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September 20, 1984

United States Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Mr. George W. Knighton, Chief
Licensing Branch 3
Office of Nuclear Reactor Regulation

SUBJECT: Beaver Valley Power Station - Unit No. 2
Docket No. 50-412
PSB Electrical Outstanding Issues

Gentlemen:

This letter forwards responses to the issues listed below which were provided by PSB in a draft SER on June 8, 1984. FSAR Changes described in these responses are intended to be incorporated upon acceptance by PSB. The following items are attached:

Attachment 1: Response to Outstanding Issue 182 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report, Section 8.2.2.2.

Attachment 2: Response to Outstanding Issue 184 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report, Section 8.2.2.5.

Attachment 3: Response to Outstanding Issue 185 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report, Section 8.2.3.1.

Attachment 4: Response to Outstanding Issue 187 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report, Section 8.3.1.5.

Attachment 5: Response to Outstanding Issue 188 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report, Section 8.3.1.4

Attachment 6: Response to Outstanding Issue 189 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report, Section 8.3.1.6.

Attachment 7: Response to Outstanding Issue 190 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report, Section 8.3.1.11.

Attachment 8: Response to Outstanding Issue 198 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report, Section 8.3.3.5.

Attachment 9: Response to Outstanding Issue 199 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report, Sections 8.3.3.7.1.

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Attachment 10: Response to Outstanding Issue 199 of the Beaver Valley Power Station Unit No. 2 Draft Safety Evaluation Report, Section 8.3.3.7.2.

DUQUESNE LIGHT COMPANY

By E. J. Woolever
E. J. Woolever
Vice President

GLB/wjs
Attachments

cc: Mr. H. R. Denton, Director NRR (w/o attachment)
Mr. D. Eisenhut, Director Division of Licensing (w/o attachment)
Mr. J. Knox (w/attachment)
Ms. M. Ley, Project Manager (w/attachment)
Mr. E. A. Licitra, Project Manager (w/o attachment)
Mr. G. Walton, NRC Resident Inspector (w/o attachment)

COMMONWEALTH OF PENNSYLVANIA)
) SS:
COUNTY OF ALLEGHENY)

On this 20th day of September, 1984, before me, a Notary Public in and for said Commonwealth and County, personally appeared E. J. Woolever, who being duly sworn, deposed and said that (1) he is Vice President of Duquesne Light, (2) he is duly authorized to execute and file the foregoing Submittal on behalf of said Company, and (3) the statements set forth in the Submittal are true and correct to the best of his knowledge.

Anita Elaine Reiter
Notary Public

ANITA ELAINE REITER, NOTARY PUBLIC
ROBINSON TOWNSHIP, ALLEGHENY COUNTY
MY COMMISSION EXPIRES OCTOBER 20, 1986

ATTACHMENT 1

Response to Outstanding Issue 182 of the
Beaver Valley Power Station Unit No. 2
Draft Safety Evaluation Report

Draft SER Section 8.2.2.2: Capability to Reestablish Power from the Offsite Power System

GDC 17 requires, in part, that each of the offsite circuits be designed to be available in sufficient time following a loss of all onsite alternating current power supplies and the other offsite electric power circuit, to assure that specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded. The description in the FSAR as to compliance with this part of GDC 17 is not sufficient to reach a conclusion of acceptability.

By Amendment 3 to the FSAR, the applicant did not provide the requested description. This item will be pursued with the applicant and the requests of the staff review will be reported in a supplement to this report.

Response:

The 138 KV circuit breaker which supplies offsite power to BVPS-2 through System Station Service Transformer (SSST) 2A (TR-2A) is controlled from the Relay House, not from the BVPS-2 main control room.

The 138 KV circuit breaker which supplies offsite power to BVPS-2 through SSST 2B (TR-2B), however, is controlled from the main control room. A lockout relay located in the Relay House must be manually reset after a switchyard bus differential, prior to operating the control switch in the main conrol room to close this breaker. 138 KV circuit breaker accumulators allow a total of 5 breaker open/close operations without recharging.

Refer to the response provided for Question 430.6, Amendment 3.

ATTACHMENT 2

Response to Outstanding Issue 184 of the
Beaver Valley Power Station Unit No. 2
Draft Safety Evaluation Report

Draft SER Section 8.2.2.5: Use of Automatic Load Tap Changer

Section 8.3.1.1.1 of the FSAR indicates that the system station service transformer specified with an automatic load tap changer.

By Amendment 3 to the FSAR, the applicant, in response to a request for information, indicated that the automatic load tap changer optimizes voltage on the 4160 volt Class 1E buses for any plant load condition and power grid voltage variation. The applicant has further implied that the design is Class 1E and meets all the requirements of a Class 1E system. Design criteria with description and analysis as to the systems compliance with GDC 2, 4, 5, 17, and 18 has not been addressed in the FSAR. This item will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

System station service transformers TR-2A and TR-2B are non-Class 1E transformers that supply offsite (preferred) power to the non-Class 1E 4,160 V buses. The automatic load tap changing capability of these transformers optimizes downstream voltages at Class 1E 4,160 V buses (2AE and 2DF) when electrically connected to the upstream non-Class 1E buses as described in Section 8.3.1.1.

Although testing capability is provided through manual control of the load tap changer (LTC) and voltage indication in the control room, periodic testing is unnecessary because the LTC's are constantly in service. If the LTC does not function properly in automatic, the operator in the control room will be alerted by voltage indication or alarms and can take manual control to restore voltage to normal before protective relaying for the 4KV and emergency buses operates. A preventive maintenance program based on manufacturer's instructions assures continued proper LTC operation. The frequency of preventive maintenance is based on cycles of operation as monitored by an automatic counting system.

NOTED AUG 9 1984 H.Marcus

transformers, each powered from a different bus of the 138 kV switchyard, reliable offsite power is available to supply BVPS-2 station service and emergency systems. The 138 kV connections between the switchyard buses and the station service transformers are made with overhead lines, with separate towers for each line. The towers for each line are separated such that failure of one tower will not jeopardize the availability of the redundant circuit. Even with the loss of all but one source of power to the switchyard, sufficient power capacity will still be available for emergency systems.

¶ ← INSERT "A" → (Pg. 8.2-3A)

8.2.1.4 Compliance with Design Criteria and Standards

8.2.1.4.1 Compliance with General Design Criterion 5

The 138 kV offsite power circuits are shared between BVPS-1 and BVPS-2. In the event of any single component failure in the shared portion of the circuit, the one offsite power circuit remaining for each unit is capable of powering the engineered safety features (ESF) equipment required for a design basis accident in one unit and the systems required for an orderly shutdown and cooldown of the remaining unit. This complies with General Design Criterion (GDC) 5.

dedicated to

8.2.1.4.2 Compliance with General Design Criterion 17

Two separate, independent circuits are provided between the 138 kV switchyard and the onsite electric distribution system. The circuits are designed and located so as to minimize the likelihood of their simultaneous failure. Each of the circuits is provided with an independent 138 kV bus, transmission path, and system station service transformer, and supplies one of the two independent redundant load groups of the onsite Class 1E power distribution system. This is in accordance with GDC 17.

8.2.1.4.3 Compliance with General Design Criterion 18

The offsite power system circuitry is designed to permit periodic testing of operability and functional performance of power supplies, relays, and switches, as described in Section 8.2.1.5, and meets the requirements of GDC 18.

8.2.1.4.4 Compliance with IEEE Standard 308-1974 and Regulatory Guide 1.32

The offsite power system, described previously, meets the requirements of IEEE Standard 308-1974, which stipulates that each redundant load group have access to a preferred power source consisting of one or more power sources. Furthermore, the design conforms to the preferred design provisions outlined in Regulatory Guide 1.32 in that these circuits are operated with the 138 kV circuit breakers normally closed to provide immediate availability of this source in the event of a loss of onsite power.

INSERT "A"

G The system station service transformers TR-2A and TR-2B, which are supplied by the 138 kV switchyard, are non-Class 1E transformers that supply offsite (preferred) power to the Non-Class 1E 4,160v buses. The automatic load tap changing capability of these transformers optimizes downstream voltages at Class 1E 4,160v buses (2AE and 2DF) when electrically connected to the upstream non-Class 1E buses as described in FSAR Section 8.3.1.1.

ATTACHMENT 3

Response to Outstanding Issue 185 of the
Beaver Valley Power Station Unit No. 2
Draft Safety Evaluation Report

Draft SER Section 8.2.3.1: Capability to Test Transfer of Power Between Normal and Preferred Offsite Circuits

The capability to test the transfer of power from the normal unit station service transformer to the station service transformer has not been specifically addressed in the FSAR.

By Amendment 3 to the FSAR, the applicant, in response to a request for information described the transfer circuitry, how it is tested during normal plant operation, and its compliance with GDC 18. Based on the description the staff concludes that the design is testable, meets the requirements of GDC 18, and is acceptable. It is the staff's concern, however, that periodic testing of the transfer may create transients in the plant if done during power operation. This concern will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

The above description has not been included in Section 8.2 of the FSAR in accordance with the guidelines of Regulatory Guide 1.70, Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants. This item will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

A voltage and load analysis has been completed for the BVPS-2 system (Calculation E-68 entitled "Station Service Voltage and Load Analysis"). Included in the calculation is an analysis of the operation of the normal full plant load (after transfer) from the normal onsite (unit station service transformers) power supply to the offsite (system station service transformers) power supply. The calculation indicates satisfactory operation after the transfer.

Operating history at BVPS-1 which has a similar one-line diagram for this system has shown that significant transients do not result from this testing. However, it is expected that this testing at BVPS-2 will normally follow current practice on BVPS-1 which is to perform the test during shutdown modes or the shutdown approach to refueling to further reduce the possibility of transients which could adversely affect power operations.

Section 8.2.1.5 has been revised to include the description of the capability to test transfer of power between normal and preferred offsite circuits in accordance with our response to Question 430.9 in Amendment 3.

8.2.1.4.5 Compliance with Regulatory Guide 1.47

The surveillance of the offsite power system is in accordance with Regulatory Guide 1.47 in that monitoring is provided to indicate the availability of the preferred power source as follows:

1. 138 kV breaker open (annunciated and monitored by the plant computer), and

2. 138 kV bus voltage level.

8.2.1.4.6 Compliance with Regulatory Guide 1.81

Compliance with Regulatory Guide 1.81 is discussed in Section 1.8.

8.2.1.4.7 Compliance with Regulatory Guide 1.93

As described in the Technical Specifications, the power operation is initiated and continued without restriction only when the limiting conditions for operation are met. If the limiting conditions for operation are not met, then power operation is restricted, as explained by the Technical Specifications.

8.2.1.4.8 Compliance with Branch Technical Position ICSB 11 (PSB)

Previous studies have shown that loss of the largest operating unit on the grid (Cheswick or Bruce Mansfield) will not result in loss of grid stability and availability of offsite power. Section 8.2.2.2 provides the results of studies performed to demonstrate stability for BVPS-2 for the most severe cases, which did not include reanalysis for loss of Cheswick or Bruce Mansfield Units. This reanalysis was not necessary since the previous studies showed that loss of either of these units had a negligible effect on BVPS-2. This is, therefore, in compliance with Branch Technical Position ICSB 11 (PSB), Stability of Offsite Power Systems.

8.2.1.5 Tests and Inspections

The DLC Procedures and Routine Manual program for testing and inspection of the electrical equipment installation associated with the offsite power meets the intent of GDC 18. These procedures cover periodic testing of protective relays, instrument transformers, power transformers, circuit breakers, and various operating checks to ensure the operability and functional performance of the components of the system. Transfer of power to the onsite distribution system from the main generator or offsite power system meets the requirements of GDC 18.

→ Put Attachment I here pg. 8.2-4A

8.2.1.6 Systems Operability Surveillance

Surveillance information for the preferred power supply system is displayed in the main control room, is annunciated, and is monitored

ATTACHMENT "I"

Each of the four nonsafety-related 4,160 V buses has two input supply breakers, one fed from the unit station service transformer, the other fed from the system station service transformer. The control circuits for these two supply breakers are interlocked via relay contacts.

The opening of one supply breaker will automatically cause the closing of the other supply breaker. The closing will, however, be blocked by any of the following:

1. Overcurrent trip of the closed breaker,
2. Manual trip of the closed breaker, or
3. Loss of voltage at the input of the open breaker.

Automatic transfer will be alarmed in the main control room.

SWITCHGEAR

The transfer may also be accomplished by operator actuation of a test switch on the main control board. Each of the four buses has two test switches to initiate transfer in each direction. Each 4,160 V bus can be independently transferred. The test switches do not have the capability of overriding the previously stated blocking conditions.

At no time during automatic initiated transfer will both supply breakers be closed simultaneously.

Plant operators will have the capability of deliberately causing both breakers to be simultaneously closed, thereby paralleling the power supplies. Synchronizing checks built into the control circuits will block a paralleling operation if power supplies are not in sync. A forced paralleling of supplies will be alarmed in the main control room.

Since the design of the transfer test switches causes a trip of the closed breaker and the subsequent operation of normal transfer circuitry, this system tests actual operation and is in full compliance with GDC 18.

ATTACHMENT 4

Response to Outstanding Issue 187 of the
Beaver Valley Power Station Unit No. 2
Draft Safety Evaluation Report

Draft SER Section 8.3.1.5: Capability of Diesel to Accept Design Load After Prolonged No Load Operation

Section 6.4.2 of IEEE Standard 6.4.2 of IEEE Standard 387-1977 requires, in part, that the load acceptance test consider the potential effects on load acceptance after prolonged no load or light load operation of the diesel generator. The applicant was requested to provide the results of load acceptance tests or anlaysis that demonstrates the capability of the diesel generator to accept the design accident load sequence after prolonged no load operation.

By Amendment 3 to the FSAR the applicant did not provide the requested test or analysis results. This item will continue to be pursued with the applicant and the results will be reported in a supplement to this report.

Response:

A test which demonstrates satisfactory load acceptance following prolonged no load r light load operation is unnecessary since it would not reflect conditions found as a result of actual diesel operating practices. As stated in the response to question 430.54, routine testing of diesels is not performed at less than 25% load. In addition, when the diesels start automatically and are not required to load (such as initiated by a safety injection signal with offsite power available) they are normally shutdown upon verifying availability of offsite power. Since testing and automatic starts contribute nearly all of the diesel run time, it can be concluded that no more than a few hours of accumulated no load or light load running will occur. Since the vendor analysis shows that as much as 24 hours of no load operation is acceptable, it would be meaningless to perform a test of operating practices which are many hundreds of percent more conservative than the vendor analysis even assuming no conservatism in the vendor analysis.

ATTACHMENT 5

Response to Outstanding Issue 188 of the
Beaver Valley Power Station Unit No. 2
Draft Safety Evaluation Report

Draft SER Section 8.3.1.4: Compliance to BTP-PSB-2

Section 8.3.1.1.15 of the FSAR describes the surveillance instrumentation provided to monitor the status of the diesel generator. In this regard, the applicant was requested to describe how the Beaver Valley design complies with the guidelines of Branch Technical Position PSB-2. By Amendment 3 to the FSAR the applicant did not provide the requested description. This item will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

The criteria for alarms and indications associated with the diesel generator unit bypassed and inoperable status as described by Branch Technical Position PSB-2 for BVPS-2, is as follows:

1. Diesel generator unit bypass inoperability status is automatically indicated in the main control room by a unique annunciator window for each of the two redundant diesel generator units. The annunciator windows indicate "Diesel Generator 2-1 Local Panel Trouble" and "Diesel Genrator 2-2 Local Panel Trouble." Local manually induced indication is not provided in each diesel generator room as automatic bypassed and inoperable status conditions are provided to alert the main control room for all required diabling functions.

2. In addition to the unique annunciator windows as described above, individual bypassed and inoperable status annunciators are also provided in both the main control room as well as in each diesel generator room. These status conditions, as depicted in Figures 7.5-28, 7.5-29, and 7.5-30 are on separate windows for both electrical and mechanical functions that would preclude each diesel generator from an automatic start. Unique local windows indicating "diesel generator trouble" are not provided for each diesel generator, as sufficient local individual windows will provide sufficient information to the operator to perform all required disabling function(s).

3. Diesel generator units are not shared on BVPS-2. They are completely independent to each other.

4. The indication system is designed and installed such that it precludes the possiblity of adverse effects on the diesel generator units. Failure in the indication equipment does not result in diesel generator unit failure or bypass of the diesel generator unit. In addition, the bypass indication does not reduce the required independence between the redundant diesel generator units.

5. The indication system has a capability of ensuring its operable status during normal plant operation to the extent that the indicating and annunciating function can be verified. This verification is provided by specific computer point indication (main control room) for the required indication operability status.

ATTACHMENT 6

Response to Outstanding Issue 189 of the
Beaver Valley Power Station Unit No. 2
Draft Safety Evaluation Report

Draft SER Section 8.3.1.6: Diesel Generator Loading Above its Continuous Rating

Section 8.3.1.1.15 of the FSAR states that the maximum load imposed on the diesel generator is less than the continuous rating. The continuous rating has been defined to be 4238 KW. In contradiction, Table 8.3-3 of the FSAR states that the worst case loading is 4261 KW. 4261 is greater than the stated maximum load of 4238 KW imposed. Justification for this contradiction will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

The 4,261 KW worst case total load indicated under the "Safety Injection Signal, Loss of Power, Unit Trip" column on page 9 of Table 8.3-3 in the FSAR is in error. The sum of the individual running loads, as listed under this column on pages 1 through 9 of the table, is less than 4,261 KW. The correct totals should be as follows:

TOTALS:	0-3 minute	4,084 KW
	3 minute-1 hour	3,974 KW
	Greater than 1 hour	3,974 KW
		4,211*KW

*Worst Case: Standby service water pump motor is only energized if the service water pumps are inoperable.

The correct worst case load summation of 4,211 KW is below the 4,238 KW continuous rating of the emergency diesel generators.

Table 8.3-3 of the FSAR is being amended to indicate the above total.

Adequate operator instructions are provided in normal, test, and emergency procedures to preclude overloading the diesel generators.

TABLE 8.3-3 (Cont)

Service Equipment and Mark No.	Total per Diesel		DBA Mode of Operation								Loss of Normal Power with Unit Trip								Safety Injection Signal, Loss of Power, Unit Trip							
	No.	Hp	No. Units Oper	Running Load BHp	Running Load kW	Inrush Amps	Load kVA	Max Oper Time	Time Delay (Min)	Start Step	No. Units Oper	Running Load BHp	Running Load kW	Inrush Amps	Load kVA	Max Oper Time	Time Delay (Min)	Start Step	No. Units Oper	Running Load BHp	Running Load kW	Inrush Amps	Load kVA	Max Oper Time	Time Delay (Min)	Start Step
Letdown cross connect valve (2RHS*MOV 750A)	1	.7	1	.7	.6	12	10	3 min	0	2	1	.7	.6	12	10	3 min	0	2	1	.7	.6	12	10	3 min	0	2
Mn stm Vs (2MSS*HVV 101A,B,C)	1	3	1	3	2.6	22.4	18.6	-	0	2	1	3	2.6	22.4	18.6	-	0	2	1	3	2.6	22.4	18.6	-	0	2
Totals					3629			0-3 min					3928			0-3 min					4084 — 4134			0-3 min		
					3522			3 min - 1 hr					3821			3 min - 1 hr					3974 — 4027			3 min - 1 hr		
					3522			Greater than 1 hr					3821			Greater than 1 hr					3974 — 4027			Greater than 1 hr		
					3756(4)								4055(4)								4261(4) 4211(4)					

NOTE:

(1) Load kW = $\frac{BHP \times 0.746}{EFF}$

(2) Inrush amp is from Motor Data Sheets or 6 times running load current.

(3) Load steps are defined as follows:
- Load Step 1 - Begins when diesel generator breaker has closed (maximum of 10 sec after start signal)
- Load Step 2 - Begins 1 sec after load step 1
- Load Step 3 - Begins 5 sec after load step 1
- Load Step 4 - Begins 15 sec after load step 1
- Load Step 5 - Begins 20 sec after load step 1
- Load Step 6 - Begins 40 sec after load step 1

(4) Worst Case: Standby service water pump motor is only energized if the service water pumps are inoperable.

(5) Time Delay - Describes delays in component operation other than the Sequential Start time delay. (See Note 3, above.)

(6) The following non-Class 1E loads are loaded manually if required:
Standby Service Water Pumps (2SWE*P21A, B)
Residual Heat Removal Pumps (2RHS*P21A, B)
Pressurizer Heater Backups (2RCP*H2A, B, D, E)

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ATTACHMENT 7

Response to Outstanding Issue 190 of the
Beaver Valley Power Station Unit No. 2
Draft Safety Evaluation Report

Draft SER Section 8.3.1.11: Description of Compliance with IEEE Standard 387-1977

A description as to how the Beaver Valley design complies with the guidelines of IEEE Standard 387-1977 as augmented by Regulatory Guide 1.9 and 1.108 has not been presented in the FSAR nor was the description provided in Amendment 3 to the FSAR as requested. This item will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

The BVPS-2 diesel generators are in full compliance with IEEE Standard 387-1977, with the exception of the following paragraphs of the above referenced standard:

Paragraph 4: Reference Standards

(8) IEEE Standard 323-1974, "Standard Criteria for Qualifying Class 1E Equipment for Nuclear Power Generating Stations." The BVPS-2 diesels are qualified utilizing the mild environment concept acknowledged by 10CFR50.49B.

(12) IEEE Standard 344-1975, "Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations." The BVPS-2 diesels are seismically qualified in accordance with IEEE Standard 344-1971.

Paragraph 5.4: Qualification

The BVPS-2 diesels are qualified utilizing the mild environment concept adknowledged by 10CFR50.49B.

Sections 1.8 and 8.3.1.2.1, which describe compliance to Regulatory Guide 1.9, wherein IEEE Standard 387-1977 is referenced, have been amended to include the information above.

The Load Capability Qualification Test, per Section 6.3.1 of IEEE Standard 387-1977, paragraphs 1 and 2, will be performed in the field, with loads applied in the order prescribed by Regulatory Guide 1.9, C.14.

TABLE 1.8-1

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USNRC REGULATORY GUIDES

RG No. 1.7, Rev. 2
FSAR Reference Section 6.2.5

CONTROL OF COMBUSTIBLE GAS CONCENTRATIONS IN CONTAINMENT FOLLOWING A LOSS-OF-COOLANT ACCIDENT (NOVEMBER 1978)

The design of the hydrogen control system for Beaver Valley Power Station - Unit 2 follows the guidance of Regulatory Guide 1.7.

RG No. 1.8, Rev. 1-R
FSAR Reference Sections 13.5, 13.1, 13.2

PERSONNEL SELECTION AND TRAINING (MAY 1977)

Selection and training of Beaver Valley Power Station - Unit 2 personnel will follow the guidance of this regulatory guide.

RG No. 1.9, Rev. 2
FSAR Reference Sections 8.3.1, 14.2.12.54, 14.2.12.55

SELECTION, DESIGN, AND QUALIFICATION OF DIESEL-GENERATOR UNITS USED AS STANDBY (ONSITE) ELECTRIC POWER SYSTEMS AT NUCLEAR POWER PLANTS (DECEMBER 1979)

Diesel-generator units used as onsite electric power systems at Beaver Valley Power Station - Unit 2 (BVPS-2) have been selected, designed, and qualified following the guidance of this regulatory guide with the following clarifications:

The diesel generators have been procured in accordance with the 1972 version of Institute of Electrical and Electronics Engineers (IEEE) Standard 387.

Seismic and environmental qualification are in accordance with IEEE Standards 344-1971 and IEEE 323-1971, respectively. Refer to the BVPS-2 positions on Regulatory Guides 1.100 and 1.89.

X

Replace with "Paragraph A"

INSERT

pg. 3A of 80
TABLE 1.8-1

 NOTED AUG 9 1984 H.Marcus

Periodic testing is performed on a regularly scheduled basis to demonstrate the operability and continuity of all Class 1E systems and components. Testing of the onsite Class 1E emergency diesel generator units, which will be in accordance with Regulatory Guide 1.108, is addressed in Section 8.3.1.1.15.

All periodic testing and inspection will be performed with full integrity and availability of the entire Class 1E power systems in conformance with the bypassed or deliberately inoperable status requirements of Regulatory Guide 1.47.

Periodic testing and maintenance will be performed for all Class 1E protection systems in conformance with the requirements of Regulatory Guide 1.118.

Compliance with Regulatory Guide 1.6

The design of the onsite electrical safety-related (Class 1E) power systems is in compliance with Regulatory Guide 1.6. The Class 1E loads for all BVPS-2 voltage levels, that is, 4,160 V ac, 480 V ac, 120 V ac, and 125 V dc, are separated into redundant and completely independent load groups. Manual and automatic interconnections between buses and loads, interconnections between safety-related (Class 1E) and nonsafety-related (non-Class 1E) buses, automatic loading and stripping of buses, and independence of redundant systems are fully described in Sections 8.3.1.1.4, 8.3.1.1.5, 8.3.1.1.8, and 8.3.1.4, respectively.

The 125 V dc Class 1E system includes four redundant battery and battery charger combinations, with redundant dc load groups specifically assigned to each dc bus without automatic connection to any other load group.

Each of the two emergency diesel generator units (Section 8.3.1.1.15) is completely redundant, physically and electrically separated relative to the other, and is connected exclusively to its designated 4,160 V ac Class 1E bus. This design ensures complete independence for the onsite emergency power sources.

Compliance with Regulatory Guide 1.9

The diesel generator units are in compliance with Regulatory Guide 1.9 with the following clarifications: "INSERT PARAGRAPH A" Pg. 3A of 80 TABLE 1.8-1. As addressed in Section 8.3.1.1.15, they have been specified, designed, manufactured, and tested to Regulatory Guide 1.9. All required tests have been performed by the manufacturer with the exception of the 2-hour short time/22-hour continuous rating test entitled, Load Capability Qualification (Section C.14 of Regulatory Guide 1.9). This test will be performed and documented for both diesel generator units when installed. The test procedure is described in Section 14.2.12.

INSERT "PARAGRAPH A" - 2 PLACES!

(PARAGRAPH A)

The Class 1E diesel generators have been procured in full compliance with the 1977 version of Institute of Electrical and Electronics Engineers (IEEE) Standard 387, with the exception of the following paragraphs:

Paragraph 4. Reference Standards

[8] IEEE Standard 323-1974, Standard Criteria for Qualifying Class 1E Equipment for Nuclear Power Generating Stations — The BVPS-2 Class 1E diesels are qualified UTILIZING THE MILD ENVIRONMENT CONCEPT ACKNOWLEDGED BY 10 CFR 50.49B.

[12] IEEE Standard 344-1975, Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations — The BVPS-2 Class 1E diesels are seismically qualified in accordance with IEEE Standard 344-1971

Paragraph 5.4 Qualification

The BVPS-2 Class 1E diesels are qualified UTILIZING THE MILD ENVIRONMENT CONCEPT ACKNOWLEDGED BY 10 CFR 50.49B.

ATTACHMENT 8

Response to Outstanding Issue 198 of the
Beaver Valley Power Station Unit No. 2
Draft Safety Evaluation Report

Draft SER Section 8.3.3.5: Electrical Independence Between Power Supplies to Controls Located in Control Room and Remote Locations

Section 8.3.1.1.10 of the FSAR indicates that controls for the diesel generator and Class 1E circuit breakers are located in the control room and at remote locations. By Amendment 3 to the FSAR, in response to a request for information, the applicant indicated that independence of controls between these locations is provided by transfer relays operated by transfer pushbuttons. The details for the electrical independence between power supplies to these controls will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

The controls for the diesel generator and Class 1E circuit breakers are fully qualified to all Class 1E requirements in the complete control scheme and related power supplies; i.e., main control room, emergency shutdown panel, and alternate shutdown locations. The term "independence of controls" between these locations, which is provided by transfer relays operated by transfer pushbuttons, was used only in the context that an operator may provide "localized control at these locations when required. FSAR Section 8.3.1.1.10 will be revised to address the ability to transfer between control stations including reference to safe shutdown capability due to a single exposure fire as described in FSAR Section 9.5.1 and the FPER.

8.3.1.1.9 Safety-Related Equipment Identification

Each piece of safety-related electrical equipment can be readily identified by the asterisk that forms part of the identification mark number. This identification mark number is physically attached to the equipment in a conspicuous location along with a color coded marker that identifies the assigned emergency train or channel. Refer to Section 8.3.1.3 for a description of the equipment numbering system. Cable and raceway identification are also described in Section 8.3.1.3.

8.3.1.1.10 System Instrumentation and Control

Remote monitoring of the 4,160 V Class 1E system is provided by bus voltmeters and ammeters located in the main control room. Bus voltmeters are also provided at the emergency shutdown panel (ESP).

Each 4,160 V load is provided with a local ammeter at the switchgear section and a transducer-driven ammeter in the main control room. A control switch, with red and white indicating lights, for each load is mounted on the main control board. A control switch, with red and white indicating lights, for selected 4,160 V loads is also located on the ESP. The red light monitors trip coil continuity and indicates if the circuit breaker is closed and breaker control power is available. The white light is dimly lit when the power circuit is de-energized and monitors availability of control power. A bright white light indicates an automatic trip of a feeder (or source) circuit.

Control switches and indicating lights for 480 V Class 1E incoming supply breakers and feeder breakers (except for MCC feeds) are located on the main control board. Control switches and indicating lights for selected 480 V loads are also on the ESP.

INSERT "AA" pg. 8.3-12

#1 Control power for Class 1E equipment is provided as follows:

Class 1E Equipment	Class 1E Control Power Source
4,160 V breaker and associated protective relaying	125 V dc system
480 V load center breakers protection relaying	125 V dc system for external relaying only. Breaker solid state protective system develops its own trip signals
480 V MCC starters	120 V ac derived from internal control transformers
Control relays, panels, and instrument racks	125 V dc and 120 V ac vital buses

INSERT "A"

¶ The controls for the two Class 1E diesel generator units are located at three remote stations: the main control room, emergency shutdown panel (ESP), and the alternate shutdown panel (ASP) (orange diesel only). All controls and power supplies are fully designed and qualified to all Class 1E requirements.

¶ These remote stations are utilized to provide localized control where required. This control is provided by means of local transfer relays operated by transfer pushbuttons, as described in Chapter 7. The ~~alternate shutdown panel~~ ASP is used to provide alternate safe shutdown capability in the event of a single exposure fire postulated in fire areas that would disable safe shutdown cables and equipment (main control room and ESP). Transfer of control to the ~~alternate shutdown panel~~ ASP (including local power supplies) electrically severs all fire-induced failed cabling and equipment and allows for safe shutdown. Refer to FSAR Section 9.5.1 and the Fire Protection Evaluation Report for a detailed description of this capability.

All control power for the ~~[illegible]~~ ASP is feed from different 1E power supplies than control power to the emergency Shutdown Panel.

ATTACHMENT 9

Response to Outstanding Issue 199 of the
Beaver Valley Power Station Unit No. 2
Draft Safety Evaluation Report

Draft SER Section 8.3.3.7.1: Description and Analysis of Compliance to GDC 50

In regard to electrical containment penetrations, a description as to how the Beaver Valley design meets the requirements of Criterion 50 of Appendix A to 10CFR50, with analysis demonstrating compliance, has not been provided in Section 8 of the FSAR.

By Amendment 3 to the FSAR, the applicant, in response to a request for information, provided a description with results of test and analysis to show compliance to GDC 50. Based on this information, the staff considers this item resolved. Documentation of the description and analysis in Section 8.0 of the FSAR will be pursued with the applicant and the results of the staff review will be reported in a supplement to this report.

Response:

A revision to the FSAR (Table 1.8-1 and Section 8.3.1.2.1) has been initiated to indicate compliance to Regulatory Guide 1.63, Rev. 2, without exception.

TABLE 1.8-1 (Cont)

Values of 1/2 percent and 1 percent of critical are used for vital piping and components for the 1/2-SSE and SSE, respectively. In addition, a value of 2 percent of critical is used for reinforced concrete structures for the 1/2-SSE. These values are less than the values given in Table 1 of the regulatory guide and are therefore more conservative.

RG No. 1.62, Rev. 0
FSAR Reference Section 7.3.2.2.7

MANUAL INITIATION OF PROTECTIVE ACTIONS (OCTOBER 1973)

The design of manual initiation of protective actions at Beaver Valley Power Station - Unit 2 follows the guidance of this regulatory guide with the following clarification:

Manual initiation of the semi-automatic switchover to recirculation following a LOCA is in general compliance with IEEE 279-1971. However, once safety injection is initiated manually, all automatic functions follow except for the opening of the containment sump isolation valves. These valves remain closed until receipt of a low level signal from the refueling water storage tank level instrumentation.

RG No. 1.63, Rev. 2
FSAR Reference Section 8.3

and the penetration protection scheme

ELECTRIC PENETRATION ASSEMBLIES IN CONTAINMENT STRUCTURES FOR LIGHT-WATER COOLED NUCLEAR POWER PLANTS (JULY 1978)

Since Beaver Valley Power Station - Unit 2 (BVPS-2) was docketed before August 31, 1978, the methods described in Regulatory Guide 1.63 were not required to be used in the evaluation of the BVPS-2 Construction Permit application. However, the design and construction of the electric penetration assemblies on BVPS-2 ~~follow~~ meet ~~the guidance of~~ this regulatory guide, with the following clarifications:

Insert B pg. 33A of 80

RG No. 1.64, Rev. 2
FSAR Reference Section 17.2

QUALITY ASSURANCE REQUIREMENTS FOR THE DESIGN OF NUCLEAR POWER PLANTS (JUNE 1976)

Quality Assurance Programs in effect at the time of systems design were followed in the design of BVPS-2 and meet the intent of Regulatory Guide 1.64 with the following clarifications and alternative:

Insert B

Circuit protection devices need not be Class 1E or seismically qualified for protection of penetrations unless required for other considerations.

Requirements of IEEE Standard 279-1971 other than the "Single Failure Criteria" of Section 4.2 do not apply

TABLE 1.8-1

Compliance with Regulatory Guide 1.32

The design of the safety-related (Class 1E) power systems is in compliance with Regulatory Guide 1.32. Two immediate access circuits are provided for the preferred (offsite) power sources from the transmission network. Each circuit is electrically connected and energized from the common switchyard and available at all times.

Each battery charger that supplies Class 1E 125 V dc systems is designed with full capacity and capability to supply the largest combined demands of the various steady state loads, while simultaneously providing sufficient power for adequate charging capacity to its designated battery from its minimum voltage level of 110 V dc, irrespective of the BVPS-2 status during which these demands occur.

Test methods, procedures, and intervals for all Class 1E battery performance discharge and service test will be in compliance with IEEE Standard 450-1975.

Independence of redundant standby sources is addressed in Sections 8.3.1.2.1 and 8.3.1.1.15.

Connection of non-Class 1E equipment to Class 1E systems is addressed in Sections 8.3.1 1.5, 8.3.1.1.15, and 8.3.1.2.1.

Selection of diesel generator set capacity for emergency power supply is addressed in Section 8.3.1.1.15.

Compliance with Regulatory Guide 1.63

Each containment electrical penetration is protected for loss of mechanical integrity for all possible values of current which can flow through the penetration conductors. This includes all possible values of overload and short circuit currents.

Where values of overload and short circuit currents are calculated or determined to fall within the thermal limits of the penetration conductors, the conductors are deemed to be self-protecting.

penetration is

Where overload and short circuit currents are in excess of the thermal capability of a penetration conductor, two overcurrent protective devices (primary and backup) are provided. These devices provide reliable protection given a single random failure of one of these protective devices. These devices consist of existing protection devices or additional devices when necessary, are qualified for their intended purpose, and are mechanically and electrically independent with the exception of the 4,160 V residual heat removal motor circuits, which require the same dc control power source.

Insert A
pg. 8.3-56A

Insert B

All containment electrical penetrations have been determined to be self-protecting or have two circuit protection devices, as required by Regulatory Guide 1.63 without exception, with the following clarifications:

Circuit protection devices need not be Class 1E or seismically qualified for protection of penetrations unless required for other considerations.

Requirements of IEEE Standard 279-1971 other than the "Single Failure Criteria" of Section 4.2 do not apply.

EDITED JR 08-17-84

ATTACHMENT 10

Response to Outstanding Issue 199 of the
Beaver Valley Power Station Unit No. 2
Draft Safety Evaluation Report

Draft SER Section 8.3.3.7.2: Compliance with RG 1.63

Section 8.3.1.2.1 of the FSAR indicates that primary and backup containment electrical penetration protection is provided only where the available fault-current exceeds the current-carrying capabilities of penetration conductors. This design for containment electrical penetration does not meet the guidelines of position 1 of Regulatory Guide 1.63. Position 1 requires primary and backup protection where maximum available fault-current exceeds the current-carrying capability of the penetration versus capability of the conductors.

By Amendment 3 to the FSAR, the applicant indicated that the Beaver Valley design provides primary and backup protection as required by RG 1.63 and that the following additional information would be provided by March 1984:

a. fault-current versus time curve for each representative type cable conductor which penetrates primary containment

b. test report which verify the capability of penetration to withstand the total range of time versus fault current for worst case environmental conditions

Revision to the FSAR to indicate compliance to RG 1.63 without exception and review of the above additional information will be pursued with the applicant. The results of the staff review will be reported in a supplement to this report.

Response:

Attached is the following additional information as requested:

a. fault-current versus time curves for each representative type cable conductor which penetrates primary containment

b. test report excerpts which verify the capability of penetrations to withstand the total range of time versus fault current for worst case environmental conditions was introduced. The copper bar was then placed between secondary modules 4 and 9 connecting together module assemblies 2-4 and 6-9. Primary modules 2 and 6 were connected to the current source and the overload current applied. By this method, module assemblies 11-8 and 2-4 were subjected to one and 6-9 to two Rated Short-Time Overload Current Tests. The cable jacket temperature of 6-9 was measured by means of thermocouple.

EXCERPT FROM REPORT PEN-TR-79-05

The locked rotor current requirement is (8) times the full load current (731A) and equal to 5848A. Since there are two conductors per phase, each conductor should carry 2924A. Required duration is 60 Sec.

(6.4.10) 4.4.5 Short-Circuit Current and Duration Test

This test was performed in the High Power Lab. at the Westinghouse Low Voltage Breaker Division, Beaver, Pa.

The three 5 foot lengths were tied together approximately 3 feet from the connection to the medium voltage penetration assembly to simulate the tie down of field cables at an installation.

A 3 foot length of 1000 KCMIL was connected to each secondary module at one end and to each other at the other end through a copper block to form the short. The copper block was then grounded.

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See Figures 3 and 4.

The spec. requirements for short circuit currents are as follows:

X/R equal or greater than 15.

Short circuit current 48,500 (RMS) for duration of 10 cycles.

Momentary first half cycle current 78,000A (RMS)

Short circuit current 42,000A (RMS) for duration of 24 cycles.

Since there are two conductors per phase, the test values required for one conductor can be halved.

(6.4.11) 4.4.6 Seismic Test

This test was performed at the Acton Environmental Testing Laboratory, Acton, Ma.

The three module assemblies were installed in the seismic testing assembly. An enclosure box was bolted to the bulkhead, and the monitoring volume pressurized to 60 psig of nitrogen. The bulkhead-nozzle assembly was secured to the shaker table and 21.2 KV DC

15

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Module Assembly	Current (I Amps)	Duration (t Sec.)	Cable Temp. Rise (°F)
11-8	4200	70	
6-9	4200	70	70 ⟶ 98
2-4	4200	82	
6-9*	4200	82	90 ⟶ 118

* This was the second Rated Short-Time Overload Current Test for module assembly 6-9. It was run in series with 2-4.

This test demonstrates each conductor can carry 4200A for 70 seconds with a temperature rise of 28°F. well above the required 2924A for 60 seconds.

4.5.8 Short-Circuit Current and Duration Test

The following 3 phase short circuit current was applied to the medium voltage assembly.

Test	Current (KA) Symmetric	Asymmetric	Peak	Duration (Cycles)	I^2t ($\times 10^8$)
Bolted Fault	53.5	79	123.7	19	9.1
MV Assy.	45.8	49.4	104.4	19	6.6

See Figures 6 through 9 for computer printout and wave forms obtained during the test.

The test was performed with a penetration having (3) modules (one per phase). The Beaver Valley M.V. penetration will have two modules per phase. It therefore can handle twice the values given above per phase.

The Beaver Valley requirements compared to the test values are shown below:

CN 773

Item	Beaver Valley Requirement	Test Values
Symmetric Current	48,500	91,600A
Asymmetric Current	78,000	98,800A
Duration	10 Cycles	19 Cycles
X/R of Circuit	15	9

Reg. Guide 1.63 - 1978 Rev. 2 requests that a supply system use the value of X/R = 15. The purpose is to introduce sufficient offset to the first 1/2 cycle. The bolted fault condition had a ratio of asymetrica current to symetrical current of 1.47 which represents a 75% asymetry. Th I^2t value exceeds the contract value by 69%.

4.5.9 Seismic Test

The medium voltage module assembly performed well during the Seismic Test. The assembly held the applied 21.2 KVDC and remained a leak tight pressure barrier. There was no indication of voltage breakdown, unacceptable leak rate, damage or deterioration during or after the test.

For results of the leak test and electrical tests performed after seismic see Parts 4.5.1, 4.5.2, 4.5.3 and 4.5.4.3. For more detail of the Seismic Test, see PEN-TR-78-02.

4.5.10 Design Basis Event-Rated Continuous Current Test

Within 15 minutes of introducing steam into the medium voltage assembly, the 15 KVAC between the conductor in module assembly 2-4 and ground broke down. The insulation resistance between the conductor and ground was measured to be 1 x 10^5 ohms, and remained in this range throughout the test.

PEN-4

A current of 600 Amps AC was run continuously for 500 hours of the test without incident through module assemblies 11-8 and 6-9. After the test was terminated, the medium voltage assembly was removed from the chamber and examined. Tracking marks were discovered across the surface of the secondary module of assembly 2-4. It appears to be the point of breakdown of the 15 KVAC.

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For results of the leak test and electrical tests performed after DBE see Parts 4.5.1, 4.5.2 and 4.5.4.4.

(6.4.14)4.5.11 Rated Maximum Duration of Rated Short Circuit

The spec requires 42KA for 24 cycles. Since there are two conductors per phase, the requirement is 21KA per conductor for 24 cycles.

As this fault is assumed to occur during the peak LOCA temperature of 330°F (165°C) at the module, the temperature reached at the end of the short circuit will be found from the formula:

$$\left[\frac{I}{A}\right]^2 t = .0297 \log \left[\frac{T_2 + 234}{T_1 + 234}\right]$$

I = Short circuit current - amperes

A = Conductor area - circular mils

t = Time of short circuit - seconds

T_1 = Max. operating temperature 165°C

T_2 = Temperature at end of short circuit

$$\left[\frac{21000}{1250000}\right]^2 \frac{24}{60} = .0297 \log \left[\frac{T_2 + 234}{165 + 234}\right]$$

T_2 = 169°C

As the LOCA test was performed at 343°F (173°C), it is evident that a short circuit current and duration which produces a temperature of 169°C will not damage the seal or the electrical integrity of the module.

PEN-5

CN 773

5.0 Conclusion

5.1 The results of this test demonstrates that the prototype penetration described in the report meets all requirements of IEEE Standard 317-1976 and 323-1974 with the exception of dielectric strength after radiation and seismic. This matter is addressed in Addendum #1 and was improved by changing the splice insulation from silicone rubber to the same epoxy used to make the seal. The tracking characteristics of the bushing were also improved (reference Report #PEN-TR-80-33). These improved designs will be used in the manufacture of the Beaver Valley penetration.

With capability to withstand 36KV dielectric test and capability to function at 16.6KV during and post-LOCA, the product will far exceed the requirements of the specification for a 5KV rated penetration.

CN 773

Westinghouse
Electric Corporation

Electronic Components
Divisions

Electronic Tube Divisions

Westinghouse Circle
Horseheads New York 14845

ADDENDUM #1 TO PEN-TR-77-59

November 11, 1977

REPORT ON THE RATED MAXIMUM
DURATION OF RATED SHORT-CIRCUIT
CURRENT TEST

W. R. Lankenau

W. R. Lankenau
Test Engineer

Approved by: Michael Yonko
M. Yonko, P. E.
44063

ADD-PEN -1

CN 773

1.0 EQUIPMENT PERFORMANCE SPECIFICATION

The test followed the requirements of IEEE Standard 317-1976, Part 6.4.14, and AEC Regulatory Guide 1.63, October 1973.

2.0 SPECIFIC FEATURES TO BE DEMONSTRATED BY THE TEST

To demonstrate the ability of the herein described nuclear penetration prototype modules to withstand the Rated Maximum Duration of Rated Short-Circuit Test without loss of containment integrity.

3.0 TEST PLAN

3.1 Equipment Description

The two modules tested (S/N 328 and 261) are described in PEN-TR-77-59. They are the same modules that were subjected to and passed all prior IEEE Standard 317-1976 prototype tests including DBE. It is important to note that "it is not the intent of Section 6.4.13 and 6.4.14 (of IEEE Standard 317) to require that an assembly be subjected to more than one qualification test situation where it would be exposed to design basis maximum postulated accident event conditions."

Because the modules performed so well during and after all other prototype tests including DBE, it was decided to see if they would also survive the Rated Maximum Duration of Rated Short-Circuit Current Test.

3.2 Service Conditions To Be Simulated

Rated maximum duration of rated short circuit current at 290°F (143°C) at 78 PSIG. This temperature simulates the penetration temperature during a LOCA which produces of 340°F ambient in the containment.

3.3 Performance Limits

Gas Leakage: Through leakage must be equal to or less than 1×10^{-2} Std-cc/sec (dry nitrogen) at rated pressure during and after the test. Electrical integrity need not be maintained.

CN 773

4.0 REPORT OF TEST RESULTS

4.1 Test Procedure

4.1.1 Rated Maximum Duration of Rated Short-Circuit Current Test

This test was performed in the High Power Lab at the Westinghouse Low Voltage Breaker Division, Beaver, Pa.

The modules were installed and secured in a test mounting collar in the same manner as they would be sealed into a bulkhead. Three cables of the same size were connected together at the inboard side of the module and their extensions on the outboard side were secured to the three phase power source. The inboard side of the module and the inboard cables were wrapped with heating tape and heated to 290°F, the temperature they would attain during a 340°F DBE. The monitoring volume of the module was pressurized to 78 PSIG. See Figures 1 and 2.

After programming the power source to produce the required amount of current for the proper number of cycles (bolted fault), the unit was turned on, thereby delivering the faulted current to the cables. At the conclusion of the test performed on the first triad of wires, the second group was connected and the test repeated. This procedure was continued until all the required cable sizes of both modules had been tested.

4.1.2 Gas Leak Rate and Pneumatic Pressure Test

The modules' containment integrity was verified during the test by observing any loss in monitoring volume pressure.

The modules' containment integrity was verified after the Rated Maximum Duration of Rated Short-Circuit Current Test by using the following techniques.

ADD-PEN-3

CN 773

S/N 328: The module was observed sealed in the test mounting collar. Any loss in monitoring volume pressure per unit time was recorded.

S/N 261: The module was sealed in a pressure chamber as it would be in the containment wall. The chamber (inboard side of the module) was pressurized to 60 PSIG of helium and the outboard end was sealed in a plastic bag. After a hold period of one hour, the possible presence of helium (and therefore a through leak) was determined by using the helium mass spectrometer leak detector "sniffer" method.

4.1 Test Results and Data

4.2.1 Rated Maximum Duration of Rated Short-Circuit Current Test

Cable Size	Symmetric (Amps)	Asymmetric (Amps)	Peak (Amps)	X/R Ratio	Duration Cycles	I^2t $(Amp)^2(Sec)$
BF[1]	35,100	38,300	74,000	4	30	6.2E8
350 KCMIL[2]	33,100	34,600	68,200	2.7	23	4.3E8
350 KCMIL	33,200	35,200	69,200	3.0	30	5.5E8
BF	30,300	33,600	62,709	4.4	18	2.8E8
250 KCMIL[3]	29,600	32,300	58,400	3.8	17	2.5E8
250 KCMIL[4]	29,400	31,400	61,300	3.3	17	2.5E8
250 KCMIL	29,300	32,000	62,000	3.8	18	2.6E8
1/0	29,200	32,200	60,700	4.1	4.32	6.1E7
BF	26,100	28,800	53,000	4.3	2.64	3.0E7
#2	24,300	26,900	50,000	4.2	2.64	2.6E7
BF	16,000	17,900	33,200	4.6	2.58	1.1E7
#4	15,300	16,200	30,700	3.0	2.58	1.0E7
BF	4,200	4,700	8,700	4.9	2.28	6.7E5
#10	4,200	4,500	8,400	3.3	2.28	6.7E5
BF	2,500	2,700	5,100	4.0	2.4	2.5E5
#12	2,100	2,200	4,100	3.3	2.4	1.8E5

CN 773

The computer print-out and wave forms are included in Figures 5A through 20B.

NOTE 1: The BF readings are the bolted fault current available to the wire sizes following in the table.

NOTE 2: The first attempt at shooting the 350 KCMIL triad resulted in the fusing of the external terminals on two phases at the module-power supply interface after 14.5 cycles. These terminals are rated for 250 KCMIL and 350 KCMIL use. See Figure 3. The second 350 KCMIL shot was run 10 minutes after the first. The two shots coupled with the inboard DBE temperature was sufficient to cause a leak (20×10^{-2} Std-cc/sec) between the inboard side and the monitoring volume. The leak, however, is not a through leak.

NOTE 3 AND 4: One wire was blown out at the external connection after 6.5 cycles. The shot was repeated. The same wire was again blown out at this same connection after 5 cycles. Sufficient time was allowed between the three 250 KCMIL shots such that the excessive temperature that developed in the case of the 350 KCMIL test was not repeated.

Figure 4 is a picture of the inboard end of S/N 261 after testing. The heating tape has been removed.

4.2.2 Gas Leak Rate and Pneumatic Pressure Test

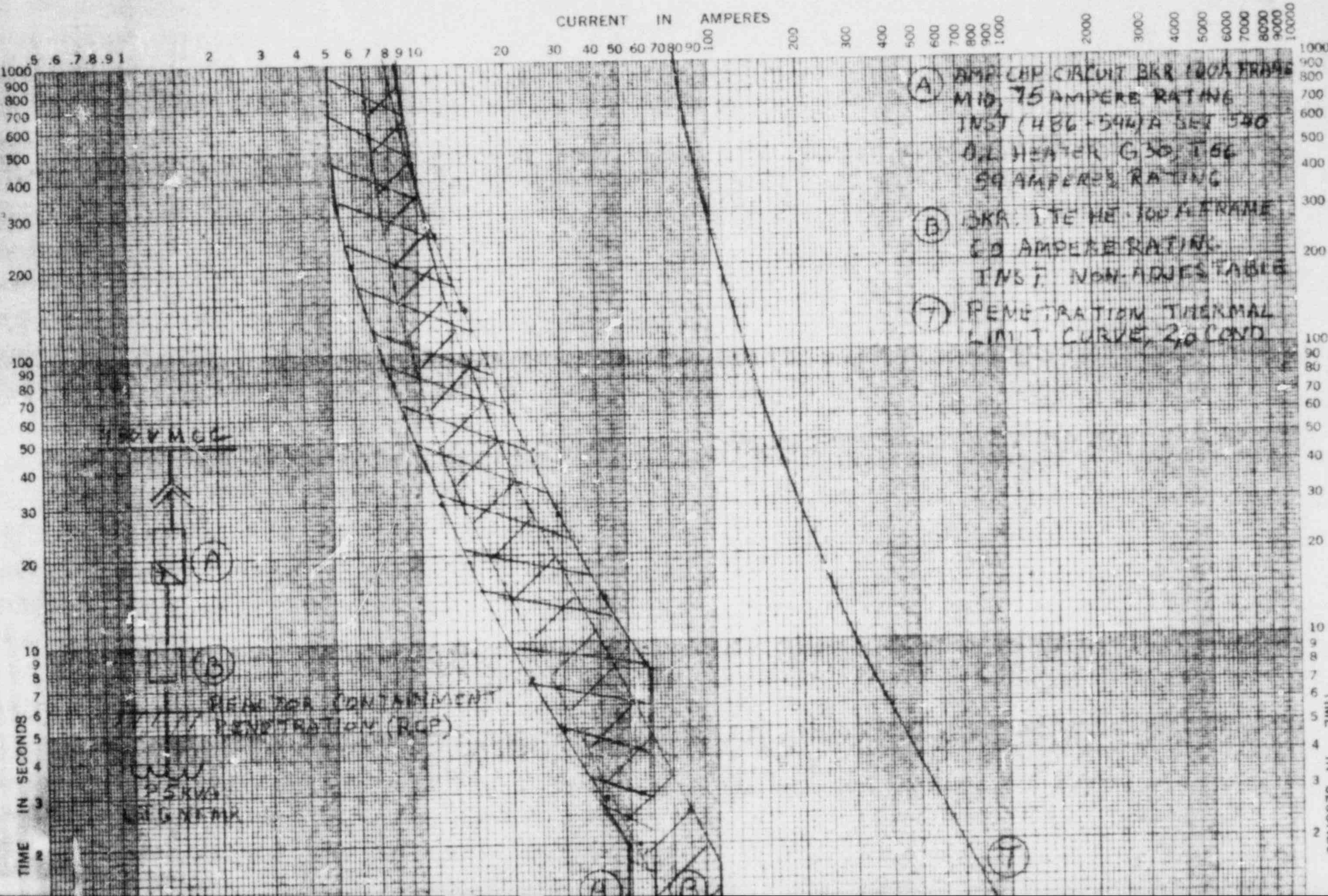
There was no through leakage detected during or following the Rated Maximum Duration of Rated Short Circuit Current Test. Using the techniques described in 4.1.2, detectability is orders of magnitude greater than the required 1×10^{-2} Std-cc/sec limit.

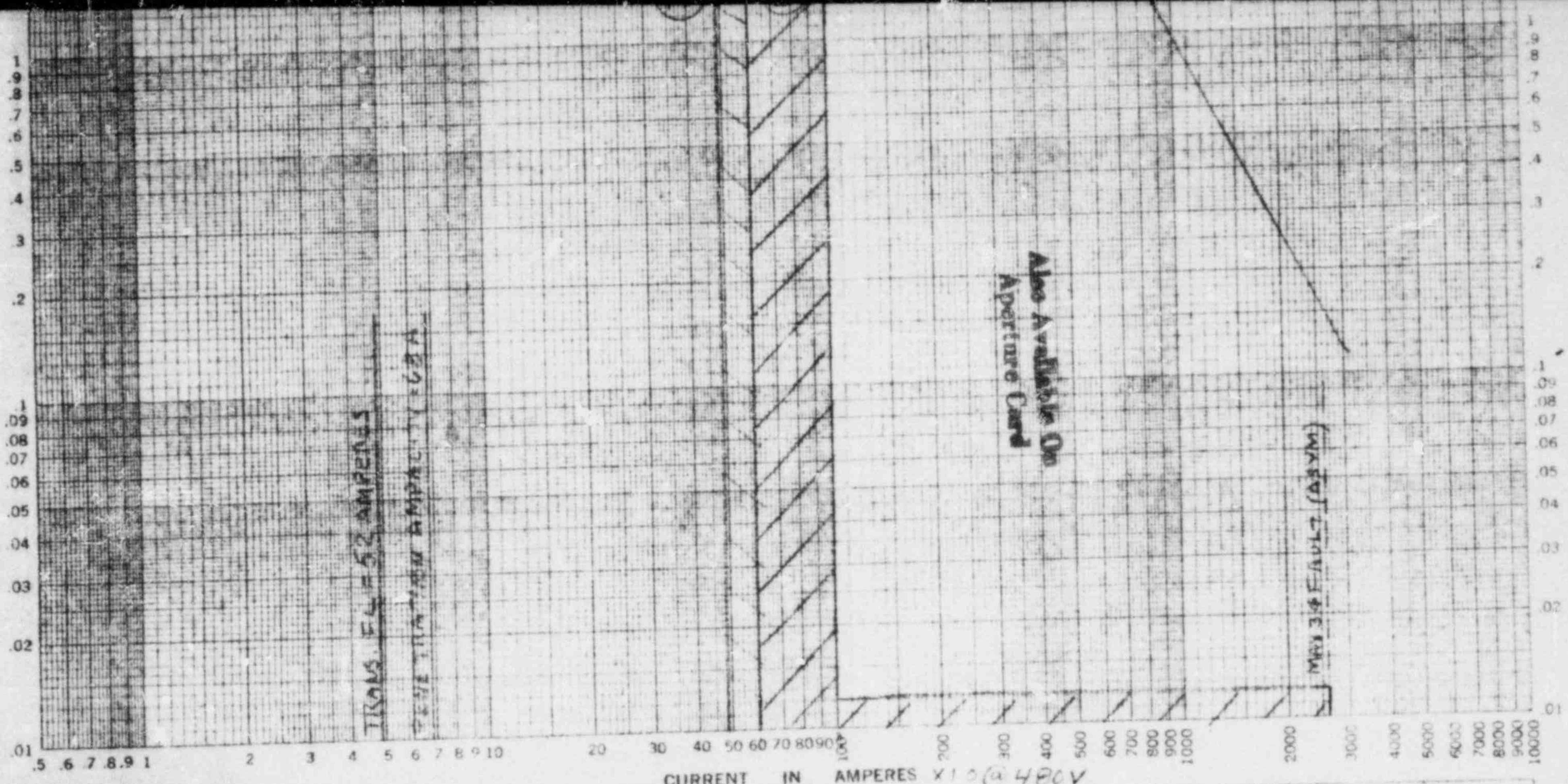
CN 773

5.0 CONCLUSION

The results of this test in conjunction with the results of the tests recorded in PEN-TR-77-59 confirm that the prototype penetrations meet the requirements of IEEE Standard 317-1976 and Standard 323-1974. This design can, therefore, be classified as 1-electrical.

The ratings determined by this test can be used to match the circuit overload protection system as required by Reg. Guide 1.63 - October 1973.


CURRENT IN AMPERES
TIME IN SECONDS
(A) AMP CAP CIRCUIT BKR 100A FRAME
M10, 75 AMPERE RATING
INST (486-594)A SET 540
O.L HEATER G30, T66
59 AMPERES RATING
(B) BKR ITE HE 100A FRAME
60 AMPERE RATING
INST NON-ADJUSTABLE
(T) PENETRATION THERMAL
LIMIT CURVE, 2/0 COND
REACTOR CONTAINMENT
PENETRATION (RCP)
P 5KW
HEATER



Also Available On Aperture Card

LIGHTING TRANSFORMER TIME-CURRENT CHARACTERISTIC CURVES

For LTG-TRF 2-R01 CKT LARNC (65A) Fuse Links. In MCC-2-16 BKR 1D

Dated H.E.M. Brown

BASIS FOR DATA Standards

1. Tests made at ______ Volts a-c at ______ p-f., starting at 25C with no initial load

2. Curves are plotted to ______ Test points so variations should be

No. 12241-ESK-150D

Date

K•E TIME-CURRENT CHARACTERISTIC 48 5258 KEUFFEL & ESSER CO. MADE IN U.S.A.

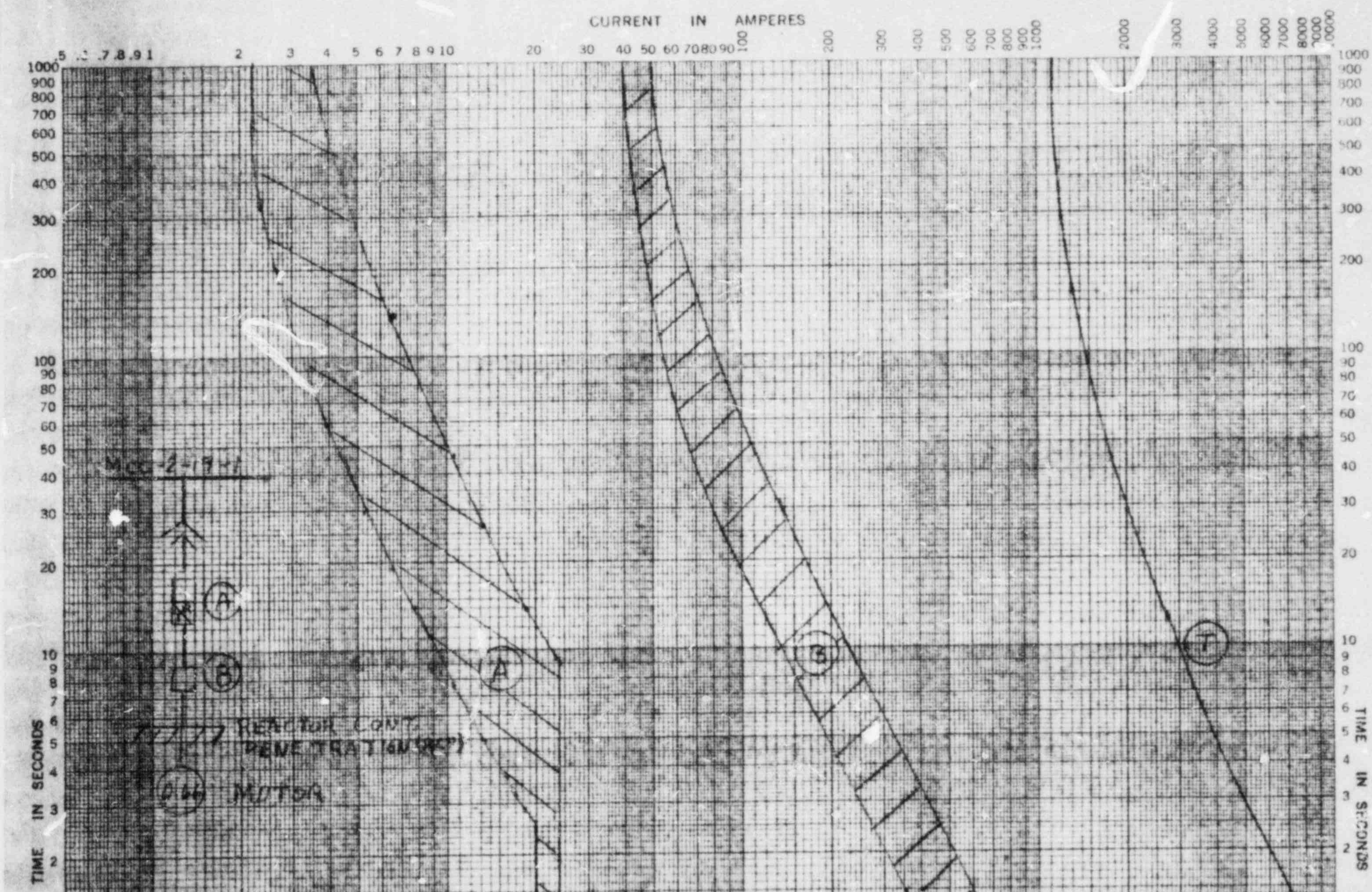
TI APERTURE CARD

DUQUESNE LIGHT COMPANY

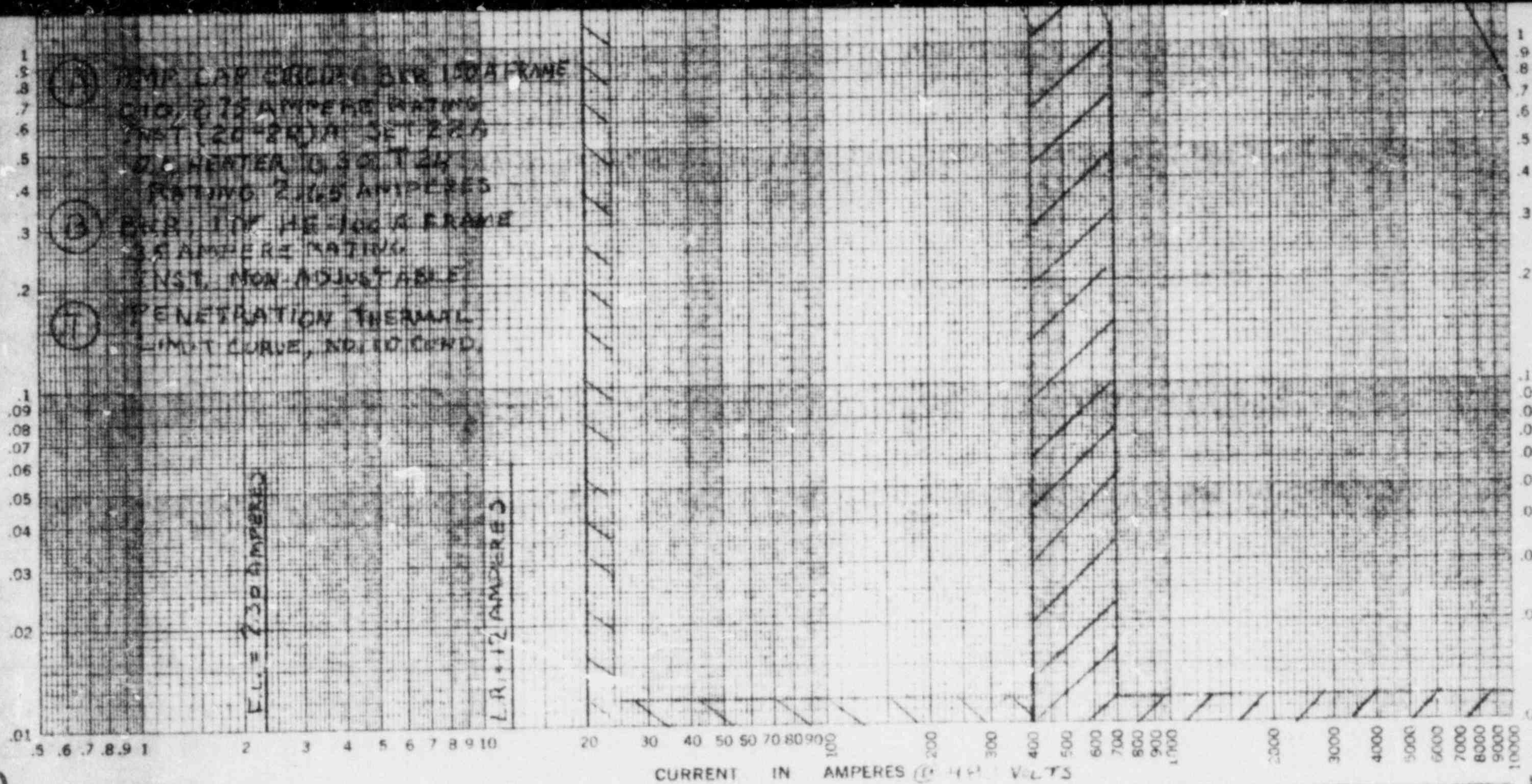
BEAVER VALLEY UNIT 2

Stone & Webster Engineering Corp.

8409280184-01



CURRENT IN AMPERES
TIME IN SECONDS
MCC-2-1-1
A
B
T
REACTOR CONT. PENETRATION(SP)
MOTOR



MOTOR OPER. VALVE TIME-CURRENT CHARACTERISTIC CURVES	
For LOOP 22 DEA ISOLATION VALVE Fuse Links. In	
BASIS FOR DATA Standards CKT. Dated 3-21-84	No. 12241-ESK-150C
1. Tests made at ______ Volts a-c at ______ p-f., starting at 25C with no initial load	Date
2. Curves are plotted to ______ Test points so variations should be	

K•E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

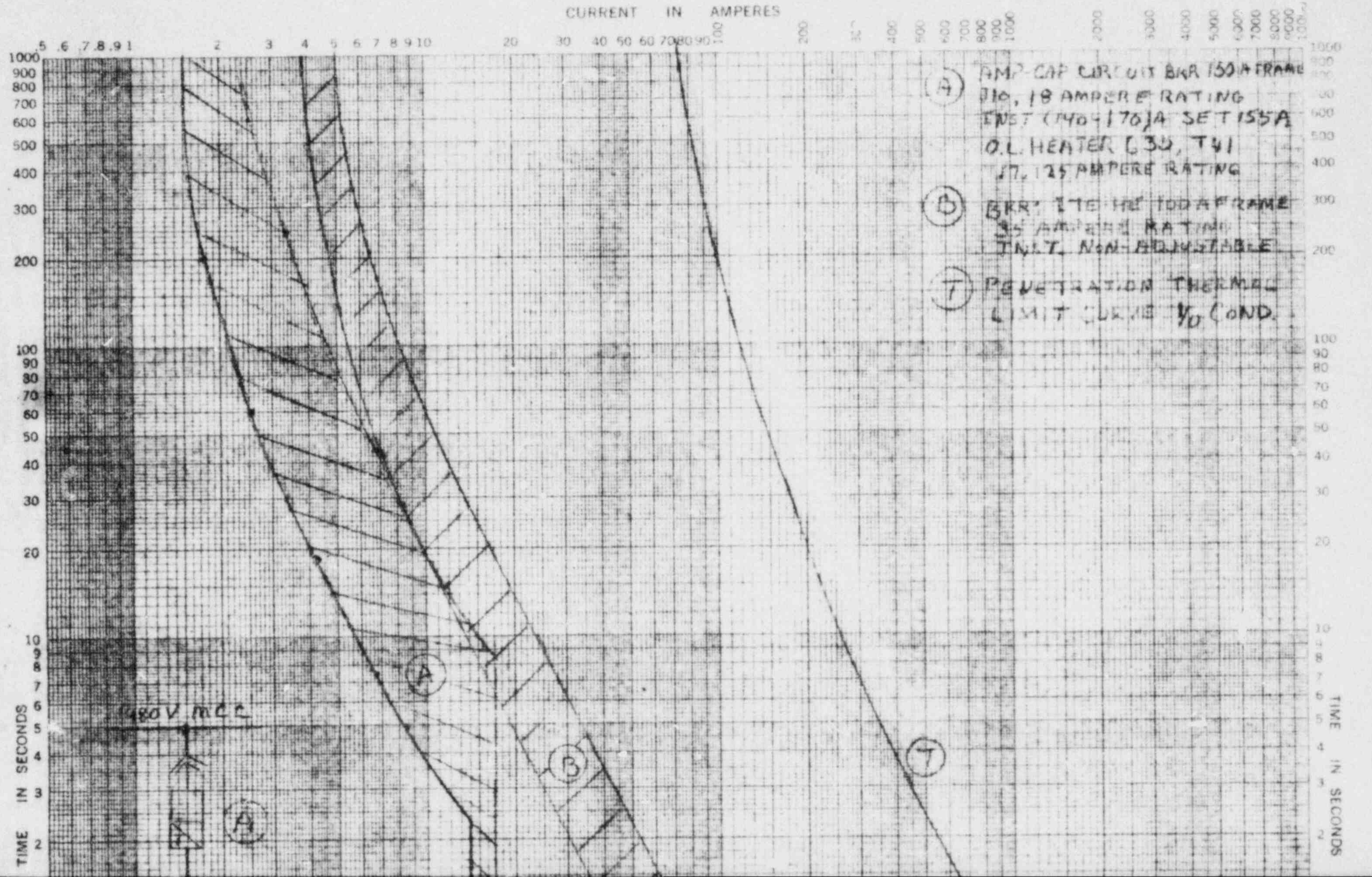
Also Available On Aperture Card

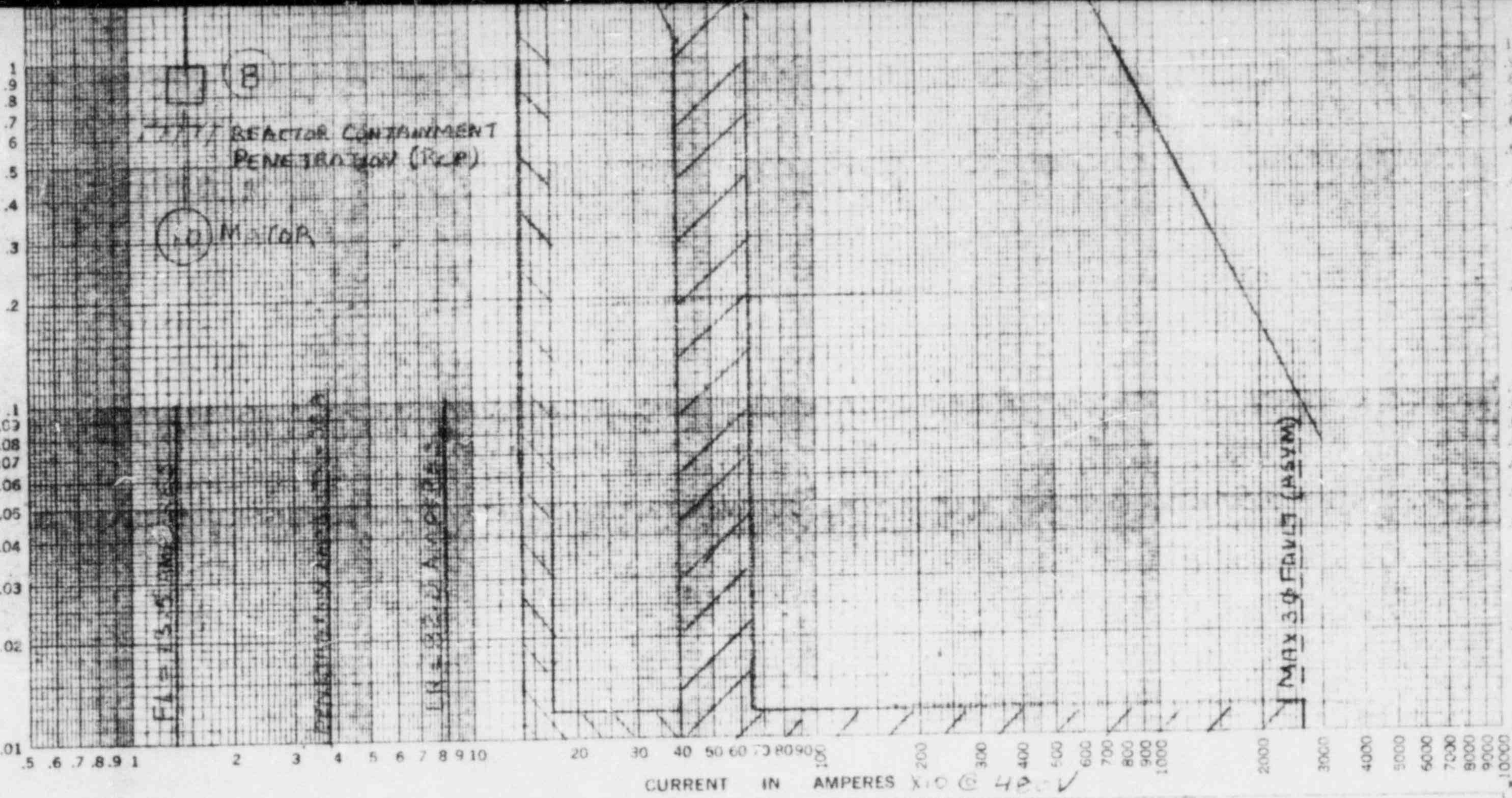
8409280184-02

TI APERTURE CARD

NUCLEAR SAFETY RELATED

DUQUESNE LIGHT COMPANY
BEAVER VALLEY UNIT 2
Stone & Webster Engineering Corp.


CURRENT IN AMPERES
TIME IN SECONDS
(A) AMP-CAP CIRCUIT BKR 150 A FRAME
J10, 18 AMPERE RATING
INST (140-170) A SET 155A
O.L. HEATER
125 AMPERE RATING
(B) BKR ITE HE 100 A FRAME
INST. NON-ADJUSTABLE
(T) PENETRATION THERMAL
LIMIT
COND.
480V MCC
(A)
(B)
(T)



BEARING LIFT OIL PUMP	TIME-CURRENT CHARACTERISTIC CURVES
For RCP BRG LIFT OIL PUMP 2RCS-P21C1	Fuse Links. In MCC-2-12 BUS 6F
BASIS FOR DATA Standards CKT K-6J (CKS)	Dated H.C. M. BRECN 3-11-84
1. Tests made at ______ Volts a-c at ______	p-f., starting at 25C with no initial load
2. Curves are plotted to ______ Test points so variations should be	

No. 12241-ESK-150 B

Date

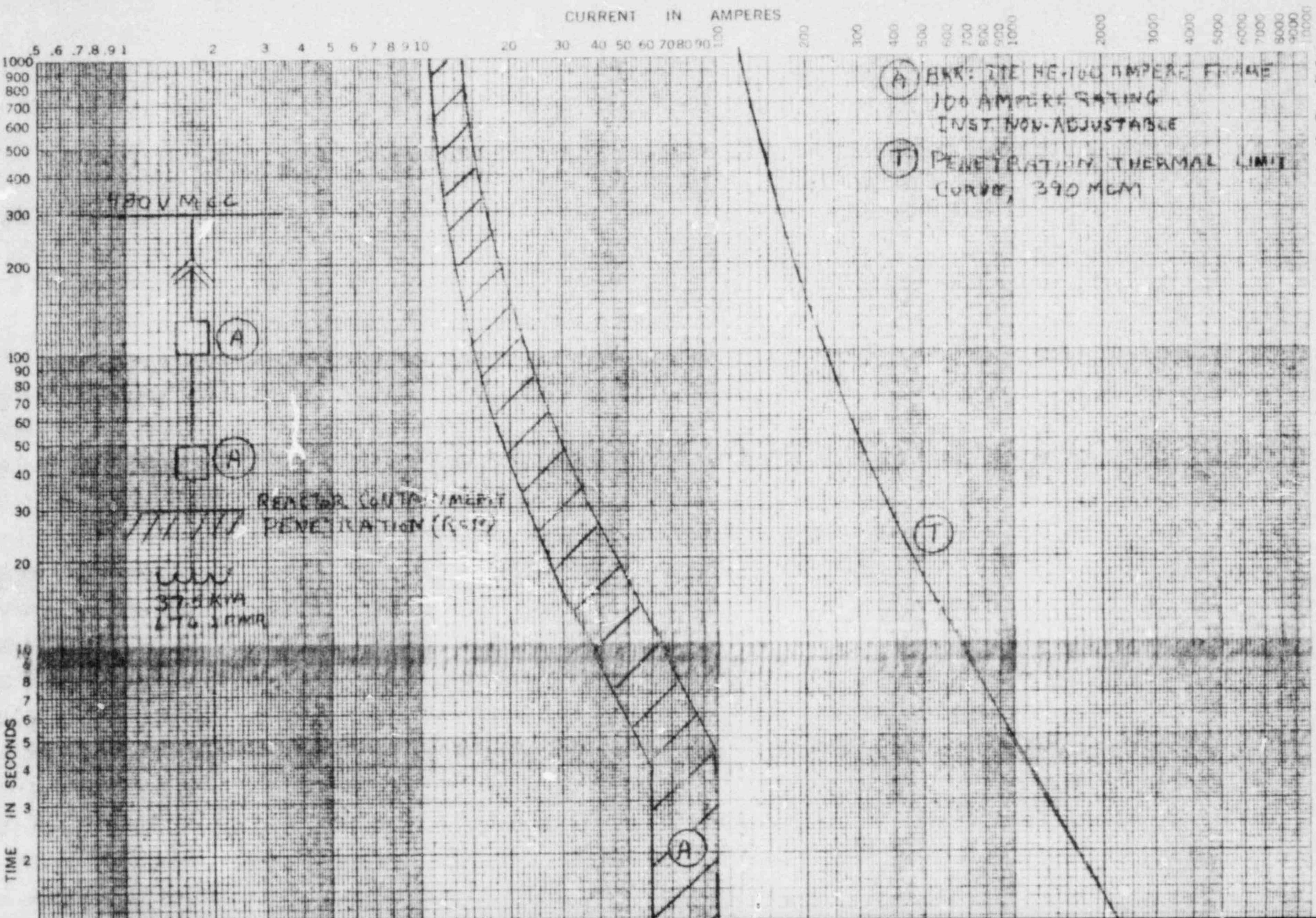
DUQUESNE LIGHT COMPANY
BEAVER VALLEY UNIT 2
Stone & Webster Engineering Corp.

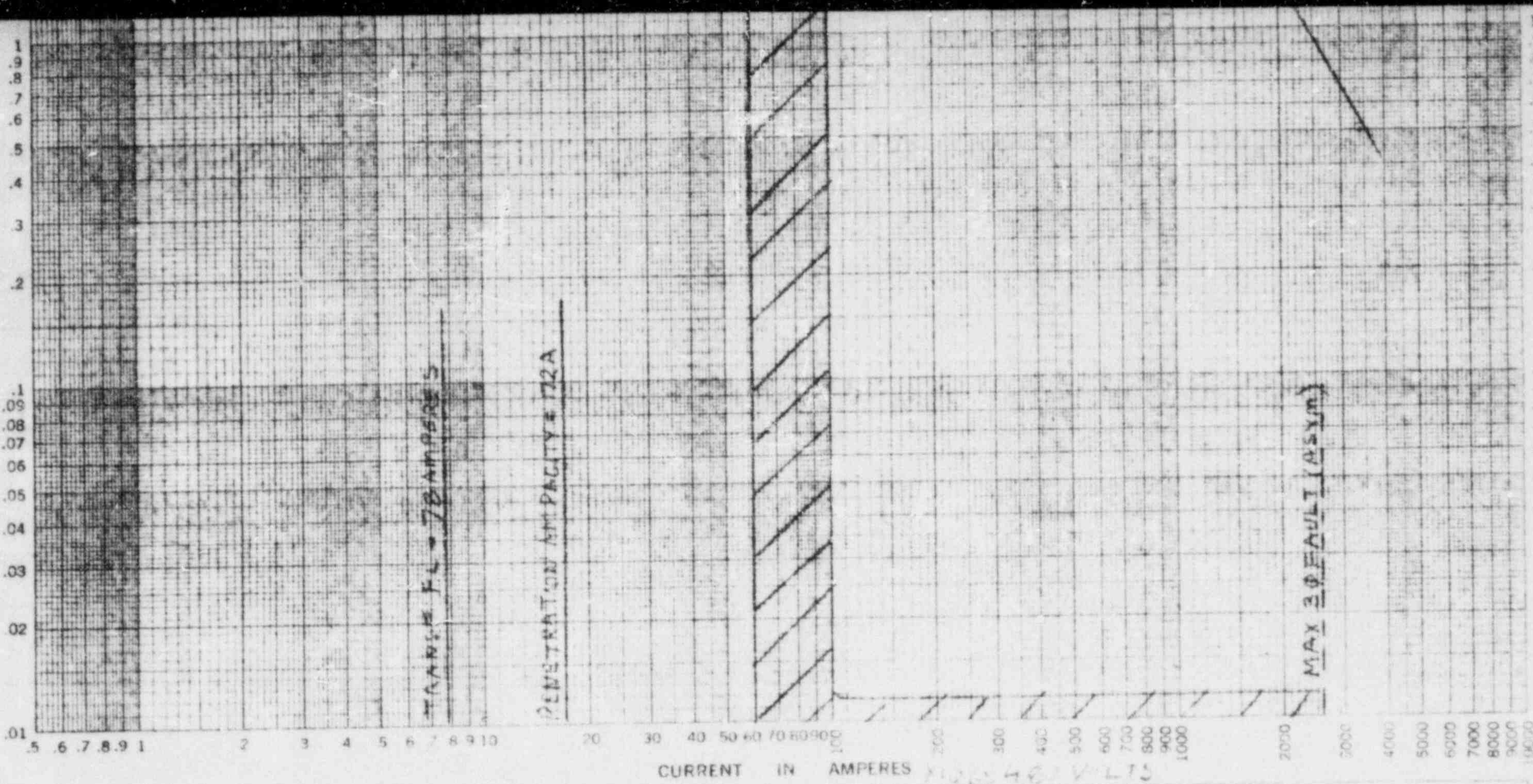
K-E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

TI APERTURE CARD

Also Available On Aperture Card

8409280184-03


CURRENT IN AMPERES
TIME IN SECONDS
(A) BKR: GE HE-100 AMPERE FRAME
100 AMPERE RATING
INST. NON-ADJUSTABLE
(T) PENETRATION THERMAL LIMIT
CURVE, 390 MCM
480V MCC
REACTOR CONTAINMENT
PENETRATION (R-1?)



37.5 KVA LIGHTING XFMR TIME-CURRENT CHARACTERISTIC CURVES

For LTG-TRF 2-107 Fuse Links In

Dated 3-11-87

BASIS FOR DATA Standards

1. Tests made at Volts a-c at p-f., starting at 25C with no initial load
2. Curves are plotted to Test points so variations should be

No. 12241-ESK-150A

Date

K+E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

DUQUESNE LIGHT COMPANY
BEAVER VALLEY UNIT 2
Stone & Webster Engineering Corp

Also Available On Aperture Card

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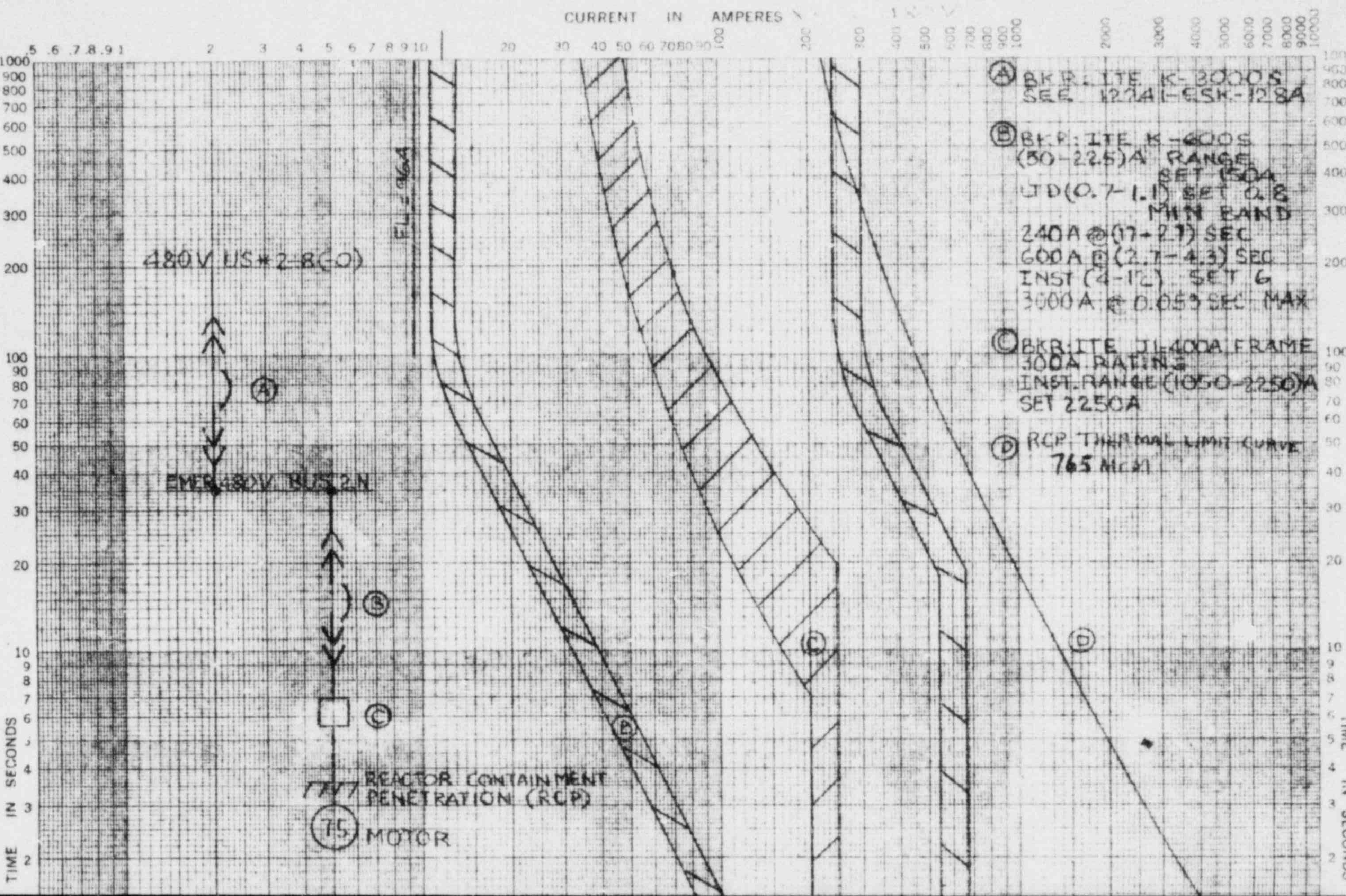
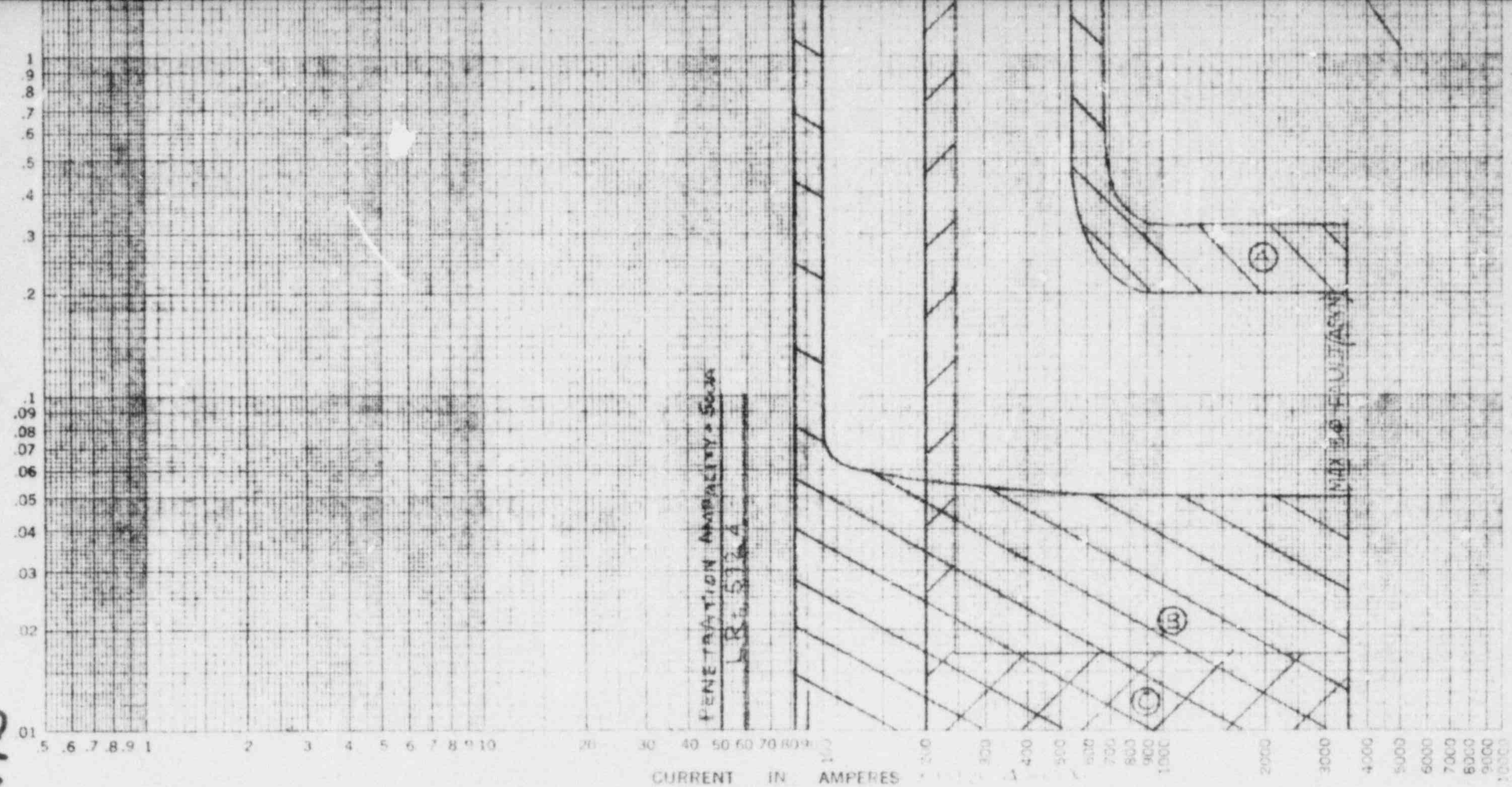
8409260184-07



CURRENT IN AMPERES
TIME IN SECONDS
Ⓐ BKR: ITE K-3000S
SEE 12241-ESK-12.8A
Ⓑ BKR: ITE K-600S
(50-225)A RANGE
SET 150A
LTD (0.7-1.1) SET 0.8
MIN BAND
240A @ (17-27) SEC
600A @ (2.7-4.3) SEC
INST (4-12) SET 6
3000A @ 0.053 SEC MAX
Ⓒ BKR: ITE JL400A FRAME
300A RATING
INST. RANGE (1050-2250)A
SET 2250A
Ⓓ RCP THERMAL LIMIT CURVE
765 MCM
480V US #2-8(-O)
EMER 480V BUS 2N
REACTOR CONTAINMENT
PENETRATION (RCP)
75 MOTOR



75 HP MOTOR	TIME-CURRENT CHARACTERISTIC CURVES
For CRDM SHROUD COOL FAN, 2HVR-FN202A1	Fuse Links. In BUS 2N, BKR 7B
BASIS FOR DATA Standards	Dated E. TABUTEAU 11-21-83
1. Tests made at ____ Volts a-c at ____ p.f., starting at 25C with no initial load	No. 12241-ESK-128P
2. Curves are plotted to ____ Test points so variations should be	Date

K+E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO.

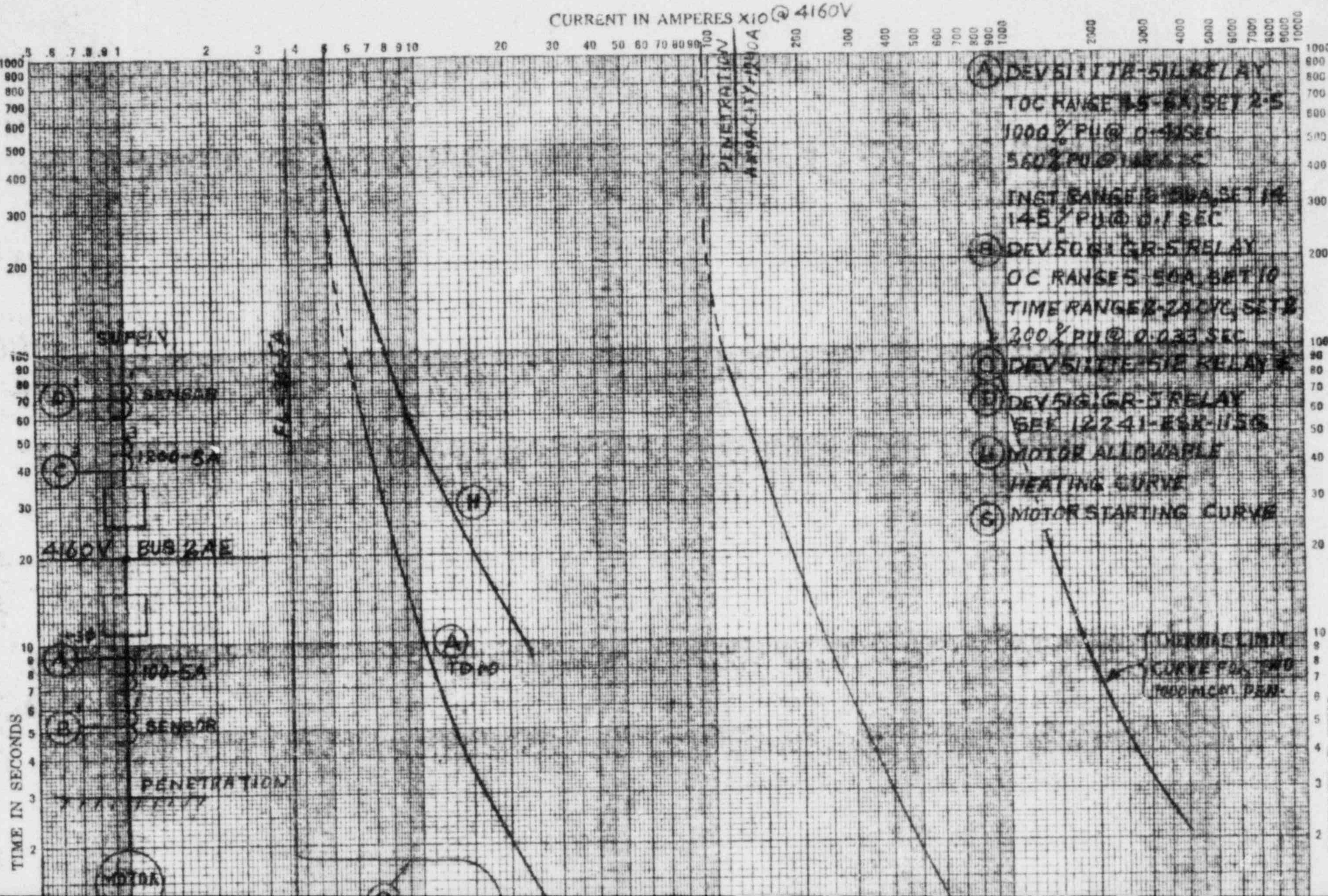
NUCLEAR SAFETY RELATED

DUQUESNE LIGHT COMPANY
BEAVER VALLEY UNIT 2
Stone & Webster Engineering Corp.

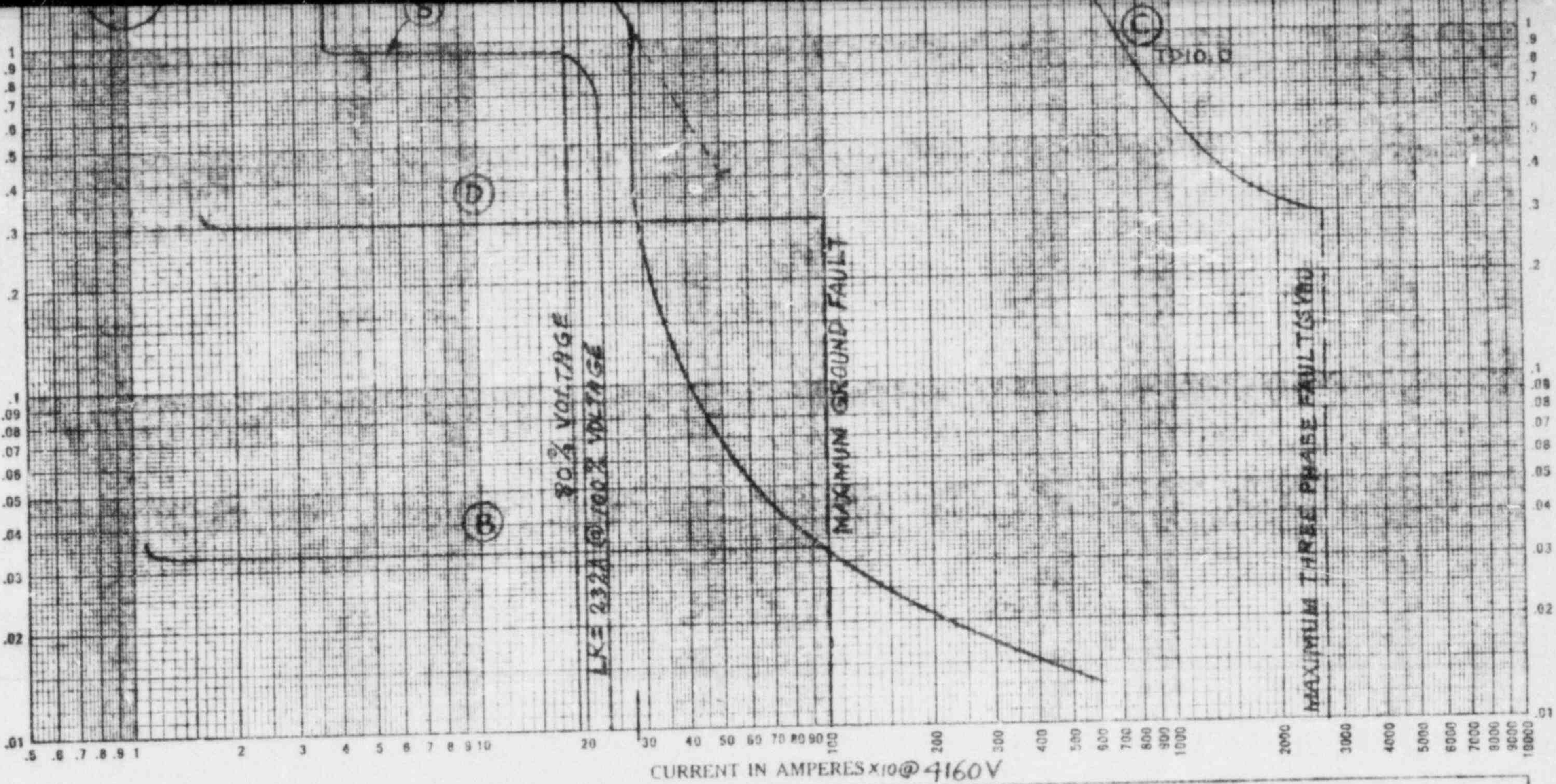
Also Available On Aperture Card

TI APERTURE CARD

8409280184-05



CURRENT IN AMPERES X10 @ 4160V
TIME IN SECONDS
A DEV 51 ITE-51L RELAY
TOC RANGE
1000% PU @
INST RANGE
145% PU @ 0.1 SEC
B DEV 50G GR-5 RELAY
OC RANGE 5-50A, SET 10
200% PU @ 0.033 SEC
C DEV 51 ITE-51E RELAY
D DEV 51G GR-5 RELAY
SEE 12241-ESK-11SG
H MOTOR ALLOWABLE
HEATING CURVE
G MOTOR STARTING CURVE
THERMAL LIMIT
PENETRATION
SUPPLY
SENSOR
1200-5A
4160V BUS 2AE
100-5A
MOTOR
TD 10



300 HP MOTOR — TIME-CURRENT CHARACTERISTIC CURVES

For RESIDUAL HEAT REMOVAL PMP, 2RHS-P21A Fuse Links In 4160V BUS 2AE BKR 2E4

BASIS FOR DATA Standards (W) 8246D50 & 663502-B Dated KJS Khunkhun 4/19/78

1. Tests made at .... Volts a-c at .... p.f., Starting at 25C with no initial load

2. Curves are plotted to .... Test points so variations should be

PENETRATION REF 12241-2001-300-217-014F

No. 12241-ESK-115D

Date REV 10-7-83 ET KJSK

DUQUESNE LIGHT COMPANY
BEAVER VALLEY UNIT 2
Stone & Webster Engineering Corp.

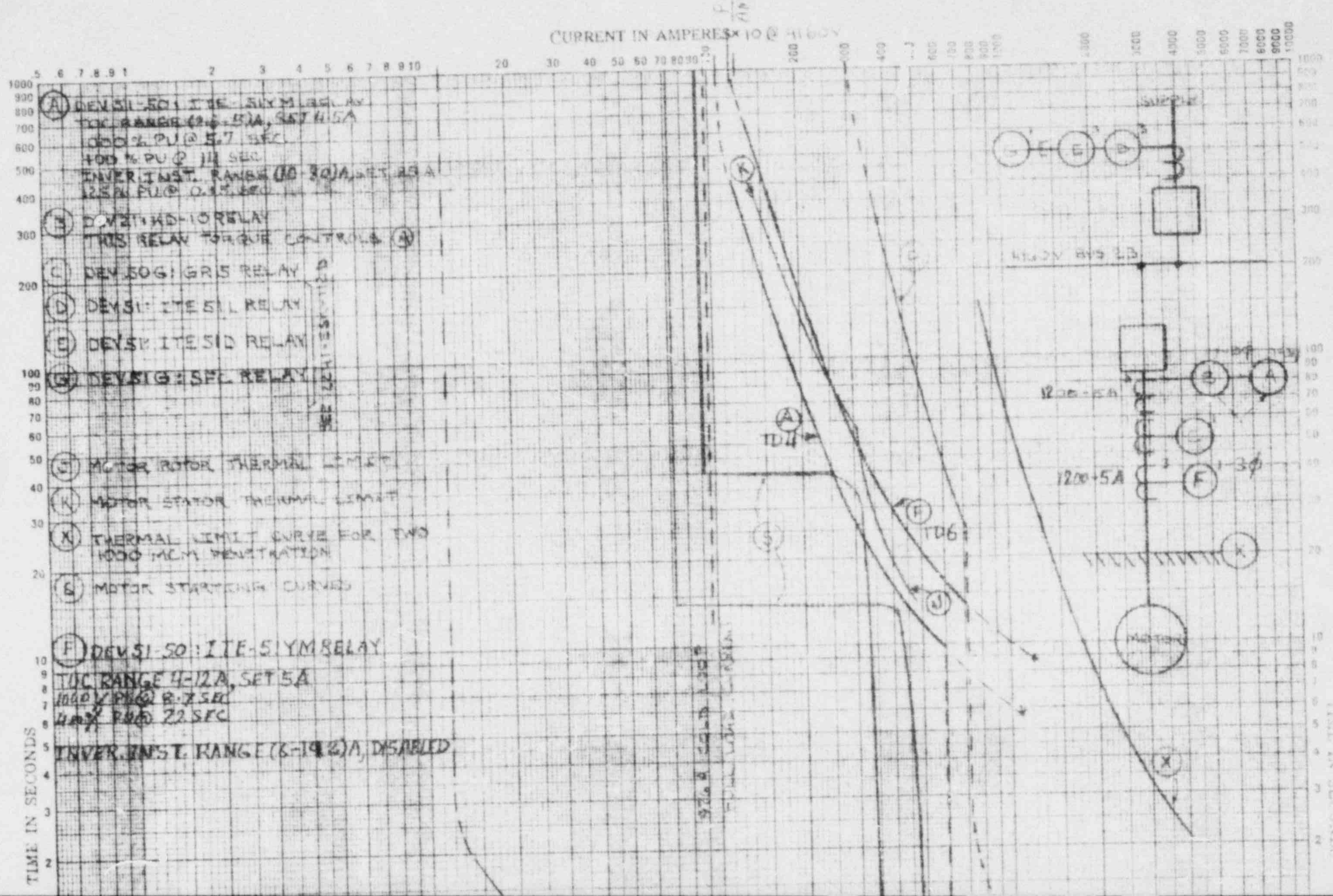
K+E TIME-CURRENT CHARACTERISTIC 42 5258 MADE IN U.S.A. KEUFFEL & ESSER CO.

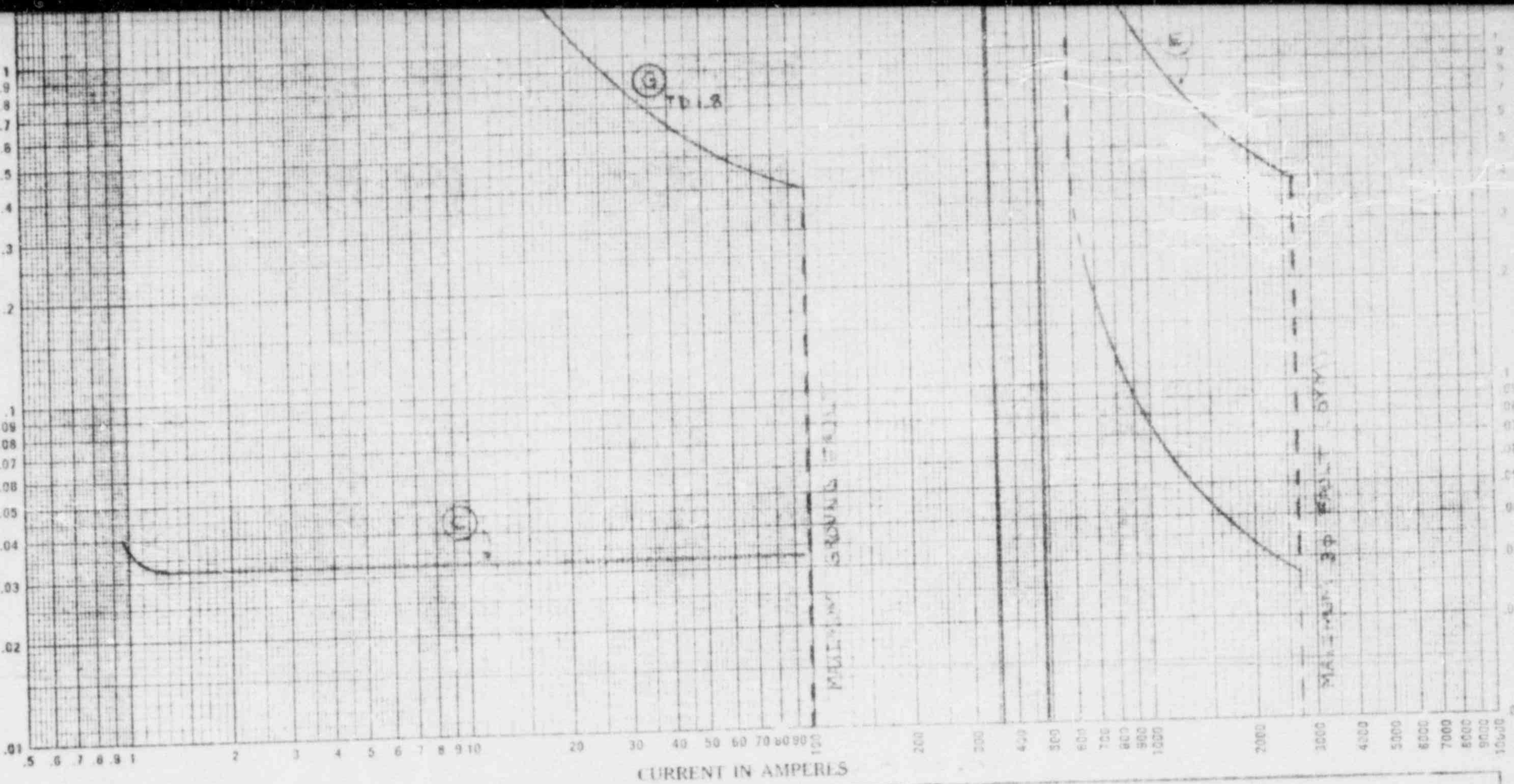
NUCLEAR SAFETY RELATED

8409280184-06

Also Available On Aperture Card

TI APERTURE CARD


CURRENT IN AMPERES x 10 @ 4160V
TIME IN SECONDS
(A) DEV 51-50: ITE-51YM RELAY
TOC RANGE (2-6)A, SET 4.5A
1000% PU @ 5.7 SEC
400% PU @ 11 SEC
INVER.INST. RANGE (10-30)A, SET 23 A
125% PU @ 0.15 SEC
(B) DEV 21: KD-10 RELAY
THIS RELAY TORQUE CONTROLS (A)
(C) DEV 50G: GR-5 RELAY
(D) DEV 51: ITE 51L RELAY
(E) DEV 51: ITE 51D RELAY
(G) DEV 51G: SFC RELAY
(J) MOTOR ROTOR THERMAL LIMIT
(K) MOTOR STATOR THERMAL LIMIT
(X) THERMAL LIMIT CURVE FOR TWO 1000 MCM PENETRATION
(S) MOTOR STARTING CURVES
(F) DEV 51-50: ITE-51YM RELAY
TOC RANGE 4-12A, SET 5A
1000% PU @ 8.7 SEC
400% PU @ 22 SEC
INVER.INST. RANGE (6-192)A, DISABLED
SUPPLY
4160V BUS 1B
1200-5A
1200-5A
3Ø
MOTOR
TD4
TD6
FULL LOAD AMPS
PENETRATION AMPACITY



TIME-CURRENT CHARACTERISTIC CURVES

For REACTOR ... Fuse Links. In ...

Dated ...

BASIS FOR DATA Standards

1. Tests made at ... Volts ... at ... p.f., Starting at 25C with no initial load

2. Curves are plotted to ... Test points so variations should be

PENETRATION REF 12241- ...

No. ...

Date REV ...

K+E TIME-CURRENT CHARACTERISTIC 43 5258 MADE IN U.S.A.

KEUFFEL & ESSER CO.

8409280184-07