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Before the Atomic Safety and Licensing Board

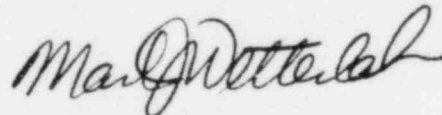
In the Matter of)
)
Philadelphia Electric Company) Docket Nos. 50-352
) 50-353
(Limerick Generating Station,)
Units 1 and 2))

APPLICANT'S REPORT REGARDING THE INVOLVEMENT
OF PHILADELPHIA ELECTRIC COMPANY MANAGEMENT
IN ASSURING THE QUALITY OF WELDING AT
LIMERICK GENERATING STATION

Pursuant to the Atomic Safety and Licensing Board's Memorandum and Order Confirming Rulings Made at Prehearing Conference (October 28, 1983) (slip op. at 7) (see also Tr. 5840), I am transmitting Applicant's "Report Regarding the Involvement of Philadelphia Electric Company Management in Assuring the Quality of Welding at Limerick Generating Station."

Respectfully submitted,

CONNER & WETTERHAHN, P.C.



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January 6, 1984

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I. Introduction

This report responds to the Atomic Safety and Licensing Board Memorandum and Order Confirming Rulings made at Prehearing Conference dated October 28, 1983 (Slip op. at 7).

The Applicant and NRC Staff were requested to set forth how they assure themselves for Limerick that welding and welder qualification, and inspections thereof, meet the design criteria and welding codes, including particularly how it is assured that non-qualified welders are not qualified by fraud as has apparently occurred elsewhere despite the presumed existence of a QA program. TR. 4895-99, 4902-04. The Applicant will file a report supplying this information about a month after the prehearing conference, and the Staff will file its information report about two weeks after the Applicant's report. TR.4919.

This report describes the management policy of Philadelphia Electric Company and its contractor, Bechtel Power Corporation, relating to quality and how these policies have been implemented in the design and construction of Limerick Generating Station, with particular emphasis on welding-related activities. The report describes both companies' welding experience and expertise and how the quality assurance program combines the talents of both to provide a high quality welding program which meets all regulatory, code and Safety Analysis Report requirements.

The quality assurance program utilizes three levels of design verification, each of which will be described in this report. Philadelphia Electric Company is the third level of review and verifies that Bechtel's design work results in

clear instruction to the Bechtel construction forces. The construction forces' application of these instructions, in the actual welding at Limerick, is also subject to a three-level verification program. Philadelphia Electric Company is again at the third level to assure that the welding is being performed and inspected in accordance with the requirements of the welding program. All three of these levels and how they interact are also discussed.

The report also describes the controls used in hiring and testing welders to assure that only qualified craftsmen are assigned the important task of welding.

From a management perspective, the report describes how the design verification, inspection, surveillance, auditing and evaluation has enabled Philadelphia Electric Company to maintain control over the welding activities to assure the achievement of a high quality end product.

II Philadelphia Electric Company's Management of the Limerick Welding Quality Program

1. Philadelphia Electric Company's Management Philosophy

Philadelphia Electric Company is a nuclear-oriented utility. The Company is an industry leader in the utilization of modern types of generating equipment. The Company led the industry in implementing high pressure and high temperature fossil fueled units which required the development of expertise in welding. The Company entered the nuclear era in 1959 with the commitment to build and operate Peach Bottom Unit 1, a high-temperature, gas-cooled reactor. Peach Bottom 2 and 3 (1100 megawatt, twin boiling water reactors) went into service in 1974 and have set domestic industry records for performance.

An indication of Philadelphia Electric Company's commitment to quality is its development for Limerick Generating Station of a graded quality program that applies to systems and components beyond those which are required by regulation to be covered. This graded program covers Balance of Plant systems (BOP) such as radwaste and other nonsafety systems which interact with safety systems. Another indication of the Company's commitment to quality is its utilization of modified quality assurance programs for design and construction of certain nonnuclear facilities.

Philadelphia Electric Company recognizes that in addition to assuring safe operation, a quality assurance program is cost effective and strongly supports its program as a means of reducing costly corrective measures through prevention, rather than subsequent detection.

2. Philadelphia Electric Company's Quality Goals

Philadelphia Electric Company's experience in nuclear power at Peach Bottom has provided the basis upon which the Company has built in establishing and implementing a quality assurance program for Limerick Generating Station. The Company realizes that the high reliability which is being achieved at Peach Bottom is the result of the high quality standards that the plant was required to meet during construction, and which continue to be met now that the plant is operational.

The high quality standards to which Peach Bottom was designed and constructed were developed through good engineering practices. The regulations in effect at the time were not as stringent and did not require the same level of quality assurance as today's regulations. The revised regulations regarding quality assurance and the industry wide improvement of quality techniques have led to the present sophistication in quality assurance programs. Because of Peach Bottom and Limerick, Philadelphia Electric Company has been in-

volved in the maturation of quality assurance. At Peach Bottom the Company learned the value of quality assurance through the problems it encountered and the resolutions it worked out. The Company has always been committed to high quality standards and, because of its experience at Peach Bottom, has committed itself to utilizing a strong quality assurance program to attain these high standards at its nuclear facilities.

In an effort to provide continuity and to assure that the lessons learned at Peach Bottom could be effectively taken into account at Limerick, Philadelphia Electric Company contracted with Bechtel Power Corporation, the Architect-Engineer for Peach Bottom, to design and construct the Limerick Generating Station.

Bechtel formed the nucleus of its Limerick project team with experienced people from the Peach Bottom team. For example, the Lead Field Welding Engineer at Peach Bottom and several of his staff continued in their same positions at Limerick. Similarly, the team of project engineers, which is responsible for design, was also formed with experienced individuals from the Peach Bottom team. As a result of this continuity, Philadelphia Electric Company has developed an effective working relationship through which the Company has established that Bechtel Power Corporation is aware of, and shares in its commitment to high quality standards.

This commitment is reflected in Bechtel's design and construction work at Limerick.

3. Philadelphia Electric Company's Welding Expertise

Philadelphia Electric Company has in-depth experience and expertise in welding and welding-related activities in both nuclear and fossil plants. The Company employs degreed metallurgists in both the Engineering and Research and the Electric Production Departments. These individuals have achieved and maintain their qualifications through formal training in various universities, industry seminars, and through years of working experience.

Engineering and Research Department is the organization responsible for the design and construction of the Company's power plants. Electric Production Department is responsible for the operation and maintenance of the plants. Although the two departments have distinct duties, the knowledge gained from performing them is shared. This is especially true in the metallurgical area. The Company has established a Materials Engineering Group (MEG) composed of engineers and metallurgists from both departments, along with a consultant metallurgist. MEG meets on a regular basis to discuss material and welding technologies and to address particular concerns which may arise. This group

is available to any Company engineer who needs metallurgical assistance in resolving a problem.

To support Philadelphia Electric Company's efforts in the welding area, the Company has an established metallurgical laboratory. The laboratory is staffed by experienced metallurgical engineers and technicians. They have participated in material selection and metallurgical problem analysis. In addition to the metallurgical laboratory staff, Philadelphia Electric Company has Nondestructive Examination technicians who are qualified to SNT-TC-1A requirements and several qualified welding inspectors. To supplement these in-house capabilities, several area firms and recognized experts in the field are under contract with the Philadelphia Electric Company for assistance and consultation in welding.

Within the Company's quality assurance organization many of the individuals are graduate engineers and registered as Professional Engineers. Several of the key individuals are AWS Certified Welding Inspectors. This quality assurance organization is in close contact with the Company's metallurgists for technical consultation and assistance. The quality assurance organization uses the Company's metallurgical laboratory for chemical and physical property tests on materials as part of the performance of audits to determine the quality of materials.

The broad range of experience and integration of welding knowledge enable the Company to properly monitor the welding performance at Limerick.

4. Philadelphia Electric Company's Participation in Codes and Standards Activities

Philadelphia Electric Company supports technical organizations both financially and through manpower support and membership. These technical organizations establish the codes and standards applicable to much of the design and construction of nuclear plants. By being active in these organizations, the Company provides itself the opportunity to remain knowledgeable in the industry practices and technologies.

Within the Engineering and Research Department, many individuals participate in technical committee work such as the ASME Boiler and Pressure Vessel Main Committee and its Subcommittee and Subgroups. In the welding area, the Company's Level III Nondestructive Examiner has been active in the American Society for Nondestructive Testing (ASNT) for most of his career. He is past National President and member of the Board of Directors of ASNT. Other organizations in which the Company participates are: American Society of Mechanical Engineers (ASME), Edison Electric Institute (EEI), American Welding Society (AWS), American Nuclear Society (ANS), American Society of Quality Control

(ASQC), Institute of Electrical and Electronic Engineers (IEEE), Electric Power Research Institute technical groups (EPRI), and Boiling Water Reactor Owners' Group (BWROG).

5. Philadelphia Electric Company Direction to Bechtel Power Corporation regarding Welding Requirements

Philadelphia Electric Company contracted with Bechtel Power Corporation to design and construct Limerick Generating Station because of its expertise, manpower, and commitment to quality. Philadelphia Electric, in accordance with the quality assurance program, oversees all aspects of Bechtel's work to continue to assure that high quality standards are being met. The overall quality assurance requirements of the Limerick Project were established by Philadelphia Electric Company management at the beginning of the project and have been updated and emphasized on an as-needed basis. Bechtel Power Corporation was directed to incorporate these quality requirements into its quality assurance program.

The quality assurance program, as it pertains to welding design, consists of three levels. At the first level, Bechtel prepared specifications, drawings, procedures and inspection plans to include all applicable regulatory, code and Safety Analysis Report requirements. The preparation of these design docu-

ments is closely coordinated so that collectively the documents form an effective welding program which provides the construction forces clear and detailed instructions. The second level consists of a design verification by individuals or groups within Bechtel, other than those who performed the original design. The scope and depth of this design verification by Bechtel is detailed in its quality assurance manuals which meet the Philadelphia Electric Company imposed requirements.

The third level is performed by Philadelphia Electric Company. At this stage, Bechtel's work is reviewed to assure that the welding program meets all the company's quality requirements. The review is performed by Company engineers who have access to the Material Engineering Group for consultation. Through this review the Company not only verifies that the design and regulatory requirements have been met, but also applies its welding experience to recommend improvements in the welding program. Examples of these recommendations which have been adopted include:

- Directing Bechtel to control all weld filler metal on site, both safety and nonsafety-related, to prevent the misuse of uncontrolled material in safety-related systems.

- Directing Bechtel to utilize marked up drawings to scope and keep account of individual structural weld inspections. This is beyond code and regulatory requirements which would allow for one inspection record to be utilized for several welds without uniquely identifying each weld.
- Directing Bechtel not to use backing rings on flued head-to-penetration welds; the use of these backing rings has caused problems in performing nondestructive examinations at other plants.

The following is a list of weld-related documents which are prepared, reviewed and approved by Bechtel Power Corporation and then reviewed and approved by Philadelphia Electric Company:

Welding Specifications
Welding Procedures
Welding Filler Material Requirements
Nondestructive Examination Procedures
Selection of Nondestructive Testing Subcontractors
On-Site Welding Administrative Controls
Welder Qualification Procedures
Weld Filler Material Controls
Welding Inspection Plans

The three-level verification program applies not only to original design, but to any subsequent changes which come in the form of revisions.

The combined efforts of Philadelphia Electric Company and Bechtel Power Corporation in the preparation, review and approval of the above documents, result in a high degree of quality in welding-associated activities. And as described later, the multi-tiered program of inspection and auditing has confirmed this conclusion.

III. Bechtel Power Corporation's Management of the Welding Quality Program at Limerick Generating Station

1. Bechtel Power Corporation's Management Philosophy

Bechtel practices the philosophy, and reinforces it through its programs, that quality assurance is initially a function of the group performing the work and not the sole responsibility of a separate quality assurance group.

The Limerick Bechtel Project Manager implements the policies of the Quality Assurance Program at Limerick Generating Station through the project team organization which performs the engineering, procurement, construction and quality assurance functions.

Recognizing the importance of welding in nuclear power plants, a separate independent department, Material and Quality Services (MQS) is responsible for providing direction on all facets of welding.

The quality of welding at the Limerick Generating Station is achieved through the use of skilled personnel, advanced planning, procedures, proper definition of job requirements, and appropriate supervision and technical direction. Quality is verified through surveillance, inspection, testing, checking, and review of work activities and documentation. Quality verifica-

tions are performed by individuals who are not directly responsible for performing the work activity.

2. Bechtel Quality Assurance Program Implementation

The welding requirements of safety-related structures, systems and components at the Limerick Generating Station are in accordance with the Bechtel Quality Assurance Program as described in the Limerick Generating Station Application. The design and construction quality assurance program meet the requirements established by Philadelphia Electric Company.

The Limerick Nuclear Quality Assurance Manual (NQAM) incorporates the Philadelphia Electric Company quality assurance requirements and provides detailed instructions to the Bechtel Limerick Project Team to implement these requirements. The NQAM, therefore, contains the requirements of the Quality Assurance Program to be followed by all Bechtel entities involved in the Limerick Generating Station. Safety-related welding activities are performed within the requirements of the NQAM.

ASME pressure retaining and component support welding is performed within the requirements of the NQAM and the Bechtel Quality Assurance Manual (BQAM). The BQAM is a more detailed subtier document to the NQAM which implements specific requirements of the ASME Code.

3. Bechtel Past Experience as Base for Goals

Bechtel has been involved in nuclear power plant engineering and construction from the inception of the nuclear power industry and has participated in engineering, procurement or construction activities in approximately 40 percent of the domestic power plants either in operation or under construction. The experience gained in these activities is factored into engineering specifications, QA programs, welding procedures and construction methods.

This is further supplemented by special centralized service organizations such as M&QS which has a staff of technical experts to assure that Bechtel remains current in welding technology. M&QS is a department of approximately 125 professional personnel representing a total of approximately 2100 man-years of experience in such disciplines as welding engineering, construction welding, metallurgy, materials selection, corrosion, and nondestructive examination.

4. Bechtel Welding and Weld Quality Requirements

M&QS has the responsibility for qualifying and preparing all Bechtel welding procedures and maintains a laboratory to perform these qualifications. All Bechtel welding procedures used on nuclear power plant construction are prepared by M&QS, approved by the Manager of M&QS and the Manager of Engineering, Bechtel

Power Corporation. The specifications and procedures for welding, qualifying welders, controlling weld metal, etc., for use at Limerick Generating Station are concurred with in a joint review by Engineering, Construction and M&QS. Philadelphia Electric Company maintains control over these activities by reviewing and approving these specifications and procedures. The list of approved specifications and procedures to be used are then transmitted to the jobsite. Construction cannot deviate from the welding specifications without completing the entire review and approval cycle for their proposed revision. M&QS furnishes the NDE procedures to be used by Bechtel personnel after the same review and approval as described above. M&QS also reviews and approves NDE contractor procedures for use on the jobsite and is responsible for testing and certifying all Bechtel NDE personnel on the jobsite to the requirements of the applicable codes.

5. Bechtel Participation in Codes and Standards Activities

Bechtel has been a leader in the industry in recognizing the importance of participating in, and supporting, the activities of various code bodies. This participation exists in all disciplines within Bechtel. There are several hundred people participating in these codes and standards activities. This involvement in code regulated work promotes an awareness and understanding within Bechtel of the current positions of the code

committees on important matters relating to the industry and provides an opportunity for Bechtel to initiate any required actions to clarify requirements, correct deficiencies or ambiguities, and to update requirements to reflect improvement in welding technology.

IV. Integration of Goals and Philosophy into Limerick Generating Station Welding Program

1. Design Practices

Welded joint designs at Limerick may be classified into two basic types, structural and pressure retaining. In general, structural welds are made in accordance with the AISC specifications and the AWS codes. Pressure retaining welds are made in accordance with the ASME code. Early in the design process, the applicable codes are determined for each structure, system, and component. The design process utilizes the requirements and guidelines given in these codes and specifications.

Structural welds are specified to carry the design load of the connecting members. Pressure retaining welds are designed to develop the strength of the adjacent base material.

The welds specified are larger than those theoretically required to transfer the actual loads. Some of the factors contributing to this margin are described below:

- (1) Simplification of the welding requirements on design drawings (e.g. an "all around" weld is specified when a partial weld would do),

- (2) Minimum sizes of welds are based on thickness of attached parts rather than on strength requirements (i.e. the minimum fillet weld size for pipes is defined to be $1.09 \times$ the nominal wall thickness of the piping).
- (3) For pressure retaining welds, joint efficiency factors may be assigned by the code dependent on the type of examination that the welds receive.
- (4) Calculated fillet weld sizes less than nominal are rounded off to the next larger nominal size rather than to the exact dimension required.

Factors of safety are used in the design of structures, systems, and components to cover a number of conditions such as: uncertainties in load definition, variations in material properties, approximations used in analytical methods and variations in construction.

Factors of safety are quite high in general, but are particularly high in design of welds. For example, even though weld metal has higher yield and tensile strength than the materials being joined, the stresses allowed in designing the connections are based on the strength of the connected material. In addition, the allowable stresses for the base material are small compared to the ultimate capacity of the material.

The use of the above factors in weld design helps to assure that the welds are able to withstand higher stresses than the structures, systems or components being joined.

2. Weld Procedures Development and Selection

Where the design dictates the use of welded connections, welding procedures that meet the design practices are prepared and qualified. M&QS is responsible for the preparation and qualification of all welding procedures used by Bechtel personnel on Bechtel jobsites.

The qualification tests are performed, in most instances, in the Bechtel Welding Engineering Laboratory. Bechtel maintains a large inventory of weld procedure qualifications covering a wide spectrum of materials, material combinations, thickness ranges, and weld processes. As new weld processes and materials are introduced, new qualifications are performed and new welding procedures developed accordingly.

In support of Engineering, M&QS reviews the welding requirements for a specific project which includes the material types, forms, and sizes involved and specifies the weld procedures which are permitted to be used on each application.

Engineering prepares project welding specifications that include the prequalified approved welding procedures. And as previously noted, Philadelphia Electric assures that all quality requirements are met by reviewing and approving the specifications including the welding procedures which are contained therein. These specifications and welding procedures are then transmitted to the jobsite and from this point on, no deviations are permitted without prior approval of Engineering and M&QS.

3. Limerick Welding Program Including Welder Qualification

The Limerick field welding program covers all aspects of the welding operation including specifying and ordering weld filler metal, control and distribution of all weld filler metal, testing and training of all welders, authorization to weld, in process inspections, field surveillance, problem solving, technical support, drawing review, final inspection, and record keeping and traceability systems.

Limerick Field Welding Engineering is responsible for providing on-site direction to construction personnel involved in welding activities. Field Welding Engineering is comprised of people with a broad mix of skills including graduate metallurgical and welding engineers, journeymen welders, and document control specialists. Presently thirty welding engineers repre-

sent a combined welding experience level of 514 years, of which 241 have been in the field of nuclear welding. That averages to seventeen years of welding experience per engineer, of which about one half is in nuclear welding. Sixty-six percent are journeymen welders, fifty-five percent are certified for Level II NDE examinations, and forty-three percent are AWS certified welding inspectors. This level of experience, combined with the availability of the Bechtel home office M&QS department, provides an efficient and experienced team to implement the Bechtel quality program.

The Limerick welder qualification program is designed to assure that only qualified welders are permitted to weld. The following describes the steps taken to preclude the possibility of "stand-ins" taking a welding test to qualify another person.

Upon arriving at the Limerick jobsite, an applicant for employment as a welder is directed to the timekeeper's office where a check of the union's referral is made. If the applicant is determined to be eligible for hire, a badge number is assigned. At this time the applicant fills out an employment record and must present his/her Social Security card and two other forms of identification.

When the above steps are complete, the applicant's photograph is taken and a picture badge is issued.

The applicant is then escorted to the weld test shop by the union steward. The weld test shop engineer checks the applicant's picture badge and fills out the "Welder Test Qualification Summary" and the "Welder Questionnaire". The applicant is then assigned a test booth and is given a copy of safety regulations, tool box inventory and work rules for the weld test shop, which he signs. The work rules, for which the applicant must sign, clearly state that he is the only person allowed in his assigned test booth and that any violations are cause for termination of his qualification testing and employment at Limerick.

The weld test shop engineer explains the welding procedure the applicant will use to take his test and then supplies the applicant with evaluation coupons which he must tack weld together. The test shop engineer evaluates the fit-up obtained during tack welding and, if satisfied, instructs the applicant to complete the welding of the evaluation coupons.

The test shop engineer closely monitors the applicant's performance and inspects the evaluation coupon weld after each layer of filler metal is deposited. The evaluation is terminated at any point where it is evident that the applicant is not capable of producing acceptable production welds. If the applicant is not capable, he/she is told so. Payroll is contacted to make ar-

rangements for his/her check, and the steward is called to escort the applicant off site.

All welder candidates must take this evaluation test prior to being permitted to begin their qualification testing. The evaluation test, which is beyond any code or regulatory requirement, precludes the possibility of an unqualified welder using false credentials. Even a welder with current qualifications from another Bechtel jobsite who makes application for employment at Limerick must complete all of the above steps including the evaluation test. If such an applicant successfully demonstrates his welding ability during the evaluation test, his qualifications are accepted.

If the applicant's evaluation coupon is acceptable, he/she is directed to begin the weld test. After clean check and fit up has been accepted on the test coupon, it is vibroetched for identification. The information etched includes the applicant's initials and craft number, the welding procedure used, the position, the date and the test shop engineer's initials and badge number.

The applicant proceeds with the test weld and the test shop engineer performs in process and final visual inspection of the welding. If all of the applicant's work is satisfactory to this point, nondestructive and/or destructive testing of the test coupon is performed for the final determination of the applicant's

ability. A successful applicant is then taken to the Field Welding Engineer's office to have his/her qualifications logged and receive his/her qualification book. The appropriate Superintendent is notified that the applicant is ready and the steward is called to take the applicant to the Superintendent.

Following assignment in the field, continued field surveillance also ensures that only qualified personnel are on the job. Random "badge checks" are performed regularly to verify that only authorized workers are on the job, and the individual performance of welders is monitored by their Superintendent. Poor performance will result in the Superintendent sending the welder back to the test shop for training and/or requalification.

The system of controlling the qualification of welders has been in effect at the Limerick jobsite throughout the years of construction, with additions and revisions from time to time to improve the system.

In conclusion, with the number of identification checks made at the time office, the forms and other information signed, the hours of personal contact with the weld test shop engineer, the precautions of identifying all coupons and the contact with other personnel in receiving their qualification book, the possibility of

a "stand-in" taking the test for an applicant is virtually nonexistent.

V. Verification of the Welding Quality Program's Implementation

1. Three-Level Verification Program

The three-level verification program mentioned earlier utilizes the defense in depth concept. Earlier, the three levels which assure that the Limerick design contains high quality standards were discussed. This section deals with the three levels of assuring that the construction is in accordance with the design.

The first level, defined as the quality control inspection function, is performed by Bechtel Power Corporation's quality control organization which is independent from the construction forces. Quality Control is responsible for assuring that the final end product meets the specified design requirements.

The second level, defined as the quality assurance surveillance function, includes the auditing and/or surveillance performed by Bechtel Power Corporation's quality assurance organization which is independent from the construction forces and Quality Control.

The third level, defined as the quality assurance auditing function, is performed by Philadelphia Electric Company's quality assurance organization which is entirely independent from all Bechtel organizations.

Philadelphia Electric Company performs quality assurance audits and surveillances to assure that the

quality assurance programs of the first and second level organizations are actually functioning as required. In addition, Philadelphia Electric Company reviews specifications, site procedures and other required documents furnished by Bechtel Power Corporation to assure that the necessary quality requirements have been incorporated in these documents.

The three organizational levels of the verification program, as they relate to welding at the Limerick Generating Station, are described below.

2. Bechtel Power Corporation Quality Control Weld Inspection Program

The purpose of the construction quality control program for inspection, examination and test control is to verify conformance of construction activities on welded safety-related structures, systems and components with the applicable requirements. This is accomplished by the use of quality control inspection instructions tailored for the Limerick project which specify the inspection activities required, the inspection criteria, and the method and frequency of the inspection activities. Construction Quality Control also provides documented evidence that the completed construction activities conform to the program requirements.

Quality of workmanship is monitored by Field Weld Engineering and Quality Control Engineering on an in-

process basis. Final visual examinations are performed by Bechtel Quality Control Engineers on safety related installations prior to submittal for Nondestructive Examination (NDE) operations. Upon an acceptable visual examination, the assigned Quality Control Engineer flags the component and initiates a Nondestructive Examination Request Form. This request form outlines the method of NDE to be performed, describes the component and its location and, if applicable, notes the welder who performed the work. This request form is submitted to Welding Quality Control where the supplied information is transferred onto an NDE Work Request Form and submitted for NDE.

Bechtel Welding Quality Control monitors and witnesses NDE operations performed by subcontractor personnel to assure NDE operations are performed on the correct items and within the parameters established by the applicable NDE procedures.

Bechtel Welding Quality Control Engineers witness 100 percent of the ultrasonic examination performed by the subcontractor and review 100 percent of the radiographic film submitted by the subcontractor for technique, film quality and component acceptability.

Bechtel Quality Control also assures that the proper welding instructions are given to the craft prior to the start of work. This is accomplished by reviewing

each weld joint field welding checklist which Field Welding Engineers prepare. Welding Quality Control Engineers review the checklists to assure entries by the Field Welding Engineers are correct and conform to the governing installation requirements. This in-line review requirement also serves to keep Quality Control aware of all new welding starts.

The inspections, examinations and tests performed by Construction Quality Control assure that the installation is in compliance with design specifications and compliance with the Bechtel Quality Assurance Program.

In addition, the Hartford Inspection Agency, acting as the Authorized Nuclear Inspector, also reviews inspection plans and establishes random inspection hold points for ASME Code-related welding. The authorized Inspector reviews 100 percent of the radiographic film on ASME installations. Hartford Authorized Nuclear Inspectors also observe welder performance qualification tests and review radiographic film on welder performance qualification tests for compliance to ASME Code requirements.

3. Bechtel Power Corporation Quality Assurance Weld
Quality Audit Program

A. Bechtel QA Program Steps

The activities associated with field welding on the Limerick Station are controlled by the Project Quality Assurance Program which has been evaluated, approved and monitored by Bechtel Quality Assurance Management, Philadelphia Electric Company and the applicable regulatory authorities (ASME and NRC). The Bechtel Quality Assurance Program for the construction of the Limerick Generating Station contains several methods which provide for the verification of the construction welding program by Quality Assurance. These methods include audit and monitoring of field activities by the Project Quality Assurance group and Management Audits of Quality Assurance.

1) Project Audits

Project audits are accomplished by the use of the Master Audit Plan (MAP) as a planning tool, which defines the frequency and scope of each audit area. Project audits are performed to cover each area annually or at least once within the life of a short term activity. Regularly scheduled audits are

supplemented with additional audits on an "as-needed basis".

The MAP for Limerick Project contains eight audit areas that specifically address welding activities and two audit areas that address nondestructive examination activities. One of these areas includes forty-two elements of verification of welding activities, which include filler metal control and distribution, welder qualification, Bechtel NDE personnel qualification, in process welding activities, welding procedures, weld repairs, Quality Control activities, post weld heat treatment, weld record documentation, and Quality Control inspector qualifications. In addition, the MAP includes the audit of subcontractors performing nondestructive examination of welds to verify their conformance with project requirements on the control of procedures and personnel qualifications.

Project audit reports, including all deficiencies noted during the audit and their scheduled completion date, are prepared and distributed to the responsible project management. All deficiencies are followed up and closed out by project quality assurance

personnel after verification of the audited organizations' response to audit findings.

2) Project Monitoring Activities

Monitoring activities are not intended to be as wide in scope as project audits, but are more in-depth, verifying the in-process controls. When determining the monitoring activities to be performed, previous monitoring and auditing results are considered. The monitoring activities cover applicable ongoing activities, utilizing construction and engineering schedules to determine the areas to be monitored and the frequency of monitoring. Monitoring includes checks for compliance to project quality program control requirements and the observance of inspection activities, reviewing records and checking work activities.

Deficiencies noted by Project Quality Assurance during monitoring activities are documented. The documented deficiency is transmitted to the applicable management entity for requested corrective action. Completed action is verified by Project Quality Assurance prior to closeout.

3) Management Audits

The project construction activities are audited by Bechtel Quality Assurance Management. The QA Management audit plan includes the audit areas of welding and nondestructive examination control. The QA Management Audit Team includes technical specialists from the M&QS support group who review project welding and nondestructive examination and related activities, in addition to QA auditors who review other project quality related activities. The welding related activities audited include welding process control, welding documentation control, welder qualification and weld filler material control.

At the completion of the QA Management audit, an audit report is transmitted to Philadelphia Electric Company and Bechtel Power Corporation project management. This report identifies all observed deficiencies which are documented as audit findings requiring corrective action. After completion of corrective action by the audited organization, quality assurance personnel verify that the action is complete and ade-

quate before the audit finding is considered closed.

4. Philadelphia Electric Company's Weld Audit and Evaluation Program

A. Philadelphia Electric Company's QA Program

Philadelphia Electric Company's third-level verification function of welding at Limerick is directed by management through Philadelphia Electric Company's Quality Assurance Program, for the design, construction and pre-operational phases of the project. This third-level function is accomplished by the performance of audits and surveillances which cover inprocess welding and the weld-related activity of the first two levels of the verification program. This audit and surveillance program provides assurance that welding activities are accomplished in a manner that meets the Federal regulations and the plant's design criteria and verifies that the first two levels of the program are effective.

These audits and surveillances are performed by members of Philadelphia Electric Company's quality assurance organization who are qualified to the requirements of ANSI N45.2.23. "Qualification of Quality Assurance Program Audit Personnel for Nuclear Power Plants". The scope and purpose of

audits are predetermined and written checklists are prepared to conduct the audits. The audits are conducted in accordance with the requirements of the implementing procedures of Philadelphia Electric Company's quality assurance program. The results of the audits are documented, reviewed and evaluated by the quality assurance organization and then forwarded to management for its review and action if necessary.

Surveillances are utilized by Philadelphia Electric Company as "mini-audits". As compared to audits, they are limited in scope, usually consisting of the verification of only one activity. As such, surveillances are very useful in the auditing process. An audit to cover an area such as welding may be scoped to verify weld rod control, welder qualification, welding technique, inspections, etc. If one of these areas is found to be deficient, a limited scope surveillance can effectively follow up on the identified area. Over 350 surveillances have been conducted throughout the course of the project.

B. Welding Audit and Surveillance Results

To date, Philadelphia Electric Company's quality assurance personnel have, on a planned and periodic basis appropriate to the status of the design

and construction activities, conducted over 1500 audits. Of these audits, over 400 have been scoped, either in total or in part, to cover welding and welding related activities. The results of these audits have confirmed that the first two levels of the quality program are working effectively to assure that Limerick Generating Station will be a safe and reliable plant. However, this does not mean that the audits have not identified areas that need improvement.

The lack of identification of such areas in an undertaking as large as the Limerick project would raise questions regarding the effectiveness of the audits. The same audit process that has identified such problems has also been used to verify that they have been satisfactorily resolved.

An example of the functioning of the audit process in the welding area was the identification by Philadelphia Electric Company's quality assurance organization of a matter requiring significant improvement; poor quality welding in the safety-related HVAC systems and components was recognized through numerous audit findings. The corrective actions necessary to resolve this matter consisted of strengthening the HVAC subcontractor's entire quality assurance program with particular emphasis in the area of inspections. Evaluation of the

problem revealed that the subcontractor did not have enough inspectors to handle the work load, and the inspectors it did have were not performing at an adequate level. This situation was remedied through increasing manpower and intensive training.

Philadelphia Electric Company's quality assurance organization devoted a considerable amount of time and audit activities to assure that the corrective actions taken were appropriate and successful. This included assigning an auditor full time for approximately one year to monitor the HVAC subcontractor exclusively. Since the interim period when the HVAC subcontractor reinspected previous work, made repairs where necessary and reestablished its quality assurance program, Philadelphia Electric Company's audits have verified that previous HVAC welding problems have been resolved and that the quality assurance program is working effectively to preclude recurrence.

Philadelphia Electric Company is confident its audit program works well. The overall scheduling of audits as well, as the techniques utilized in performing the audit function, provide this confidence. Audits have been scheduled to cover all aspects of the work activities while taking into consideration the quantity, difficulty

and importance of each activity. As previously mentioned, Philadelphia Electric Company has performed over 1500 audits. Where these audits have identified nonconformances, the audit activities have been increased or Bechtel has been directed to perform additional inspections to determine the extent of the problems. In the majority of instances, a nonconformance is investigated and found to be an isolated case. The HVAC welding problem was an exception, but demonstrates the effectiveness of the audit program.

Philadelphia Electric Company also utilizes audits to monitor the corrective actions taken to resolve problems identified by Bechtel. All Bechtel Power Corporation's Nonconformance Reports, Management Audit Reports and Quality Assurance Audit Reports are sent to Philadelphia Electric Company. If there are any questions about any item in the Bechtel reports, the quality assurance organization performs an audit. This has been effective in assuring Philadelphia Electric Company management that Bechtel's corrective actions are satisfactory. For example, Bechtel identified a problem with large pipe hanger welds. The problem was caused by the lack of coordination between the two disciplines of Quality Control (QC) which were inspecting the hangers. Piping QC was inspecting

the installed configuration of the hangers and Welding QC was inspecting the hanger welds. Upon notification from the construction forces, Welding QC was inspecting the welds and closing its inspection plans. Piping QC also inspected each hanger, and sometimes, identified conditions which required rework. If the rework required new welds to be made, Welding QC was not always informed and since its inspection plans were already closed, there was a potential for welds to go uninspected.

The resolution to the problem required reinspection of all large pipe hanger welds. To preclude the possibility of future problems, the weld inspections were performed on the same inspection plan as the configuration inspections and by the same QC discipline. The piping quality control engineers were cross-qualified to be able to perform both inspections.

Philadelphia Electric Company's auditing of this Bechtel identified problem and its resolution assured that the root cause of the problem was properly identified. For example, had the cause been poor inspections rather than lack of coordination, it could have affected more than just large pipe hangers. The auditing also verified that the piping quality control engineers were

properly qualified and proficient in their welding inspections.

5. Communications with Management

Philadelphia Electric Company's quality assurance organization prepares weekly, monthly and annual reports to inform the Vice President of the Engineering and Research Department, to whom it reports, of all the quality assurance matters related to the Limerick project. The Vice President also receives all audit and finding reports.

The receipt of these reports often results in the Vice President initiating discussions with the Company's Manager of QA and/or the QA Field Branch Head. These discussions are made to obtain additional information or updates or to give direction in certain matters.

There are numerous other communications with the Vice President necessitated by the normal course of conducting the quality assurance organization's business. Notification to the Vice President is required whenever a "Stop Work" order is issued or whenever an identified problem is considered potentially reportable to the NRC. A "Stop Work" is issued by the quality assurance organization when it determines that the continued practice of certain activities could result in a degradation of quality. The Vice President also becomes involved in the quality assurance organization's matters

when responses to finding reports become excessively overdue. Failure of an audited organization to respond to a finding report results in successive request letters from escalating levels of management up to the Vice President.

The Vice President also receives and discusses with the quality assurance organization the results of Bechtel Power Corporation's QA reports as well as reports from several outside organizations which audit the Limerick project activities. In addition, the Vice President holds a monthly project status meeting at which both Philadelphia Electric Company's and Bechtel Power Corporation's quality assurance organizations report on the progress they have made in obtaining and verifying corrective actions to past findings as well as new problems which may have been identified.

6. Outside Agencies Verifications of the Welding Quality

The welding quality assurance program at the Limerick generating Station is also subject to review and verification by five independent outside organizations:

- A) The American Society of Mechanical Engineers
(ASME)

Bechtel Power Corporation has maintained its certificate to install nuclear pressure retaining components by receiving certification from the

ASME. ASME teams audit every three (3) years with welding being one of the major areas covered.

B) National Board of Boiler and Pressure Vessel Inspectors

Members of the Board participate in the ASME surveys and in the decision to grant the certificates.

In addition, members of the National Board certify the Authorized Nuclear Inspectors who perform the ANI inspections described below.

C) Hartford Steam Boiler Inspection and Insurance Company

Hartford maintains a staff of Authorized Nuclear Inspectors (ANI) on site as required by the ASME Code. These inspectors monitor ASME welding-related activities and have the authority to assign hold points on construction activities past which construction cannot proceed until their inspection is satisfactorily completed. In addition, Hartford supervision performs semi-annual audits of applicable Bechtel activities associated with ASME Code welding.

D) Joint Utility Management Audits (JUMA)

Philadelphia Electric Company has been a participating member in a Joint Utility Management Audit Group (JUMA) since the late 1970's. This group annually audits the Philadelphia Electric Company quality assurance organization's activities.

These JUMA audits of Philadelphia Electric Company are conducted by senior supervisory quality assurance personnel from other utilities.

E) Institute of Nuclear Power Operations (INPO) -
Construction Project Evaluation (CPE)

The INPO Construction Project Evaluation was developed as a standard method of evaluating utilities' nuclear construction programs.

Philadelphia Electric Company supports INPO CPE and has actively participated in the development and trial of the Phase I evaluation.

The above organizations' evaluations, auditing and verifications of the Limerick project have all been positive. The ASME audits have resulted in the extension of Bechtel's ASME Certificate of Authorization. The on-site Authorized Nuclear Inspector has verified that ASME welding is done in accordance with the Code requirements. The semi-annual audits by Hartford have never identified a major problem. And, every JUMA au-

dit and INPO evaluation have concluded that the Limerick Generating Station quality assurance program is effective and is being effectively implemented. None of the evaluations or audits has revealed a welding hardware problem.

The INPO evaluations and JUMA audits go beyond verifying conformance to the established programs. INPO and JUMA also evaluate the programs and make recommendations for improvement. Philadelphia Electric Company has evaluated the INPO and JUMA recommendations. Some of the recommendations which Philadelphia Electric Company has adopted include:

- Having Bechtel transmit NCR's to Philadelphia Electric Company as soon as they are dispositioned so that the Company can review the disposition and make any desired comments prior to the start of rework or repairs. Prior to this recommendation being implemented, NCR's were only forwarded once a month.
- Having Field Change Requests trended to determine if repeated FCR's are the result of poor original design work.
- Having Philadelphia Electric Company quality assurance organization develop a formal notification system for establishing hold

points during audits. Prior to implementing this recommendation there was no formal procedure to establish an audit hold point.

- Having Philadelphia Electric Company develop an escalating corrective action request policy. This has been previously discussed in the "Communication with Management" section.

The results of these outside agencies' evaluations and audits have been beneficial to Philadelphia Electric Company. They have reported to the Company's management on the effectiveness of the program from a different perspective and this has further increased the confidence the Company has in its quality assurance program which, in turn, leads to a higher degree of confidence in the welding quality.

7. Philadelphia Electric Company Management's Perspective of Welding At Limerick

Philadelphia Electric Company is confident that the welding on the Limerick Project meets the Company's objectives for Limerick to be a safe and reliable plant. The competent people Philadelphia Electric and Bechtel have working within the quality assurance program have led to this confidence. The three levels of verification applied to the design of the welding program and three levels of verification applied to the welding

performed within the program, have enabled Philadelphia Electric Company to maintain a constant awareness and control of the welding activities.

There will be several hundred thousand safety-related welds at Limerick. With this volume of activity there is potential for occasional welding problems and some have been experienced at Limerick. However, Philadelphia Electric Company is confident that the problems have been identified and the company has monitored their satisfactory resolution.

In conclusion, the Limerick quality assurance program, which encompasses all phases of welding, from design to final verification, has been effective in assuring that the welding meets the quality requirements and satisfies the design criteria required for the safe operation of the plant.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of)	
)	
Philadelphia Electric Company)	Docket Nos. 50-352
)	50-353
(Limerick Generating Station,)	
Units 1 and 2))	

CERTIFICATE OF SERVICE

I hereby certify that copies of "Applicant's Report Regarding the Involvement of Philadelphia Electric Company Management in Assuring the Quality of Welding at Limerick Generating Station" dated January 6, 1984 in the captioned matter, have been served upon the following by deposit in the United States mail this 6th day of January, 1984:

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Board	Commission
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