

PHILADELPHIA ELECTRIC COMPANY

2301 MARKET STREET
P.O. BOX 8699
PHILADELPHIA, PA. 19101

SHIELDS L. DALTROFF
VICE PRESIDENT
ELECTRIC PRODUCTION

(215) 841-5001

November 1, 1984

Docket Nos. 50-277
50-278

Mr. Darrell G. Eisenhut
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUBJECT: Peach Bottom Response to NRC Generic
Letter 84-15 titled, "Proposed Staff Actions
to Improve and Maintain Diesel Generator
Reliability," dated July 2, 1984

Dear Mr. Eisenhut:

On July 2, 1984, the NRC issued Generic Letter 84-15, titled, "Proposed Staff Actions to Improve and Maintain Diesel Generator Reliability". The generic letter requested information be provided to the NRC dealing with three items concerning diesel generators at operating reactors. Philadelphia Electric Company, by letter dated August 16, 1984 from M. J. Cooney to D. G. Eisenhut, requested an extension to November 1, 1984, for submitting the Peach Bottom response. This letter will restate the three items requested and provide our response. Additionally, your letter requested that our response be provided to you under oath or affirmation. Attached you will find an appropriate affidavit.

Request 1:

1. Reduction in Number of Cold Fast Start Surveillance Tests for Diesel Generators

This item is directed towards reducing the number of cold fast start surveillance tests for diesel generators which the

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staff has determined results in premature diesel engine degradation. The details relating to this subject are provided below. Licensees are requested to describe their current programs to avoid cold fast start surveillance testing or their intended actions to reduce cold fast start surveillance testing for diesel generators.

Fast Start Testing

The staff has for sometime had under review and assessment methods of diesel generator testing. The staff has determined that many licensees use a method of testing which does not take into consideration those manufacturer recommended preparatory actions such as prelubrication of all moving parts and warmup procedures which are necessary to reduce engine wear, extend life and improve availability. The existing Standard Technical Specifications require fast starts from ambient conditions for all surveillance testing which in many engine designs and operating practices subject the diesel engine to undue wear and stress on engine parts. Concerns were expressed by ACRS regarding the imposition of severe mechanical stress and wear on the diesel engine due to frequent cold fast starts. Nuclear Industry related groups (INPO and American Nuclear Insurer) have also expressed concern based on operating experience that cold fast start testing results in incremental degradation of diesel engines and that, if proper procedures covering warmup prelubrication, loading/unloading, etc., were taken, an improvement in reliability and availability would be gained. Similar views have been identified by the nuclear power industry and the regulatory authority in Sweden. The authority in Sweden has taken corrective actions to reduce the frequency of fast starts.

It is the staff's technical judgement that an overall improvement in diesel engine reliability and availability can be gained by performing diesel generator starts for surveillance testing using engine prelube and other manufacturer recommended procedures to reduce engine stress and wear. The staff has also determined that the demonstration of a fast start test capability for emergency diesel generators from ambient conditions cannot be totally eliminated because the design basis for the plant, i.e., large LOCA coincident with loss of off-site power, requires such a capability.

In view of the above, the staff has concluded that the frequency of fast start tests from ambient conditions of diesel generators should be reduced. An example of an

acceptable Technical Specification to accomplish this goal is provided in the attachment to this enclosure. Licensees are requested to describe their current programs to avoid cold fast starts or their intended action to reduce the number of cold fast start surveillance tests from ambient conditions for diesel generators. Licensees are encouraged to submit changes to their Technical Specification to accomplish a reduction in the number of such fast starts.

Other Testing

Also, the staff is concerned regarding a number of additional diesel generator tests that are currently being required by Technical Specifications for some of the earlier licensed operating plants. For example, when subsystems of the emergency core cooling system on some plants are declared inoperable, the diesel generators are required to be tested. The staff has concluded that excessive testing results in degradation of diesel engines. In order to make those few plants consistent with the majority of the plants, it is the staff's position that the requirements for testing diesel generators, while emergency core cooling equipment is inoperable, be deleted from the Technical Specifications for such plants. The affected licensees are encouraged to propose Technical Specifications to make such changes.

Response 1:

Reduction in the Number of Cold Fast Start Surveillance Tests for the Diesel Generators

PECo recognizes the need to minimize the number of cold fast starts on the diesel generators. Such starts could impose severe mechanical stress on the engine internals, increase engine wear, and ultimately result in degraded diesel generator reliability. The Peach Bottom surveillance test program is designed to minimize the number and the consequences of cold fast starts by adherence to the following:

- A. Engine Prelubrication - When the diesels have not been operated for an extended period of time, the lubricating oil on their bearing surfaces drains back to the crankcase such that these surfaces may become essentially dry. The following program is employed at Peach Bottom to minimize bearing wear associated with engine starting:

1. All routine diesel generator starts are preceded by a three-minute engine prelube period, including starts for surveillance testing and for routine plant operations such as carrying the emergency busses while swapping offsite feeds. The three-minute prelube period allows sufficient time for the oil to coat all crankshaft and turbocharger bearings while not filling the cylinder liners above the upper piston and precipitating a hydraulic lock. This procedure is in conformance with the manufacturer's recommendations.
 2. Each diesel generator is exercised on an approximately weekly basis to ensure that sufficient oil film is present on the bearing surfaces in the event of an emergency start, when the prelubrication cycle is bypassed.
 3. The capability of the diesels to respond to an emergency start signal from both a loss of offsite power (undervoltage condition on either associated 4kV bus) and a LOCA signal - without engine prelube - is verified during each refueling outage. Assuming satisfactory completion of the appropriate surveillance test procedures, this practice restricts the number of cold engine starts to two on each engine per plant operating cycle.
- B. Keepwarm Systems - The diesel generators are equipped with both a standby lube oil warming system and a standby engine jacket coolant warming system, which continuously operate when the diesel is shut down. The standby lube oil warming system maintains the temperature of the oil in the engine sump above 125 F to reduce the oil viscosity and therefore supply oil to moving parts earlier in the startup transient. The standby jacket coolant warming system circulates water through the engine passages to maintain the engine block above ambient temperatures, such that thermal gradients and consequent mechanical stresses are reduced during the engine warmup period. The jacket coolant temperature is restricted to between 105 F and 110 F, such that the viscosity of the residual lubricating oil film on the engine moving parts is not degraded, yet the engine temperature is still maintained above ambient.

Failure of either the standby lube oil or the standby jacket coolant warming system is alarmed at the local control panel and also actuates the common diesel generator trouble alarm in the control room.

- C. Annual Inspection Program - Each diesel generator is subject to a thorough maintenance program which includes both periodic routine inspections and comprehensive examinations. Each diesel generator is disassembled, inspected, and overhauled as necessary on an approximately annual basis, timed to coincide with a refueling outage on one unit. The inspection focuses upon those areas known to be subject to operational degradation, such as valves, bearings, crankshafts, and other moving parts. Those components which are known to experience wear as a result of engine starting are examined in detail. A representative of the manufacturer is brought on site to provide technical guidance during this work.

The above program has an excellent track record at Peach Bottom. In the life of the plant, there has not been one diesel generator failure attributed to "cold fast starts". Neither has any significant operational degradation resulting from a lack of prelubrication been observed during either surveillance testing or the annual diesel inspections.

PECo believes that the existing diesel testing and maintenance programs at Peach Bottom adequately address the subject of reducing the number of cold fast starts.

Request 2:

2. Diesel Generator Reliability Data

This item requests licensees to furnish the current reliability of each diesel generator at their plant(s), based on surveillance test data. Licensees are requested to provide the information requested below.

The reliability of diesel generators has been identified as one of the main factors affecting the risk of core damage from station blackout. Thus, attainment and continued maintenance of high reliability for diesel generators is necessary to the resolution of USI A-44. To assist the staff in assessing the current reliability of diesel generators at operating plants, licensees are requested to report the reliability of each diesel generator at their plant for its last 20 and 100 demands. This should include the number of failures in the last 20 and 100 demands indicating the time history for these failures. Licensees are requested to indicate whether they maintain a record which itemizes the demands and failures experienced by each diesel generator unit, in the manner outlined in Regulatory Guide 1.108 position C.3.a, for each diesel generator unit. Licensees should also indicate whether a yearly data report is maintained for each diesel generator's reliability. The criteria for determining the reliability of diesel generators is as follows:

- a. Valid demands and failures are to be determined in accordance with the recommendations of Regulatory Guide 1.108 position c.2.e.
- b. The reliability of each diesel generator will be calculated based on the number of failures in the last 100 valid demands.

Response 2:

Diesel Generator Reliability Data

As requested in the generic letter, the current reliability for each diesel generator for its last 20 and 100 demands is presented below. All data is prior to August 1, 1984:

| <u>Diesel Generator</u> | <u>LAST 20 STARTS</u> | | <u>LAST 100 STARTS</u> | |
|-----------------------------|-----------------------|--------------------|------------------------|--------------------|
| | <u>#Failed</u> | <u>Reliability</u> | <u>#Failed</u> | <u>Reliability</u> |
| E1 | 0 | 100% | 0 | 100% |
| E2 | 0 | 100% | 0 | 100% |
| E3 | 0 | 100% | 1** | 99% |
| E4 | 0 | 100% | 0 | 100% |

** D.G. #E3 was removed from service for five days on 9/7/83 due to turbocharger failure.

The data above shows a very high degree of reliability for the Peach Bottom diesel generators. However, the limited sample presented in the above data does not accurately reflect the long-term consistently high reliability they have demonstrated. For this reason, each diesel generator's individual lifetime records and their current 2 1/2 year averages are presented below:

| <u>DG</u> | <u>LIFETIME</u> | | | <u>2 1/2 YEAR AVERAGE</u> (Ending 8/1/84) | | |
|-----------|-----------------|----------------|--------------------|--|----------------|--------------------|
| | <u>#Failed</u> | <u>Demands</u> | <u>Reliability</u> | <u>#Failed</u> | <u>Demands</u> | <u>Reliability</u> |
| E1 | 5 | 725 | 99.31% | 1 | 186 | 99.46% |
| E2 | 5 | 733 | 99.32% | 0 | 191 | 100% |
| E3 | 3 | 708 | 99.58% | 1 | 178 | 99.44% |
| E4 | 7 | 701 | 99.00% | 0 | 164 | 100% |
| | <u>20</u> | <u>2867</u> | <u>99.30%</u> | <u>2</u> | <u>719</u> | <u>99.72%</u> |

As shown, Peach Bottom's four diesel generators have started and sustained load successfully for all but 20 tests in over 2800 demands. Further, they have averaged more than 140 successful tests between failures.

NRC Regulatory Guide 1.108, Revision 1 establishes a reliability goal of 99% at a nominal 50% confidence level. All four of Peach Bottom's diesel generators have lifetime records which meet this goal. At 50% confidence level, the diesels have demonstrated a collective 99.2% lifetime reliability. Even this excellent record has improved in recent years.

Since January 1, 1982, the PBAPS diesel generators have demonstrated greater than 99% reliability with a 93% confidence level. This surpasses the NRC 50% confidence level goal by a substantial margin.

The above data was generated from the records of the diesel generator surveillance tests and from meeting minutes and Licensee Event Reports maintained in the plant archives. Philadelphia Electric Company believes that our in-house programs of Nuclear Plant Reliability Data (NPRD) and Nuclear Records Management (NRM) adequately maintain reliability data for each of the diesel generators at Peach Bottom.

Request 3:

3. Diesel Generator Reliability

Licensees are requested to describe their program, if any, for attaining and maintaining a reliability goal for their diesel generators. An example of a performance Technical Specification to support a desired diesel generator reliability goal has been provided by the staff. Licensees are requested to comment on and compare their existing program or any proposed program with the example performance specification.

In the staff's ongoing program to resolve USI A-44, Station Blackout, diesel generator reliability is one of the factors used to determine the length of time a plant should be able to cope with a station blackout. If all other factors are constant, the higher reliability of the diesel generator will result in the lower probability of a total loss of AC power. Maintaining diesel generators at or above specific reliability levels is assumed in the development of the resolution of USI A-44. The reliable operation of diesel generators should be assured by a reliability program designed to monitor, improve (if necessary), and maintain reliability at a specified level.

In view of the above, licensees are requested to describe their diesel generator reliability improvement program, if any, for attaining and maintaining a reliability goal. The program description should address the surveillance and testing the licensee performs to demonstrate the selected diesel generator reliability. All licensees have received the staff's previous letter transmitting the findings of NUREG/CR-0660, "Enhancement of Onsite Emergency Diesel Generator Reliability, February 1979" identifying areas where

diesel generator operational problems were occurring in general. Licensees should consider the recommendations of NUREG/CR-0660 in their reliability program. The staff has developed an example for a diesel generator performance Technical Specification to support the maintenance of diesel generator reliability at a specified level. The proposed performance specification encompasses certain aspects of the existing requirements for surveillance testing of diesel generators stipulated in Regulatory Guide 1.108 and the qualitative recommendations of NUREG/CR-0660. This performance specification is presented, as an example, in the attachment to this enclosure. Licensees are requested to comment on and/or compare their program with the performance specification and provide comments for staff consideration in finalizing surveillance testing requirements for diesel generators.

Response 3:

PBAPS Diesel Generator Reliability Program

The excellent reliability history of the Peach Bottom diesel generators could not have been achieved or maintained without a comprehensive reliability program involving many PECO operations, maintenance, and engineering personnel. This program falls into four major categories, and is discussed in detail below:

- A. Maintenance - In addition to the annual inspection program described in Response 1.C., above, an aggressive preventive maintenance program has been implemented at Peach Bottom. The program reflects consideration of the manufacturer's recommendations, in-house experiences during the ten years of Peach Bottom operation, and consideration of the applicable industry-wide experiences. In addition, routine observation of engine operating parameters facilitates evaluation of any deviation from the expected norm, and corrective action if any problem or perceived weakness is detected.
- B. Operations - The diesel generators are operated in accordance with documented procedures that reflect the requirements of the plant Technical Specifications, the Final Safety Analysis Report, in-house operating experiences, manufacturer's recommendations and applicable industry-wide experiences. The procedures incorporate routine inspection requirements and proper startup, normal operation and shutdown requirements.

Diesel generator reliability is demonstrated through comprehensive surveillance tests requirements that consist of the following:

1. A full-load test is conducted on each diesel generator on a monthly basis in conformance to the plant Technical Specifications. The diesels are prelubed, verified to have started and reached required speed and voltage within the proper time (10 seconds), synchronized to the grid with the governor in droop mode, gradually loaded to the DEMA continuous rating, and operated for at least one hour so that steady-state pressures and temperatures are reached. Operating data is recorded during these tests as an aid in detecting potential problems.

In the event that one diesel is inoperable, this test is conducted daily as required by the plant Technical Specifications, except that each of the remaining diesels is operated parallel to the grid for one half hour.

2. Each diesel generator is exercised on an approximately weekly basis, as discussed in Response 1.A.2, above. In order to provide positive assurance of continued reliability, a complete full-load test as discussed above is used for this exercise.
3. The capability of the diesel generators to start automatically upon receipt of a LOCA signal with coincident LOOP is verified once per refueling outage for each unit. The diesel generators are not prelubed for this test. The test also verifies the capability of the diesel generators to accept the design accident loading sequence at the proper time intervals.
4. The capability of the diesel generators to respond to an undervoltage condition on the associated 4kV busses is verified separately for each bus during the corresponding unit refueling outage. In this test, the diesels are started without prelude once for each offsite feed.

The results of each of these tests are documented and stored in the plant permanent records. If a test is failed, or review of the operating data indicates a deviation from expected values, the root cause of the problem is determined and appropriate corrective actions are taken. These corrective actions are also documented in the plant permanent records.

- C. In-House Reviews of Operating and Maintenance Experiences - The Peach Bottom Maintenance Engineer and his staff monitors the failure rates and causes for the diesel generators and other plant equipment in order to identify the need for additional investigations and/or corrective actions.

This practice has proven to be an effective means of identifying the need for special attention to developing problems with the diesel generators. Examples of this are discussed below:

1. At least two of the Peach Bottom failures occurred due to the misalignment of diesel skid-mounted auxiliary system valves. Investigations determined that more detailed Piping and Instrumentation Diagrams were needed to enable the operators to accurately and consistently perform necessary operations. As a result of this determination, each diesel auxiliary system was inspected and appropriate controlled drawings were developed.
2. Degraded diesel performance was experienced at Peach Bottom due to governor malfunctions. Governors of an improved design were procured and retrofitted to the Peach Bottom diesels.
3. Problems were experienced at Peach Bottom with the air start control valves. Investigations indicated that these malfunctions were due to particulate contamination of the starting air. Specially designed, particulate-immune valves have been installed which eliminated this concern, and also the potential for problems associated with diesel air start systems discussed in NUREG/CR-0660.

D. Engineering Reviews of Industry-Wide Operating Experiences

PECo keeps apprised of operating experiences throughout the nuclear power industry by using appropriate sources of information. NRC Inspection and Enforcement Bulletins, Circulars, and Information Notices are reviewed for applicability to Peach Bottom, and the results of these reviews including any appropriate corrective actions are permanently documented. In addition, relevant INPO Significant Event Reports and Significant Operating Experience Reports, NRC Licensee Event Reports, NUREG's, and EPRI reports are reviewed by cognizant engineering and operations personnel. If these reviews indicate a potential problem at Peach Bottom, appropriate corrective actions are taken. Recent examples of PECo consideration of reported diesel generator problems are presented below:

1. The E.I. Hatch plant experienced repeated failures of their upper crankshaft bearings. Hatch prelubricated their engines for only one minute prior to each test start, whereas the manufacturer recommended a three minute prelude. PECo confirmed that the design and procedures for the operation of the Peach Bottom emergency diesels utilize the recommended three minute prelude cycle.
2. The Dresden plant experienced failures of diesel generator cooling water check valves. PECo maintenance procedures have been revised to require that all valves in similar service at Peach Bottom are disassembled and rebuilt during the overhauls of each diesel generator.
3. A control logic problem at Millstone and North Anna prevented automatic restart of the diesel generators for a period of time following engine shutdown. If an emergency start signal was present, starting air would continue to be fed into the cylinders, and air start system depletion would result. The control logic design for the Peach Bottom diesels has been reviewed by PECo, and it has been determined that an analogous problem could develop. Modifications are currently being implemented at Peach Bottom to rectify this concern.

The above program has served well to ensure the reliability of the Peach Bottom diesel generators without the need for a "Performance Technical Specification" as suggested in Enclosure 3 to the subject Generic Letter.

Comments on the Proposed Technical Specifications

PECo has reviewed the example Performance Technical Specification, and provides the following specific comments:

1. Statistical Treatment - The sample Technical Specification proposes that action be taken based on the reliability of the diesels for their most recent 100 demands. The reliability $(1 - (\#fail/\#test))$ is simply a point estimate. In order for reliability to be meaningful, the "confidence level" must be expressed as well. Statistical confidence describes the probability that an estimate will fall within specific bounds. Regulatory Guide 1.108 cites a reliability goal of 99% at a nominal 50% confidence level. For a normal distribution over a range of 20 or 100 starts it is not possible to maintain a 99% reliability with anything less than a perfect record; e.g., one failure in 100 starts at 50% confidence yields a reliability lower limit of 98.3%.

Thus, to be consistent with Reg. Guide 1.108, 50% confidence level, 5 failures in 100 should be expressed as a minimum reliability of 93.5% at 50% confidence, and ten failures in 100 should be expressed as minimum reliability of 88.0% at a 50% confidence level.

2. NUREG/CR-0660 - This document makes qualitative recommendations on the design and operation of the diesel generators. Each of the recommendations has been addressed by PECO and those applicable to Peach Bottom have been incorporated. Therefore, a remedial action program which requires the evaluation of NUREG/CR-0660 items would not be appropriate for inclusion in the Plant Technical Specifications.
3. Reporting Requirements - The comprehensive reporting requirements delineated in Attachment 1 to the sample Technical Specification would be an unnecessary burden on plants which have excellent reliability histories such as Peach Bottom. In light of the demonstrated effectiveness of the reliability program already in

place at the station, PECO feels that the imposition of these requirements would not be warranted. The resulting manhour expenditures required to institute such a program would not result in any increase in plant reliability or any increase in the safety or well being of the general public.

4. Diesel Generator Testing with ECCS Subsystems Out of Service - PECO agrees with the Commission's position to delete the existing Technical Specification requirements for extra diesel generator surveillance testing when subsystems of the emergency core cooling system are out of service. Peach Bottom Technical Specifications do not require frequent diesel generator testing with ECCS subsystems out-of-service.
5. Reduction in Surveillance Tests - PECO recommends that a significant reduction in the number of surveillance tests be achieved by changing the eight-hour requirement in sample Technical Specification 3.8.1.1 to 24-hour intervals. Additional reductions in diesel generator surveillance test starts could be achieved by specifically allowing credit for post-maintenance operability testing and actual demands placed on the diesel generators outside the "staggered test basis" of Table 4.8.1, provided the specified intervals are not exceeded.
6. Plant-Specific Test Frequencies and Out-of-Service Times - The proposed sample Technical Specifications appear to have been written for a plant with only two diesel generators. The test frequencies and allowable out-of-service times were based on this supposition. This does not account for plants with alternate configurations (e.g., the four diesel generators at Peach Bottom) which may provide increased capability to mitigate the consequences of an accident. PECO recommends that the allowable time intervals for each of the scenarios discussed in the sample Technical Specifications be proposed by the licensee, based on previous reliability, experience, and plant-unique safety analyses.
7. Root-Cause Determination - PECO recommends that each failure report be required to contain a failure analysis and evidence that the root cause was identified and corrected. Blanket requirements for extra surveillance testing should only be invoked when the root cause cannot be determined. Such testing does not increase the reliability of the diesel generators, nor does it

indicate statistically that reliability is increased. This testing will only cause further wear and degradation of the engines, as well as providing a sense of false security.

For example, a failure to start or accept load due to the failure of an electrical relay contactor, caused by dust or corrosion, will not be proven to be resolved by an additional seven successful starts over a short period of time. In this case a program to monitor and correct the contactor problem would be of more benefit than additional diesel generator surveillance testing. If the problem with the relays was traced to another source such as an internal failure, then a component-specific requalification program addressed solely to the electrical relays would be more appropriate.

8. Testing of Remaining Diesel Generator Units - PECO interprets the sample Technical Specification to read that in the event of a failure on a specific diesel generator unit, then only that unit would be subject to the increased testing requirements. This is a change from the existing Standard Technical Specifications, which uses the number of failures on a per nuclear unit basis to determine diesel surveillance test frequencies. PECO agrees that this would reduce wear and degradation of the remaining units, and supports its implementation for those plants operating under the Standard Technical Specifications.

Conclusion

It is PECO's position that the existing Peach Bottom reliability program meets the intent of the Commission's proposed "Diesel Generator Increased Reliability Program", the existing requirements of NRC Regulatory Guide 1.108, and the recommendations of NUREG/CR-0660. The existing station programs for operation and preventive maintenance, coupled with routine observation of engine operating parameters and immediate corrective action when problems occur, have resulted in an outstanding reliability record in the ten years of Peach Bottom operation. Specifically, this program has eliminated cold fast starts as a concern at Peach Bottom. Based upon this proven history, the proven design of the diesel generators, and the existing comprehensive surveillance test program, PECO is confident that the Peach Bottom diesel generators will continue to provide the

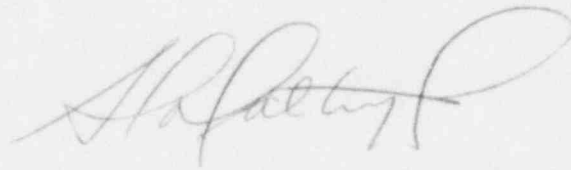
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exceptionally high reliability throughout the remaining life of the plant.

If you require any further information, please do not hesitate to contact us.

Very truly yours,

A handwritten signature in cursive script, appearing to read "A. R. Blough". The signature is written in dark ink and is positioned to the right of the typed name.


Attachment

cc: A. R. Blough, Site Inspector
Document Control Desk

COMMONWEALTH OF PENNSYLVANIA :
: SS.
COUNTY OF PHILADELPHIA :

S. L. Daltroff, being first duly sworn, deposes and
says:

That he is Vice President of Philadelphia Electric
Company; that he has read the foregoing response to Generic
Letter 84-15 relative to Peach Bottom Units 2 and 3 and knows the
contents thereof; and that the statements and matters set forth
therein are true and correct to the best of his knowledge,
information and belief.



Subscribed and sworn to
before me this 2ND day
of November 1984

Patricia D. Scholl

Notary Public

PATRICIA D. SCHOLL
Notary Public, Philadelphia, Philadelphia Co.
My Commission Expires February 10, 1986