) **Mitigation by Interlocks**
 - 4) **Common Cause Initiating Events**

LOW POINT PRECIPITATE TANK
NITROGEN PURGE



DRAWING NO. W 750041

Supplemental
Purge

NITROGEN SUPPLY
TO GASOLERS

MM229-PSA-1/2

SET AT
12 PSIG

PSV
7172

SET AT
10 PSIG

PI
7466

PPV130-P145-1/2

Low
Flow
N₂

FLOOR ELEV.
ABOVE GRADE

SOUTH
WALL

PEN1203-P241-3

MM201-P68-1/4
MM210-P68-1/4
MM211-P68-1/4
9(SPP3) B

SPARE ELECTRICAL
FOR
TRANSFER PUMP

PNE36-P68-3
18(SPP3) 110

FLW75-P68-3

-9-

NOTE 15



FAULT TREE LOGIC FOR INCLUSION OF INTERLOCKS

**System Fault Conditions
Cause Variable HHH (or LLL)
And Interlock Fails to
Shutdown System Properly**

AND

**System Fault
Conditions Cause
Variable HHH
(or LLL)**

**(Basic Events Which
Cause System Upset
Conditions are called
Initiating Events)**

**Interlock Fails
to Shutdown
System Properly**

**(Basic Events Which
Cause Interlock
Failure are Called
Enabling Events)**

FAULT TREE LEVELS

LEVEL

- 1. Top Event, Fire or Explosion within LPPT (APPT)**
- 2. Top Event Segmented According to Operational Phases:**
 - A) Filling (1/HR/44 HRS)**
 - B) Standby (42 HRS/44 HRS)**
 - C) Pumpout (1 HR/44 HRS)**
 - D) Transfer Jet (Spills) (1/YR)**
 - E) Maintenance (1/5 YRS)**
 - F) Steam Jet [Pump Malfunction] (1/10 YRS)**
- 3. Operational Phases Further Segmented According to Events that Cause Fire or Explosion to Occur (Fire Triangle)**
 - A) Loss of Baseload N2 Purge (Fill, Standby)**
 - B) Air Inleakage (All Modes)**
 - C) Loss of Supplemental Purge (Pumpout)**

Consider Mitigation Logic, Success Criteria and Ignition Sources.

FAULT TREE LEVELS (CONTINUED)

LEVEL

4. Inputs to Figure Triangle

A) Ignition Source

- i) Tank Static Charge (All Modes)**
- ii) Agitator (All Modes)**
- iii) Transfer Pump (Pumpout)**

B) Benzene Concentration Between LEL and UEL (All the Time, 1 in 50 transfers?)

C) Oxygen Concentration Above MOC

- i) Loss of Base Load N2 Purge (Fill, Standby)**
- ii) Air Inleakage (All Modes)**
- iii) Loss of Supplemental Purge (Pumpout)**

5. Failure of Mitigators (AND Gates) that Ameliorate the Effect of Initiating Event

A) Failure to Close PVVS Vent Valve

B) Failure to Provide Supplemental Purge

C) Failure to Turn Off Pumps/Agitators, etc.

DISCUSS 1991

FAULT TREE STRUCTURE

JANUARY 1992 FTA

- BENZENE CONCENTRATION ABOVE LEL
1 IN EVERY 50 TRANSFERS
4 HOURS DURING 44 HOUR CYCLE
- INITIATING EVENT FREQUENCY REDUCED BY
 $1/50 \times 4/44 = 1.8 \times 10^{-3}$

**Howard Lambert Ph.D., P.E.
FTA ASSOCIATES
3728 Brunell Drive
Oakland, CA 94602**

**Telephone 510-482-1492
FAX 510-482-0631**

January 20, 1992

**TO: Brion Taki
FROM: Howard Lambert
RE: Low Point Precipitate Tank, LPPT, FTA**

Two fault tree runs were run for the LPPT FTA. The top event analyzed was "Fire or Explosion within the LPPT." The FTA assumed that 1 in 50 transfers from the auxiliary low point tank has benzene concentration above the LEL for a period of 4 hours after the transfer.

Two cases were analyzed. The first case involved analysis of the current design without any mitigation. The second case assumed that the following two softwired interlocks exist (see attached drawings for analyzers described below):

- (1) Transfer to the LPPT is not permitted if anyone of the following three conditions occur, (1) low nitrogen flow, (2) high oxygen concentration (60% of MOC) in the vent header exhaust or (3) high nitrogen flow was not achieved in the previous transfer. High flow nitrogen is achieved by opening the supplemental purge valve, HCV-7468. (These checks insure that the low flow and high flow nitrogen is working prior to the transfer.)
- (2) Turn on the high flow nitrogen if anyone of the following two conditions exist after the transfer is initiated, (1) low flow of nitrogen or (2) high oxygen concentration in the vent header exhaust

The FTA assumes that these softwired interlocks and analyzers are checked once a year. Also, in the event of a DCS failure, the supplemental purge valve will fail open.

The probabilistic FTA gave the following results for the annual frequency of fire or explosion in the LPPT:

case 1 (without mitigation) -- $3.8 \times 10^{-4}/\text{yr}$

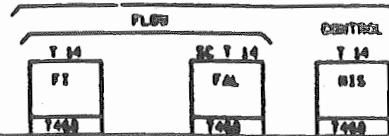
case 2 (with supplemental purge mitigation) -- $1.1 \times 10^{-4}/\text{yr}$.

Yours truly,

Howard Lambert

enc. drawings

LOW FLOW PRECIPITATE TANK
REVERSE PURGE



DRAWING NO. W 750041

Supplemental
Purge

WATER SUPPLY
TO BASIN

W2220-PSA-1/2

SET AT
12 PSIG

PSV
292

SET AT
10 PSIG

PCV
7172

P1
7466

P1
7467

PPV130-P145-1/2

FLOOR ELEV.
ABOVE GRADE

Low
Flow
N₂

SOUTH
WALL

-17-

PEN1203-P241-3

W2207-P60-1/4
W2210-P60-1/4
W2211-P60-1/4

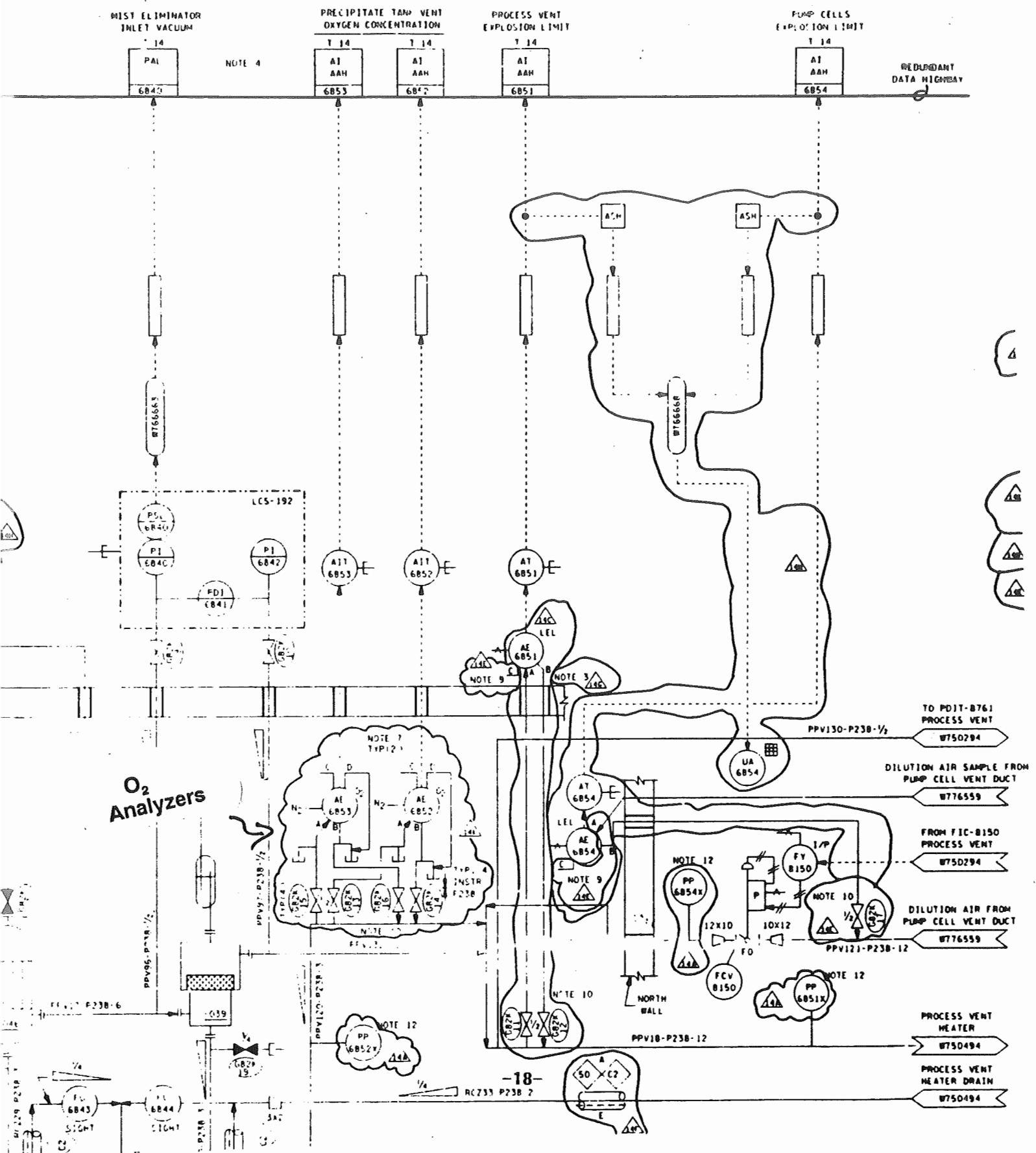
SPARE ELECTRICAL
FOR
TRANSFER PUMP

PNE 36-P60-3
10 (SPPS) 110

FL 75-P60-3

NOTE 15

25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9
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Westinghouse
Savannah River Company

P.O. Box 616
Aiken, SC 29802

DX-91-0042

June 12, 1991

Dr. Howard E. Lambert
3728 Brunell Drive
Oakland, California 94602

Dear Howard:

REQUEST TO PRESENT RISK ASSESSMENT TALK (U)

I am pleased to approve your request to present the risk assessment talk you gave here June 3, at Lawrence Livermore National Laboratory. Let me also express our appreciation for the excellent technical support you have given to the Defense Waste Processing Facility during our design activities. We believe we have a demonstrably safe facility, and your role in that achievement is significant.

Very truly yours,

Mal McKibben

J. M. McKibben, Sr. Project Manager
DWPF Projects

JMM:jch

CC: J. C. Eargle, TC-S1
T. R. Neal, TC-S1
Central Files, 703-A