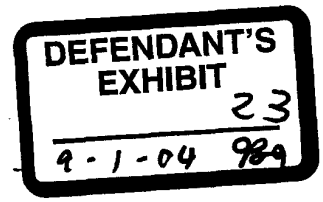
R. C. Herman
CEA 1430

MONSANTO COMPANY
ANNISTON, ALABAMA



NEAR-MISS ACCIDENT INVESTIGATION

REPORT NO. 1-69

PERSONS INJURED:	None
DATE & TIME:	April 9, 1969 - Approximately 2:00 p.m.
LOCATION:	Biphenyl Flaker-Bagger Area
TYPE OF ACCIDENT:	Explosion and Fire in Biphenyl Flaking-Packaging System
NATURE OF INJURIES:	None
ANTICIPATED DISABILITIES:	None
INVESTIGATION COMMITTEE:	J. A. Taylor R. A. Haydel J. J. Andrews T. D. Tucker G. W. Miller, Chairman

THE INCIDENT

On Wednesday, April 5, at approximately 2:00 p.m., an explosion and fire occurred in the biphenyl flaking-packaging area located in the new plant warehouse. The plant was extremely fortunate that no personal injuries were sustained and damage to process equipment was negligible. Prompt action by plant and city fire brigades controlled the fire within thirty minutes.

Further detail:

Four men were working in the packaging area when the explosion occurred. At the time of the incident only the biphenyl portion of the flaking-packaging complex was in operation. The system was started at 7:00 a.m. and had run continuously with little or no interruption prior to the explosion. (The attached drawings, Appendix A, show the biphenyl system layout and its relation to the Solid Aroclor packaging system which occupies the same area.)

Because there are differences in the relation of events as told by eye witnesses, individual accounts are given.

1. Tom Townsend - Department Chief Operator

   Mr. Townsend had climbed to the third level to inspect flaker operation approximately 15 minutes prior to the explosion. The biphenyl flaker

WATER_PCB-SD0000051693

was operating smoothly. The south door of the biphenyl flaker had been removed several days before, and the north door had been proped open to facilitate inspection of the flaker operation. Upon returning to the ground level, Townsend worked 10-15 minutes adjusting the flexible hose which feeds biphenyl to the bagger spout. From his vantage point, he heard a "muffled explosion" and saw a flash on the third level. Townsend immediately started to climb to the third level to inspect the area. Upon reaching the second level the department sprinkler system activated, and Townsend returned to the ground level. Townsend immediately shut down the biphenyl flaker feed pump, the flaker drive motor, and called in the plant fire alarm. These actions were accomplished within 3 minutes of the explosion. Townsend then changed the position of the biphenyl diverting gate from bagger to drum station to prevent accumulation of molten biphenyl in the bagger hopper.

Townsend further commented on the days activity preceding the fire.

A. At the beginning of the day's run approximately 250 pounds of material were dropped out through the bagger chamber. This material contained large lumps of black biphenyl which had apparently been burned. These black lumps would not feed through the bag filler. This was an unusual occurrance; however the committee learned, also, on Tuesday evening prior to the fire on Wednesday 1000 to 1500 pounds of similarly blackened material had been removed from the bagger chamber.

B. The flaker had been run to maintain a minimum product level in the biphenyl hopper all day. The discharge chute and biphenyl hopper had been rapped with a hammer and rodded out respectively several times during the morning, but not since 11:00 a.m. Due to improper design flaked biphenyl has consistently lodged on the funnel portion of both the chute and the hopper. Laborers are required to rap the chute and rod out the biphenyl hopper quite frequently to prevent product holdup.

After the fire Mr. Townsend inspected the area and gave the following account.

A. On the third level the north door to the biphenyl flaker had been blown off and was lying on the floor covered with unburned biphenyl. The flaker drum was covered and the flaker pan was full of unburned biphenyl. Even though considerable smoke damage was noticed along the north penthouse wall and on the flaker hood, there apparently was no fire in the flaker area.

B. Product in the biphenyl hopper was fused, but not burned.

C. A secondary explosion which occurred after the fire started was attributed to an aerosol oil can which had exploded from overheating on the first level.

WATER_PCB-SD0000051694

2. Doyle Walker - Department Laborer

Doyle Walker was operating the bagger at the time of the explosion. At first he thought the explosion was only normal blow back from the bagger chamber; however he looked up and saw a flash on the bottom of the third level. Upon seeing the flash and smoke, Walker left the area. When answering the questions of the investigating committee, Walker commented that several other laborers had been shocked when rodding out the biphenyl hopper through the door on second level. This task is commonly performed with a piece of 3/4 inch pipe which is left on the second level catwalk.

The committee questioned Mr. Calvin Bowman, who was not present at the time of the fire, but who had commented to Walker about getting a shock while rodding out the hopper. Bowman stated that when rodding out without gloves he was frequently shocked. The shocks occurred when holding the rod out pipe in the hopper and touching the metal hopper or catwalk.

3. Fred Turner - Department Laborer

At the time of the explosion this laborer was at the bag check weigher on the first level north of the bagger. He heard a muffled noise and saw the C-clamp blow off the hopper door on the second level. As the door flew open, flames emerged and ignited biphenyl dust lying on the biphenyl hopper. The fire climbed to the third level, and a loud explosion occurred.

Upon returning to the area after the fire, Turner made two additional observations: (1) the material in the biphenyl hopper was all burned but burned worse at the bottom of the hopper, and (2) the let down air line from the chamber to the hopper was plugged which would cause excessive blow back.

Turner also commented that on several occasions he had been shocked while rodding out the biphenyl hopper.

4. Arthur Lanier - Department Laborer

Arthur Lanier had noticed that the bagger was feeding slowly and went to the second level to see if the hopper was blocked. He noticed that the hopper had been bridged about 6 inches above the sight glass, but that product was flowing freely from the chute. Realizing that the increasing weight on the product bridge would break the blockage, he closed the door and fastened the C-clamp. He returned to the first level and was standing southwest of the bagger, when about one minute later, the hopper door blew open and fire emerged. Biphenyl on the outside of the hopper caught fire and rose toward the third level.

WATER_PCB-SD0000051695

It is of particular interest to note Lanier's comments that the product level in the biphenyl hopper was 6 inches above the sight glass and that he heard only one muffled explosion which he thought came from the hopper.

The committee also questioned Mr. Lamar Faulkner, PNP Department Supervisor. Mr. Faulkner has recently served as start-up supervisor for this packaging system and inspected the area immediately after the fire.

Faulkner stated that immediately after the fire he inspected the biphenyl hopper and found that it was full to within 2 feet of the top and that the product was not burned. Mr. Faulkner was further questioned concerning bagger operation and potential heat sources in the system. He stated that on Tuesday afternoon prior to the fire some difficulty was encountered with the butterfly valve immediately above the bagger chamber. The valve was operating slower than normal. This valve is the only part in contact with biphenyl and biphenyl dust which moves often enough to be considered a potential heat generation source. It is also possible that this valve could produce a spark when being operated.

RESULTS OF THE INVESTIGATION

The accident investigation committee upon review of the eye witness statements agrees that the explosion which resulted in a small fire confined primarily to the outside of the hopper-product conveyor system was due to the detonation of biphenyl dust present in the biphenyl hopper. The committee was unable to determine the source of energy which caused the detonation; however

THE MOST PROBABLE CAUSE WAS AN INCENDIVE SPARK DISCHARGE.

This discharge could be attributed to the rapid movement of a large quantity of flaked biphenyl from a lodged position in the biphenyl chute to the biphenyl hopper. The testimony of two eye witnesses about the level in the biphenyl hopper immediately before and after the fire indicates that a large quantity of material was received in the hopper from the chute concurrently with the explosion-fire occurrance This rapid material movement fulfills the prerequisite statement for static electricity-dust explosion as given in the National Fire Protection Association Booklet No. 77M entitled Static Electricity.

"In all instances in which static electricity was authentically established as the cause of ignition, the ignition resulted from a spark between an isolated conductor and ground."

"Common sources of static electricity generation include pulverized materials passing though chutes or pneumatic conveyors."

WATER_PCB-SD0000051696

Several hundred pounds of biphenyl could have become lodged in the biphenyl chute between 11:00 a.m. and 2:00 p.m. This material was insulated from the chute by a layer of biphenyl dust. Presumably, as this large portion of material broke away from the chute and began falling to the biphenyl hopper, a static charge was developed which when arced to ground caused a dust explosion in the hopper.

This sequence of events would explain the following points:

1. The large product volume change in the hopper during the time of the explosion and fire.

2. The occurrance of charred material in the bottom of the hopper and unburned material on top after the fire.

Other possible causes are:

1. The butterfly valve could produce a spark when operating on the bagger chamber. The resultant dust explosion would drop material from the chute and explain the points given in the most probable cause.

2. An explosion could have been generated in the dust collection system by contacting hot therminol lines in the solid Aroclor flaker area. This is possible because the solid Aroclor and biphenyl systems are manifolded to a common dust collection line. This source of ignition is considered highly improbable due to the positive pressure gradient between biphenyl dust sources and the therminol lines.

COMMITTEE OBSERVATIONS

During the investigation of the incident, the committee observed several factors which constitute potential safety hazards in the processing area.

1. A ground wire connecting the flaker pan with the overflow line was loose and ineffective in grounding the product free fall. A second ground wire connecting the hopper and the bagger frame was loose at the bagger frame.

2. The hopper and chute system used to convey biphenyl from the flaker to the bagger was constructed in several flanged sections. These sections were bolted together with a gasket between and no specific grounding straps connecting the hopper sections.

3. There is only one escape route from the second and third levels of the flaking-packaging area. Personnel could be trapped on either of these two levels if the stairway were blocked during an emergency.

4. Housekeeping in the area is at best, poor. Contributing to this problem are: (1) an ineffective dust collection system, which continuously spills product on the second level piping and the ground level floor and (2) flaker doors, which have become broken allowing product to spill on the floor and vapors to escape and cover all process equipment on the third level.

WATER_PCB-SD0000051697

5. There are undefined smoking practices in the packaging area. No smoking permit has been posted for the packaging area. Men have been smoking at the wash room 30-35 feet from the bagger operation, because "CED installed a lighter on the wash room wall and we thought smoking was permitted."

RECOMMENDATIONS

Based on the conclusion that a spark discharge in the biphenyl hopper area was most probably the cause of the explosion-fire, the committee recommends the following actions.

Specific

1. A continuity check should be performed on the Flaker-Hopper-Bagger system. Additional grounds should be installed at all points on the system where no specific ground straps were provided.

   Responsibility: Production and Maintenance

   This recommended action was completed on April 11 as stated in a letter from L. L. Faulkner to the Investigating Committee.

2. Establish procedure to visually check ground connections on hopper system weekly.

   Responsibility: Production EDC 5-1-69

3. Inspect hopper butterfly valve as potential heat or spark source.

   Responsibility: Production EDC 5-1-69

4. Provide copper rod for rodding out flaker hopper to minimize sparking as a interim safety precaution until rodding can be eliminated.

   Responsibility: Production EDC 5-15-69

5. Install manually controlled inert gas supply to snuff fires within hopper system.

   Responsibility: L. L. Faulkner - CED ECD 7-1-69

6. Develop adequate background information to predict and control explosion-fire potential of the biphenyl packaging system. EXPLOSION VENTING

   Responsibility: TSD EDC 8-1-69

7. Review and revise hopper design as required to prevent large product holdup in hopper areas.

   Responsibility: L. L. Faulkner - CED EDC 10-1-69 VIBRATORS

DSW 577638

WATER_PCB-SD0000051698

8. Provide alternate escape route from second and third levels of the packaging area. It is understood that an addition to CEA 1430 has been designed to provide an escape route from the third level. It is recommended that the existing proposal be reviewed to incorporate a means of escape from the second level.

   Responsibility: L. L. Faulkner - CED EDC 7-1-69

9. Provide adequate door design for both Biphenyl and Aroclor flakers which meet operational needs and curtail product and vapor loss from the flaker systems.

   Responsibility: L. L. Faulkner - CED EDC 8-1-69

10. Review operation and design of dust collection system to eliminate spillage of product on second and third level of flaking area.

    Responsibility: L. L. Faulkner - CED EDC 10-1-69

11. Review present practices of keeping open fiber paks and broken bags in packaging area to minimize open flammables in the packaging area.

    Responsibility: Production EDC 4-20-69

12. Establish and communicate procedure for immediate packaging area shutdown if charred biphenyl appears again in the process. Investigate cause at time of occurrance.

    Responsibility: Production EDC 4-20-69

Plant Wide

1. All plant departments review hazards of static electricity in monthly safety meetings. All employes should be encouraged to report any evidences of static deischarge in plant systems. This is especially important because the problem of static discharges in the biphenyl packaging area had not been called to the attention of supervision until after a sub-major accident.

   Responsibility: All Departments EDC 6-69

2. Review status and expedite upgrading plant fire alarm system.

   Responsibility: TSD EDC 4-30-69

WATER_PCB-SD0000051699

cc: G. L. Gorbell - General Offices
R. E. Howard - General Offices
R. M. Kountz - General Offices
R. E. Miller - General Offices
R. J. Startmeyer - General Offices
All Bulletin Boards - Anniston
All Members of Supervision - Anniston
Dr. J. C. Francis - Anniston
J. A. Taylor
R. A. Haydel
J. J. Andrews
T. D. Tucker

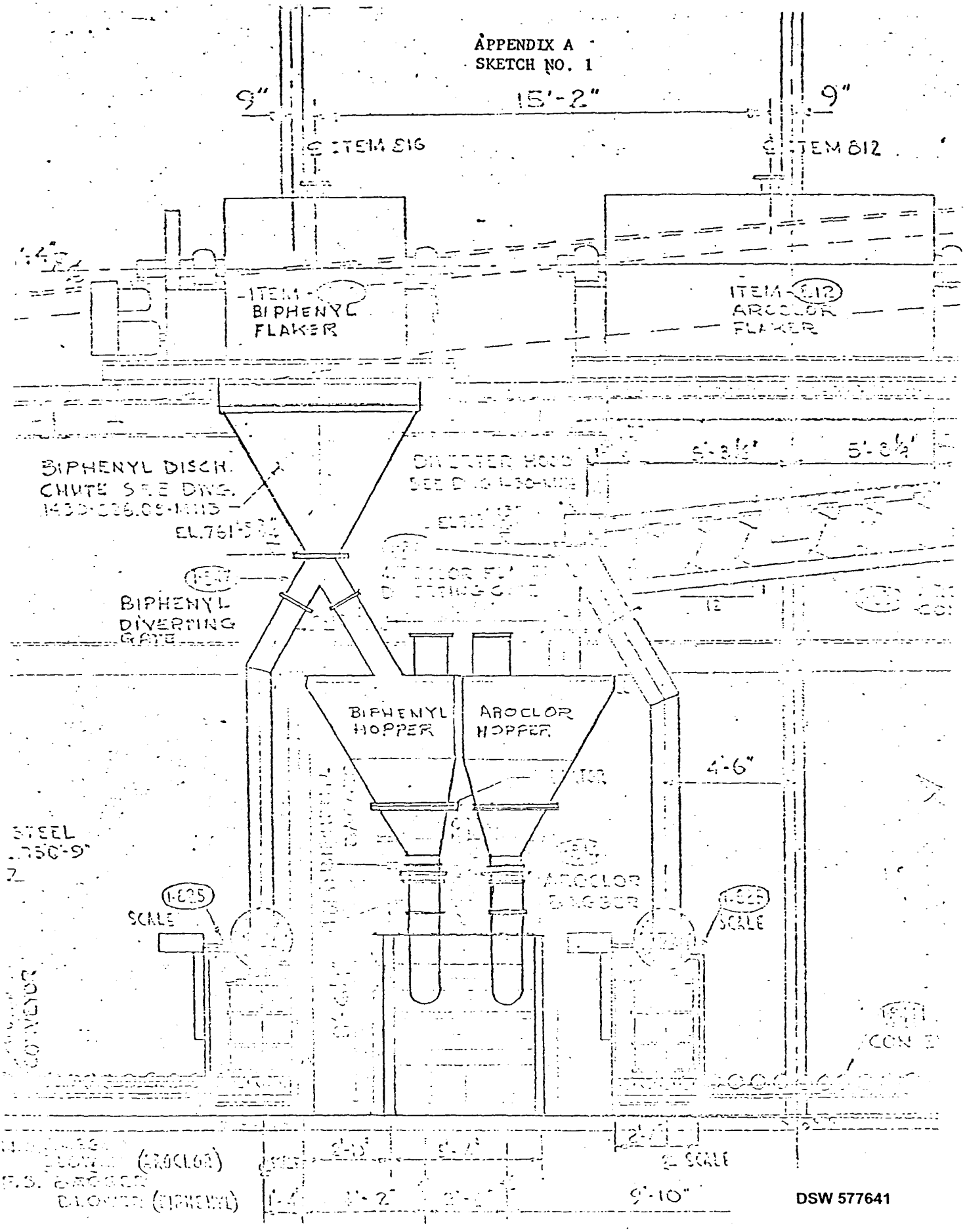
G. W. Miller, Chairman
Investigating Committee 1-69

/bs

DSW 577640

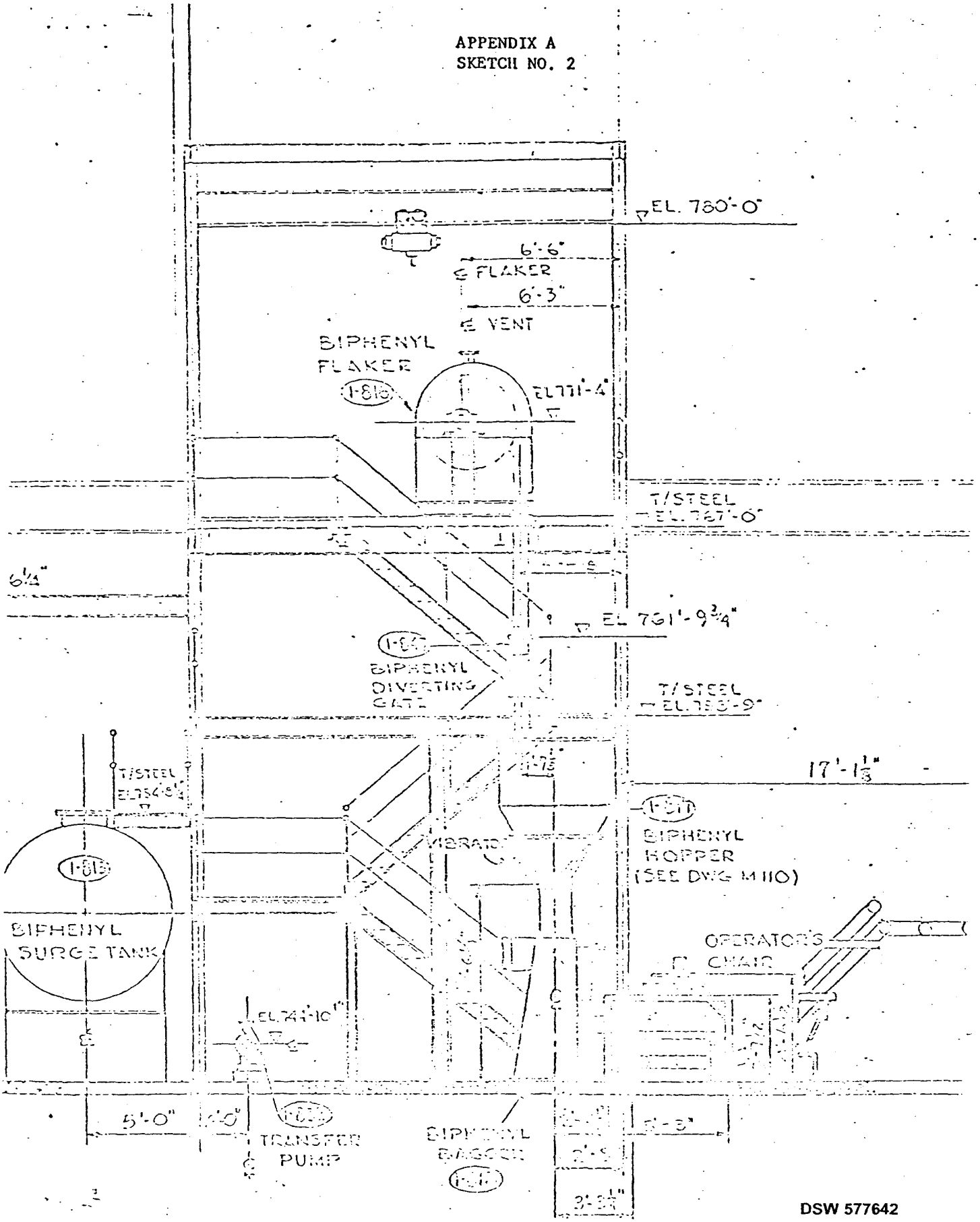
WATER_PCB-SD0000051700

APPENDIX A
SKETCH NO. 1



WATER_PCB-SD0000051701

APPENDIX A
SKETCH NO. 2



WATER_PCB-SD0000051702