



(CSS-76-79)

TO: Files

FOR: Distribution

FROM: C. S. Stutts

RE: PVC Power Failure, December 2, 1978
(ESR 60214-4)

DATE: June 4, 1979

INTRODUCTION

On December 2, 1978, the power supply to the PVC plant failed due to a cable ground fault. The emergency power backup systems failed to operate in the desired manner as described in the attached memorandum which was issued previously. This report contains recommendations for improving the PVC electrical system to improve its reliability. The evaluation was conducted by Messrs. H. S. Thacker and L. C. Elliott and the writer, and has been reviewed by plant operating personnel. Mr. Elliott has previously issued recommendations regarding other plant emergency systems (i.e. nitrogen and instrument air supplies).

SUMMARY

Several modifications to the PVC plant emergency power circuits are recommended to improve the reliability of the system and to allow automatic restarting of both instrument air compressors. Thorough testing of the system is recommended to assure conformance to design specifications.

DISCUSSION

The following is a summary of the status of tasks that were assigned in a joint meeting by Operations, Maintenance and Engineering held December 12, 1978.

1. Assure that NORMAL-EMERGENCY switch will not transfer to EMERGENCY unless the emergency generator is operating properly (Brown & Root, TCI Engineering):

It has been confirmed that the NORMAL-EMERGENCY switch will not transfer to EMERGENCY unless power from the emergency generator is at the proper voltage and frequency; however, the switch does shut down all equipment on the emergency generator circuit after a power failure. NORMAL power must now be reinstituted manually by a toggle switch in the motor control center. A design has been completed which will permit automatic restarting of equipment on NORMAL power if the emergency generator fails to start, or fails after starting. This modification will require the shutdown of equipment on the emergency generator for a short period of time. It is recommended that this modification be postponed until it can be done in conjunction with a plant power outage.

2. Have the vendor check the operation of emergency generator, including testing with load applied (TCI Maintenance):

TEN 1431

The generator was tested using a water resistance load subsequent to the December 2 failure. It was determined that a partially plugged fuel filter prevented the engine from operating under full load.



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3. Design an installation to permit regular load testing of emergency generator (Brown & Root, TCI Engineering):

It is recommended that load testing of the generator be conducted using an outside service. Installation of facilities by Tenneco does not appear to be financially justifiable at this time. It is recommended that testing under load be done at least quarterly. This is a lower frequency than originally recommended in Brown & Root's operating guidelines, but appears to be adequate when consideration is given to the possibility of a power failure occurring while the generator is out of service for load testing. Monthly inspection or replacement of the engine fuel filter is also recommended. Mr. L. Cox will include these items in his preventative maintenance program.

4. Evaluate the design for restart sequencing of equipment on the emergency power circuit, particularly considering automatic restart if the emergency generator does not operate and normal power returns. Also consider other potential malfunctions such as UPS failure, sequencer failure, etc. (Brown & Root, TCI Engineering):

The proposed system for restarting upon failure of the emergency power supply has been discussed in Item 1. Design of the entire system has been evaluated and specific comments will be discussed later.

5. Evaluate operation of the "static switch" in the UPS (switch from normal to alternate power sources) to assure it will switch to the alternate power source at the proper level of battery depletion and that it will not switch unless the alternate power supply is available (Brown & Root, TCI Engineering):

The static switch will change to the alternate source if the battery voltage depletes, regardless of the status of the power from the alternate source. Since the output of the UPS is used in the control circuit for the alternate source power supply, the alternate source cannot be used unless the UPS is already operational. To correct the problem, the control circuit will be modified to enable the alternate source supply at all times.

6. Formalize operating procedures to prevent blowing the fuse on the UPS normal power supply when transferring from battery source to normal power source (TCI Operations, TCI Engineering):

A recommended operating procedure is being developed by Mr. Thacker.

7. Determine why an instrument air compressor does not automatically restart on the emergency generator as it was intended to do (TCI Engineering, H. Thacker):

An error in the original Brown & Root electrical design prevents automatic restarting of the air compressors after a power failure. Revisions to the circuit have been designed which will correct this error. The revisions can be made while shutting down one compressor at a time. No impact on plant operation is anticipated while making these ch. TEN 1432



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8. Formalize procedure for complete testing of the emergency power system (including restart sequencing) during any scheduled plant outages (TCI Operations, TCI Maintenance):

Messrs. Thacker and Elliott will review the existing test procedure used by Maintenance. In addition, a "live" test is proposed later in this report.

9. Determine the time settings on under voltage time delays for all reactors and correct as needed (TCI Maintenance, TCI Operations):

All reactor agitator undervoltage time delays were checked by Maintenance.

10. Determine if two instrument air compressors can operate using the emergency generator. With the expanded plant, one compressor on emergency power is insufficient (Brown & Root, TCI Engineering):

It has been determined that operating loads on the emergency power motor control centers will permit the operation of two instrument air compressors on the emergency generator. Circuit modifications have been designed for this installation. It is recommended that the changes be made in conjunction with Item 7.

11. Improve documentation for troubleshooting the emergency power supply system for operating personnel (TCI Operations, TCI Engineering):

Existing documentation supplied by Brown & Root has been reviewed by Engineering and appears to be adequate with some exceptions. Corrections will be made where required and the information will be reissued to the appropriate Operating personnel.

In addition to the items described above, investigation of the system has lead to the additional recommendations that the entire system should be tested under closely supervised conditions by (a) tripping the NORMAL power supply breaker, and (b) using the test circuit. This should be done after modifications recommended above have been completed. This test would permit evaluation of the entire system, something which has never been done under closely monitored conditions, and would assure proper operation of modifications. The risks incurred in such a test should be minimal.

It was discovered that the circuit breakers from the generator must be manually reset if they open due to an engine overcrank or overspeed. The breakers must be manually reset to correct this situation. While it is not known if such a situation existed on December 2, it would result in consequences identical to those which occurred. The circuit breakers are connected to an alarm in the motor control center. The importance of this alarm should be



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emphasized to all operating and maintenance personnel and inspection of the breakers should be made a part of the weekly generator test procedure.

C S Stutt
C. S. Stutt

CSS/cjm
Attachment

cc: D. C. Coldiron
R. E. Harmond
C. G. Thompson
W. Rupp
F. S. Klopp
G. I. Rozand
C. E. Crain
L. Cox
C. A. Hendricks
J. F. Robins
D. R. Keck
E. O. Rouse
H. S. Thacker
S. E. Richter
L. C. Elliott
D. O'Conner
L. L. Bird

A.R. 12

Tenneco Chemicals

CAPITAL APPROPRIATION REQUEST

ALL PROJECTS \$10,000 AND LESS

CAR No
0 7 0 4 7TYPE
0 4

DIV	RESPONSIBILITY	ASSET ACCT
5	1 2 3 3 6 0	0 0 4 0 4

DIVISION /

BUSINESS GROUP PolymersLOCATION Pasadena, TexasTITLE PROVIDE IMPROVED PVC EMERGENCY POWER INSTRUMENTATION

FINANCIAL SUMMARY		AUTHORIZATION AMOUNT	
NEW SALES OR SAVINGS	\$ <u>N/A</u>	FIXED CAPITAL	\$ <u>2.5M</u>
COSTS AND EXPENSES	\$ <u>0.28M</u>	WORKING CAPITAL	\$ _____
NET OPERATING INCOME	\$ <u>(0.28M)</u>	TOTAL	\$ <u>2.5M</u>
CASH FLOW	\$ <u>(0.10M)</u>		

ROI <u>N/A</u> % PAYOUT <u>N/A</u> YRS.		PROJECT TYPE	
START OF EXPENDITURE <u>On approval</u>		01 POLLUTION	XX 04 DEFENSIVE/ NON PROFIT
COMPLETION OF EXPENDITURE <u>Six months</u>		02 SAFETY/HEALTH INSURANCE	05 COST REDUCTION
IN SERVICE DATE <u>Six months</u>		03 REPLACEMENT & REPAIR	06 NEW PRODUCT
PROJECT LIFE, YRS. <u>17</u>			07 EXPANSION 99 OTHER
			08 R & D <u>describe</u>
			09 ENERGY

PROJECT DESCRIPTION & JUSTIFICATION:

This CAR is for modification of the existing emergency power system instrumentation to allow for automatic switching back to normal power after a power failure. This modification would also assure that the "static-switch" will switch to the alternate power source at the proper level of battery depletion and that it will not switch unless the alternate power supply is available.

CONTROLLABLE EQUIPMENT TAG No.	% TCI LABOR CAPITALIZED (FOR RIKs)	PURCHASE MATERIAL REQUISITION No.	WORK ORDER No.	CHECK ONE OF THE FOLLOWING:
				LABORATORY FACILITIES _____
				SHOP FACILITIES _____
				TOOLS & EQUIPMENT _____
				FURNITURE AND EQUIPMENT _____
				R & D _____

CAPITAL ASSET DISPOSAL INFORMATION - CADR CONTROL No. _____					
PURCHASE DATE	DISPOSAL DATE	GROSS BOOK VALUE	SALVAGE VALUE	DISMANTLING COSTS	No. PURCHASED LAST 5 YEARS

APPROVALS

GENERAL MANAGER

DATE

BUSINESS DIRECTOR

DATE

OPERATIONS DIRECTOR

DATE

DEPT HEAD

DATE

INITIATOR

DATE

TEN 1435

CAPITAL APPROPRIATION REQUEST
ALL PROJECTS \$10,000 AND LESS

0 1 1 1 5

DIVISION

BUSINESS GROUP

Polymers

LOCATION

Pasadena, Texas

TITLE

FINANCIAL SUMMARY

NEW SALES OR SAVINGS \$ 5.20
COSTS AND EXPENSES \$ 1.10M
NET OPERATING INCOME \$ (4.10M)
CASH FLOW \$ (4.65M)

AUTHORIZATION AMOUNT

FIXED CAPITAL \$ 0.00
WORKING CAPITAL \$ 0.00
TOTAL \$ 0.00

ROI 21.1 % PAYOUT 2.13 YRS.

START OF EXPENDITURE On Approval

COMPLETION OF EXPENDITURE 6 months

IN SERVICE DATE 6 months

PROJECT LIFE, YRS. 17

PROJECT TYPE

☐ 01 POLLUTION	☐ 04 DEFENSIVE/ NON PROFIT	☐ 07 EXPANSION	☐ 99 OTHER
☐ 02 SAFETY/HEALTH INSURANCE	☐ 05 COST REDUCTION	☐ 08 R & D	
☐ 03 REPLACEMENT & REPAIR	☐ 06 NEW PRODUCT	☐ 09 ENERGY	

PROJECT DESCRIPTION & JUSTIFICATION:

Presently the emergency generator is load tested by an outside service firm at a cost of \$1,300 per test. This test is performed yearly and this is a lower frequency than recommended in the operating guidelines. A quarterly load test is recommended which would increase the probability of the generator being able to support all the equipment on the circuit.

Load testing on a quarterly basis would cost \$5,200 per year. Tenneco's Maintenance personnel are required to participate in the tests so little additional manpower would be required for the testing.

CONTROLLABLE EQUIPMENT TAG No.	% TO LABOR CAPITALIZED (FOR RIKs)	PURCHASE MATERIAL REQUISITION No.	WORK ORDER No.	CHECK ONE OF THE FOLLOWING LABORATORY FACILITIES _____ SHOP FACILITIES _____ TOOLS & EQUIPMENT _____ FURNITURE AND EQUIPMENT _____ R & D _____
FOR CAPITAL SPARES				
FOLIO No.	STOCK AUTH. No.	MIN	MAX	ON HAND
				No. PURCHASE LAST 12 MONTHS

CAPITAL ASSET DISPOSAL INFORMATION - CADR CONTROL No.

PURCHASE DATE	DISPOSAL DATE	GROSS BOOK VALUE	SALVAGE VALUE	DISMANTLING COSTS	No. PURCHASED LAST 5 YEARS

APPROVALS

GENERAL MANAGER

DATE

BUSINESS DIRECTOR

DATE

DEPT HEAD

TEN 1436