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January 23, 1986

Herbert Grossman, Esq., Chairman
Administrative Law Judge
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dr. Richard F. Cole
Administrative Law Judge
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dr. A. Dixon Callihan
Administrative Law Judge
102 Oak Lane
Oak Ridge, TN 37830

Re: In the Matter of Commonwealth Edison Company (Braidwood Station, Units 1 and 2, Docket Nos. 50-456 and 50-457 OL

Gentlemen:

Commonwealth Edison's final report on the Material Traceability Verification Program was sent to you on November 15, 1985. This corrective action program addresses concerns raised by the NRC Staff in I&E inspection report 83-09 and the Intervenors in subcontention item 10.B. with respect to the traceability and acceptability of certain piping material installed at Braidwood Station.

The report has now been bound with a pretty cover. Several corrections have also been made and they are shown on the second page of the report. The enclosed copies should be used to replace those provided on November 15.

Sincerely,

Joseph Gallo
One of the Attorneys for
Commonwealth Edison Company

JG/kit

cc: Service List

Enclosure

DS03

Commonwealth
Edison

Material Traceability Verification at Braidwood

Docket Nos. 50-456 and 50-457

November 1985

Commonwealth Edison
One First National Plaza, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690

November 20, 1985

Mr. James G. Keppler
Regional Administrator
U.S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, IL. 60137

Subject: Braidwood Generating Station Units 1 and 2
Material Traceability Verification Program
NRC Docket Nos. 50-456 and 50-457

Reference (a): L. O. DelGeorge letter to J.G. Keppler dated November 12, 1985

Dear Mr. Keppler:

On June 25, 1985, Commonwealth Edison personnel met with you and members of your staff to discuss the results of our Material Traceability Verification (MTV) Program. Reference (a) transmitted the report which documents the results of that program and indicated that a redistribution of the report in bound printed form would be forthcoming. This letter accomplishes that redistribution. Several minor changes have been made in this version to correct typographical errors in the version transmitted by Reference (a). The changes are delineated in Attachment A.

One signed original and 19 copies of this letter and the attachments are submitted for your use.

Very truly yours,

Louis O. DelGeorge

Louis O. DelGeorge
Assistant Vice President

Attachments
cc: H.R. Denton-(NRR) w/attachment(5)
J.M. Taylor-(I&E) w/attachment(5)

0908K

ATTACHMENT A

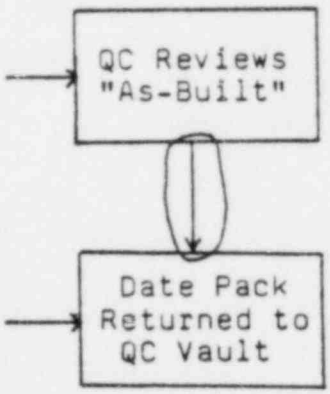
ERRATA

The changes made to Reference (a) are either underlined or circled, and deletions are shown with dashes through them.

Page I-1, Second Paragraph:

> It was reported in NRC Inspection Report 83-09 that verification of material traceability may have been performed by quality control inspectors. Documentation of those inspections was not generally available. Because, in the Staff's view, undocumented inspections are not an appropriate means for satisfying the NRC's Quality Assurance Criteria, ~~and as~~ such inspections cannot be relied upon. Hence, the NRC Staff concluded that a violation of Criterion X had occurred.

Page I-6, Lower-right two boxes



0908K

Page B-1, First Paragraph

The ASME Code requires that a record of NDE be retained for Class 1 materials, unless it can be shown that one of the following exemptions is satisfied:

1. For piping material less than or equal to 1 inch, Class 2 design rules may be used for Class 1 installation. Class 2 rules do not require NDE. (NB-3630(d))

2. For piping material greater than 1 inch but less than or equal to 2 inches, NDE is not required if the stress level of the installation satisfies a lower stress allowable (NB-2510(~~2~~a)) than would otherwise be required for Class 1 installations when NDE is performed.

Commonwealth
Edison

Material Traceability Verification at Braidwood

Docket Nos. 50-456 and 50-457

November 1985

MATERIAL TRACEABILITY VERIFICATION AT BRAIDWOOD

Table of Contents

I. BACKGROUND

The NRC staff conducted inspections at Braidwood Station during the second half of 1983 and January and February 1984, which were reported in NRC Inspection Report 83-09 on May 7, 1984. The NRC Staff determined, among other things, that Phillips-Getschow Company (PGCo), the on-site contractor responsible for the installation of ASME piping materials, did not have a documented inspection program requiring the quality control inspectors to verify at the time of installation that for the piping items to be installed, the heat numbers on the items matched the heat numbers on the pertinent documents in the data package (i.e., Stores Request). Although not expressly stated in 83-09, it appears the NRC Staff considered these inspections necessary to satisfy the requirements in Criterion VIII of the NRC's Quality Assurance Criteria Appendix B to 10 C.F.R. Part 50 and the ASME Code for material control and traceability.

It was reported in NRC Inspection Report 83-09 that verification of material traceability may have been performed by quality control inspectors. Documentation of those inspections was not generally available. Because, in the Staff's view, undocumented inspections are not an appropriate means for satisfying the NRC's Quality Assurance Criteria, such inspections cannot be relied upon. Hence, the NRC Staff concluded that a violation of Criterion X had occurred.

Criterion X requires the performance of inspections to verify conformance with documented procedures, instructions and drawings established by the licensee and its contractors for the accomplishment of various activities during the course of nuclear power plant construction. Apparently the NRC Staff reasoned that Criterion VIII and the ASME Code required these inspections in order to verify piping material traceability. In commonwealth Edison's view, the inspections identified as necessary by the NRC Staff were not required by either the ASME Code or Criterion VIII for purposes of verifying material control and traceability; and, therefore, need not be a part of the procedures or instructions developed by Edison or its contractor, Phillips, Getschow Company. We believe that inspections as contemplated by Criterion X and as discussed in 83-09 are not required to demonstrate material traceability.

Phillips, Getschow Company had established a Stores Request System for achieving the necessary piping material control and traceability required by the ASME Code and Criterion VIII. This system is referred to in Section 5 of the Phillips, Getschow Company Quality Assurance Manual and it is described in Figure I-1 of this report. In summary, piping material was inspected at the time of its receipt at the site. The receipt inspection included verification of the traceability identification numbers on the material which was traceable to the vendor supplied documentation. When piping material was needed for field installation, a form called a "Stores Request" (Figure I-2) was completed by a PGCo Field Supervisor and reviewed by PGCo field engineering and quality control for completeness. The stores request identified the piping material required for a specific location. Upon review of the stores request, a warehouseman located the prescribed piping material, recorded the heat numbers or other traceable identification on the stores request and presented the material and a copy of the stores request to the requestor. The requestor then transported the material to the installation site and it was installed. A copy of the stores request was placed in the data package and stored in the QC office for future reference. This system, which was in effect at the time the plant materials questioned by the NRC Staff were installed, met the requirements of the ASME Code for material traceability. This conclusion is explained further below.

The requirements applicable to the installation of the piping material in question are specified in the 1974 Edition and Summer 1975 Addenda of Section III of the ASME Boiler & Pressure Vessel Code. Paragraphs NA-4440 and NA-4441 set forth the requirement for piping material control and traceability. These paragraphs state:

NA-4440 IDENTIFICATION AND CONTROL OF MATERIAL AND ITEMS

NA-4441 Establishment and maintenance of Identification and Control Measures

Measures shall be established for identification and control of material and items, including partially fabricated assemblies. These measures shall assure that identification is maintained either on the item or on records traceable to the item throughout manufacture or installation. These measures shall be designed to prevent the use of incorrect or defective items, and items which have not received the required examinations, tests, or inspections.

Sub-paragraph NA-4441 makes clear that measures for the control of materials shall assure that material traceability is maintained either on the piping item or records traceable to the piping item up through installation of the material. The ASME Code does not require permanent physical identification marked on the item. The ASME Code does not prescribe the means for implementing this requirement. Rather, compliance with this and other ASME Code requirements is determined by the approval of the measures proposed by a company when it seeks accreditation from the ASME Subcommittee on Nuclear Accreditation. In the case of Phillips, Getschow Company, it was accredited by the ASME as a qualified installer of ASME Class 1, 2 and 3 piping material as early as 1971, using a traceability system similar to that employed at Braidwood.

Prior to certification by the ASME for the Braidwood Project, Phillips, Getschow Company procedures and quality requirements were the subject of a complete accreditation survey by an ASME survey team which is made up of Code-knowledgeable experts. This survey was conducted in August 1978. A second ASME renewal survey was conducted in 1981 to verify conformance with ASME requirements. The accreditation included the Stores Request System described above. No exceptions were taken by the ASME survey team with respect to the Stores Request System. In addition, the Authorized Nuclear Inspector (ANI) conducts periodic inspections of the Stores Request System as required by Section NA-5000 of the ASME Code. Any issues raised by these inspections have been resolved to his satisfaction in order for the installation of piping material to proceed. Based on the audits by the ASME survey team, the subsequent certification of Phillips, Getschow Company, and the ANI Inspections, it can only be concluded that the Phillips, Getschow Company Stores Request System met ASME Code requirements for the traceability of safety related piping materials without the need for permanent retention of physical identification markings on the piping.

A special review conducted in March 1984 by ASME Code-knowledgeable experts from Commonwealth Edison Company, Sargent & Lundy Engineers and the Hartford Steam Boiler Inspection & Insurance Co. independently examined the Phillips, Getschow Company Stores Request System to determine whether the program met ASME Code

requirements for material control and traceability. They concluded that the Phillips, Getschow Company Stores Request System provided a means for assuring traceability through installation of the piping material, and therefore that system satisfied the requirements of paragraph NA-4441. Finally, since there is not substantive difference in the language of paragraph NA-4441 and the language of Criterion VIII, it can also be concluded that the Phillips, Getschow Company Stores Request System satisfied Criterion VIII. In addition, the National Board of Boiler and Pressure Vessel Inspectors performed an assessment of the Stores Request System. As reported in Appendix A, this assessment resulted in the opinion that there is no basis for believing that PGCo's Quality Assurance program, as described in the Quality Assurance Manual, did not meet the requirements or intent of the 1974, Winter '75 Addenda of the ASME Code, Section III, Para. NA-4441.

The approach suggested by the NRC Staff in 83-09, namely, material traceability verification by means of a documented QC inspection at the time of installation, is also an acceptable means for meeting the Code and Criterion VIII. However, it is not the exclusive means of achieving that result. The ASME accreditation system allows any type of system as long as it satisfies the objective of the Code, which in this case is the proper control and traceability of piping material. In fact, Phillips, Getschow Company had supplemented the Stores Request System by providing additional documentation requirements in its QA Manual.

Nevertheless, in order to answer the NRC Staff questions raised by Inspection Report 83-09 and to eliminate the uncertainty which those questions created, Commonwealth Edison directed Phillips, Getschow Company to modify their procedures to require the approach suggested by the NRC Staff, namely, a documented quality control verification of material traceability at the point of material installation. Modifications to the procedures were implemented during 1983, and the change resolved NRC Staff questions with respect to ongoing and future work.

Additionally, in order to provide the NRC with assurance that the Stores Request System provided adequate material traceability and that the installed piping was acceptable, Commonwealth Edison directed Phillips, Getschow Company to reverify piping material

installed prior to the dates of interest. A sample reverification was initially performed as part of the effort by Commonwealth Edison to be responsive to the questions posed by the NRC Staff. However, the Staff continued to question compliance with the material traceability provisions of the ASME code and the NRC's Quality Assurance Criterion VIII. In light of the NRC's continued concerns, Edison performed a 100% reverification of the small bore and large bore piping materials installed prior to September 6, 1983, and January 1, 1983, respectively. This 100% reverification program called the "Material Traceability Verification Program" (MTV), is the subject of this report.

Figure I-1

Phillips, Getschow Materials Store Request System

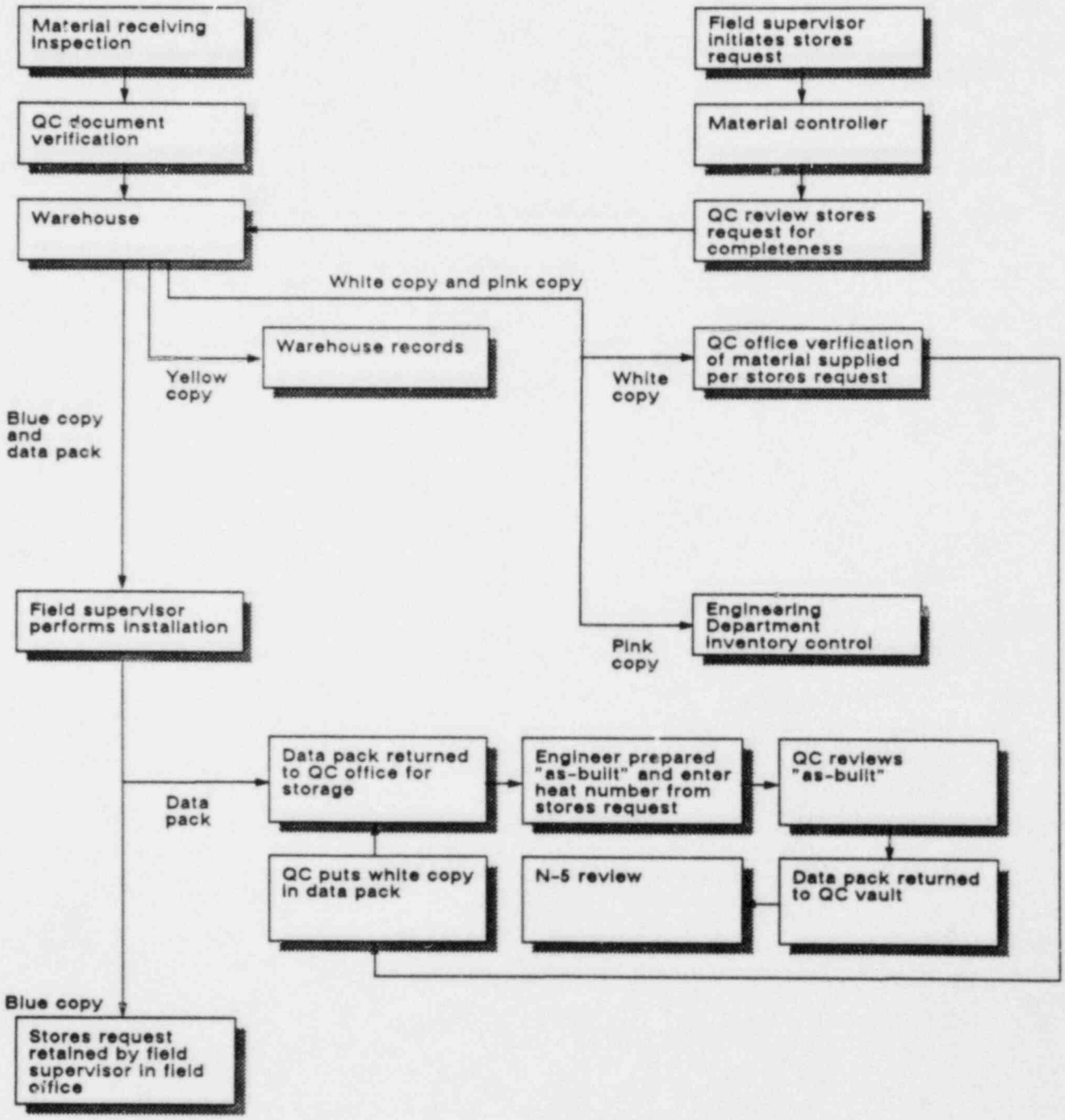


Figure I-2

Stores Request Form

PHILLIPS, GETSCHOW CO.

REQ BY JOE FITTER

STORES REQUEST

DATE 5-24-85

Q. A. CLASS B HT. NOS. REQ'D. YES ☒ NO ☐

SYSTEM	QUANTITY	DESCRIPTION	HEAT NO.
OFF GAS	4'6"	3" S/40 SA-106 GR.B C.S. SMLS PIPE	366340
2A-06-60-1			P355
REV. 1	1	3" S/40 SA-234 GR. WPB B.W. L.R.	DH6M
		C.S. 90° ELL	F605

EXAMPLE

NUCLEAR

PREPARED BY
Joe Fitter
5-24-85

FIELD ENGINEERING M. Hamburger 5-24-85 WAREHOUSEMAN J. J. Fitter 5-24-85 Q. C. SIGNOFF T. G. Schwudke 5-24

FORM—PG109-8

SUPERVISOR - QUALITY CONTROL

II. PROGRAM DESCRIPTION

The purpose of the MTV Program is two-fold. First, it demonstrates the reliability of the Stores Request System as a means to satisfy the material traceability requirements of Section NA-4441 of the ASME Code and verifies the traceability of ASME Class 1, 2 and 3 large and small bore piping and integral attachments for the time periods of interest. Second, material installation acceptability was verified by checking the traceability results against installation specifications for correct material schedule, type, grade, and class.

A. PROGRAM SCOPE

As discussed in Chapter I, the MTV program was established to provide 100% verification of:

1. ASME Section III large bore (nominal pipe diameter 2-1/2" and larger) piping installed prior to January 1, 1983; and

2. ASME Section III small bore (nominal pipe diameter 2" and smaller piping installed prior to September 6, 1983.

The total scope of the program involved 25,815 individual items inspected. An item is generally considered to be a single piece (i.e., pipe section or fitting), or unmodified spool between field welds. The number of items inspected were 13,941 small bore items, 11,382 large bore items, and 492 integral attachments.

Not included in the above scope are 514 items of the containment spray system located in the dome of the Unit 2 containment building. Thee items are inaccessible until the erection of extensive scaffolding is practical. This scaffolding is planned to be erected later in the construction of Unit 2 at which time inspection of this system will be completed. It is not expected that the inspection of these items will

yield results different from identical items inspected in Unit 1. Therefore, the lack of these results for the Unit 2 containment spray system do not affect the conclusions in this report.

B. PROGRAM PROCEDURE AND ORGANIZATION

A separate and special procedure, QCP-B31, was developed by Phillips, Getschow company (Figure II-1) to implement the MTV Program. This procedure was reviewed and approved by Phillips, Getschow Company, the Authorized Nuclear Inspector, Commonwealth Edison Company, and Sargent & Lundy.

Both large bore and small bore trial packages were developed and walked through this procedure. This walk through assured that the procedure met the Program objectives and acted as a "shake-down-run" to assist in final procedure refinements and personnel training.

The Phillips, Getschow company Project Engineering Group identified the installations that fell within the established scope of the program. That determination was made by a review of the Phillips, Getschow Company Weld Completion Documentation/Statusing Log, the production installation data package, the Field Change Order Control logs, and/or any other information source available that was beneficial to this review activity.

After an installation was determined to be within the scope of this program, a Phillips, Getschow Company Material Traceability Verification (MTV) package was assembled for that installation by the Project Engineer. After the MTV package was prepared, it was independently reviewed for completeness of all engineering requirements by a checker. The MTV Index/Routing Traveler was signed off and the package was forwarded to the Phillips, Getschow Company QC Department. The QC Supervisor reviewed the Project Engineer's MTV package for completeness and accuracy. A QC sign-off on the MTV Package Index/Routing Traveler documented

completion of this review. The QC Supervisor then issued the MTV package to the QC Field Inspectors for verification actions in accordance with the marked up drawings and inspection checklists/instructions.

C. MTV DOCUMENTATION PACKAGE

All Material Traceability Verification (MTV) packages consisted of the following items:

1. An MTV Package Index/Routing Traveler itemized the total contents of the MTV package and served as a Signature/Routing Traveler. This traveler followed that package from engineering assembly through QC final review, as well as compilation of results, and final storage in the records vault.

2. An isometric of the piping configuration was highlighted in a standardized color coding system which differentiates certain drawing/installation conditions. The standardized color coding was:

   Red -- Fabricator's Spool Boundaries

   Yellow -- Phillips, Getschow Field Welds

   Pink -- Phillips, Getschow Added Welds

   Green -- Unaltered Fabricator's Spools

   Orange -- Altered Fabricator's Spools

3. Phillips, Getschow rework spool drawings for those altered fabricator's spools, refabrications, or new spools fabricated by Phillips, Getschow Company at the Braidwood site were included in the MTV Package. These packages show the spool configuration, and indicate the added Phillips, Getschow Company materials on the altered fabricator's spools. The Phillips, Getschow Company spool rework drawings (or the isometrics when conditions required) were marked with standardized stamps and symbols which indicate specific locations on those drawings where the QC Inspector was to record, by initials and date, the information gathered during his field verification.

4. Step-by-step inspection/instruction checklists for each spool to be inspected were provided. These checklists provided specific direction in a standard, sequential manner for each spool inspection. They also provide inspection sign-off points as well as inspection data recording locations. A set of standardized written instructions and pictorial representations were an integral part of each checklist. This system minimized misinterpretation of required actions. Space is also provided for the inspector to explain and/or detail unique or questionable conditions or situations. Provision existed for either a written description, or pictorial representation, or both.

   For large bore pipe spools, the material traceability attributes on the quality control inspection checklist included: fabricator's spool serial number and spool mark number, manufacturer's heat or heat code numbers, manufacturer's specification number, Material and Equipment Receiving and Inspection Report (MRR) number, and NDE identification with method of marking for Class 1 piping systems.

   For small bore piping, the material traceability attributes on the quality control inspection checklist included: material manufacturer's heat or heat code numbers, and NDE identification with method of marking for Class 1 piping systems.

5. A Material Traceability Verification log sheet listed the items to be inspected and verified. The engineering portions of this log were completed only after the package wa finally assembled, checked, and reviewed for completeness. The Project Engineer completed the first three (3) columns of the MTV log. These columns noted the drawing, revision, component itemization and component description of the items being inspected. The remaining twenty-five (25) log entry columns were completed by the QC review technicians in their review/analysis of the field inspection data.

D. QUALITY CONTROL ASSESSMENT

Upon completion of the field inspection and documentation package by the Quality Control Inspector, PGCo Quality Control technicians performed an assessment. There were several phases in this assessment. The first phase involved a determination that each item did have traceable identification and the second phase was to determine acceptability of the installed item.

For purposes of determining traceability, the results of the field inspection were first compared against the stores request. The traceability information identified by field inspection was reviewed for correctness to verify that the heat number was a valid number. PGCo Nonconformance Reports were written if the field inspected heat number could not be verified as a traceable heat number. The heat number log, which is a listing of acceptable heat numbers for ASME material received on site, and other traceability documentation was used for this purpose.

The stores request installation documentation from the data package for each item was then examined to compare the heat number from the documentation against the inspected heat number. Traceability was verified when these numbers agreed or could be easily reconciled. When this comparison resulted in irreconcilable heat numbers, PGCo Nonconformance Reports were written.

The second phase of the quality control assessment, the determination of installation acceptability, involved comparison of the items, as defined through the traceability documentation in the first phase, with the installation specification. This included comparison through the traceable documentation back to the manufacturer's records for characteristics such as material, schedule, type, grade, and code classification against the installation specification for that item. PGCo Nonconformance Reports were written for all deficiencies discovered in this check for acceptability.

E. PROGRAM CONTROLS

1. PGCo Program Controls

The PGCo Braidwood Site Manager, in conjunction with the PGCo Corporate Q.A. Manager, had overall program responsibility for the contractor. The PGCo Project Engineer and the Supervisor-Quality Control were charged with the implementation responsibilities of this program. The implementation of this program was subject to audit by the PGCo Site Q.A. Coordinator in accordance with the PGCo's Quality Assurance Manual and implementation surveillances required by Procedure QCP-B31.

The Supervisor-Quality Control performed a second level review on 100 percent of the MTV packages. The minimum review percentage per package was 50 percent. The second level review included: a review of heat traceability numbers for acceptance/rejection; assurance that all sign-offs on MTV checklists were complete; assurance that all items on the MTV log were addressed for acceptance/rejection as applicable; comparison of the MTV computer printout to the MTV log for correctness. Discrepancies identified during second level review were documented and this information was fed back to the first level reviewer responsible for the discrepancy to improve the quality of first level review.

The program was implemented utilizing qualified and, where applicable, certified personnel. PGCo personnel were not allowed to proceed in any phase of this program without proper and documented training on the approved procedure QCP-B31.

A statusing/reporting mechanism was established based on the sequence of signature completions on the progressing MTV Package Index/Routing Traveler and the MTV Log Sheet.

2. Commonwealth Edison Company Program Controls

The Braidwood Project Manager had the overall responsibility for the MTV program. The Site Project Construction Superintendent had direct implementation responsibility for the PGCo activities relative to this program. These responsibilities included: procedure review and acceptance, monitoring status of program completion, and initial review of nonconforming conditions. Additionally, the Site Project Construction Superintendent closely monitored this program to assure that an adequate number of qualified personnel were assigned to ensure a timely completion.

Commonwealth Edison Company Project engineering Department, and Sargent & Lundy reviewed and accepted the contractor procedure. Additional responsibilities included the review of nonconforming conditions and providing technical expertise to support program implementation.

Commonwealth Edison Company Quality Assurance monitored all aspects of the MTV program. Their review and approval of the PGCo implementing procedure assured that all necessary quality requirements were included. As an additional assurance, Site Quality Assurance performed audits and surveillances of this activity.

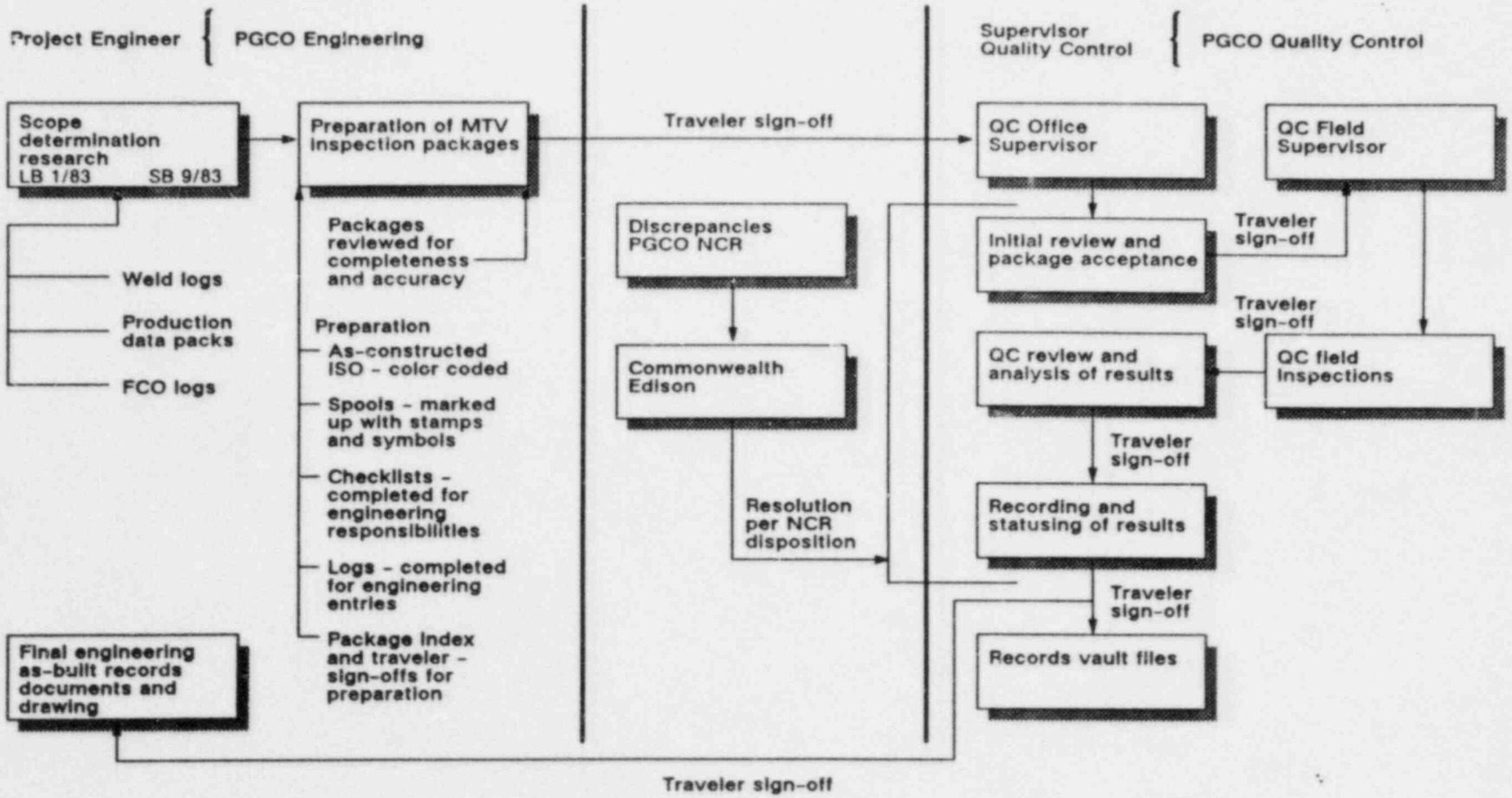
F. COMPARISON OF MTV TO N-5 REVIEW

PGCo is required to perform a separate and final documentation review prior to the ASME Code stamping of each system, called the N-5 review. This review is conducted in order to complete the Form N-5 code Data Report in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section III, Division 1. The N-5 review includes a document review to verify traceability and material acceptance, in addition to certifying completed bolting, welding, NDE, and the completion of hydrostatic or pneumatic testing.

The MTV program was structured in part to support the N-5 documentation review with the added benefit of field inspections. The MTV documentation fulfills the requirements of the N-5 review for those attributes inspected, namely, heat traceability numbers, correct material, schedule, type, grade and class, and pressure rating for fittings. It is reasonable to conclude that most of the findings discovered in the MTV program would have been discovered and dispositioned later during the N-5 review.

Figure II-1

PGCO MTV Program Flowchart QCP-B31



6500-2 11-85 KPS

III. PROGRAM RESULTS

The MTV Program inspected 25,815 items of large and small bore piping. A determination of the existence of material identification numbers on the stores requests and the installed items yielded the following four categories of data which are displayed in Figure III-I.

a. 21,167 items had both physical identification and stores request documentation.

b. 3,990 items, of which approximately 900 items were inaccessible, had stores request documentation only. The PGCo traceability system relied on the Stores Request System and did not require permanent retention of physical identification to meet Code requirements.

c. 577 items had physical identification only. Physical identification marked on the item is an acceptable traceability system.

d. 81 items had neither stores request documentation nor physical identification.

The data in category a. above was used to establish the reliability of the PGCo Stores Request System as a means to effect material traceability. This subject is presented in Section 1 below. The 25,815 items were evaluated to verify that they are in fact traceable. This evaluation is presented in Section 2. The inspection results for the 25,815 items also were used to verify material installation acceptability through an evaluation of the pertinent documentation. This information is presented in Section 3.

1. RELIABILITY OF STORES REQUEST SYSTEM

The efficacy of the PGCo Stores Request System can be determined by an analysis of the 21,167 items for which both physical identification and stores request documentation exist. A comparison of the material traceability markings on the items with those recorded on the stores request showed that 20,214 had matching identification numbers. Of the 953 non-matching identification numbers, 390 were deemed to be equivalent identification numbers. Thus, out of a total of 21,167 piping items that were supported by identification numbers recorded both on the stores request and the item itself, 97% had equivalent identification numbers.

Identification numbers on 344 of the remaining 563 items, though deficient in minor respects, were readily determined to be traceable. These deficiencies were due solely to a failure to record accurately the identification number on either the stores request or the installed item. In these cases, the Stores Request System had otherwise been effective to assure that the item withdrawn from the warehouse was installed at the location documented in the stores request. Therefore, minor recording errors, which were readily reconcilable, could be considered equivalent identification numbers. If these items are included in the category of equivalent identification numbers, the success rate would increase to 99%. The remaining 1% (219 items) failed to have equivalent matching numbers and required further evaluation to determine traceability.

The success rate of 97%, or 99% if the readily reconciled recording errors are counted, provides adequate assurance to conclude that the ASME-accepted Stores Request System used by PGCo was a reliable system for establishing material traceability at the time of installation. Moreover, verification of the Stores Request System justifies its use to verify traceability of those items which are inaccessible or for which physical identifications are otherwise unavailable.

The 390 items that were deemed to be the equivalent of matching identification numbers involved partial physical identification of no more than two missing digits. Physical identification numbers on items with partially visible characters are to be expected given the fact that the inspections under the MTV Program were conducted many months and, in some instances, years after their installation. Partially obliterated markings resulted from construction activities during the interval between installation and the inspections. Therefore, it would not be appropriate to classify items in this category as shortcomings in the Stores Request System provided that the partial physical identification could be reliably matched with a valid traceability number on the applicable stores request.

Partial physical identification missing two digits or less had to meet the following acceptance criteria before they could be considered a match with the corresponding stores request. First, the heat number log was reviewed to determine whether the apparent partial physical identification was not itself a valid traceability number. If the partial marking was not a valid traceable number, a review of the heat number log was conducted to determine that the partial marking could not be identified with more than one valid traceable identification number. If the partial physical identification passed both tests it was considered a match with the Stores Request identification number.

The 344 minor recording errors referred to above were only considered readily traceable if the differences between the identification numbers on the stores request and the installed item were due to:

a. A difference involving no more than two transposed adjacent characters within a valid traceability number. For example, if a valid number of A24B1 is assumed, A42B1 would be a transposition that was readily corrected and, therefore, traceable.

b. A difference involving the improper substitution of no more than one character. For example, if a valid traceability number of 60321 is assumed, 60322 would be a substitution that was readily corrected and, therefore, traceable.

c. A difference involving the improper addition of no more than one character. For example, if a valid traceability number of 411A is assumed, 4111A would be an addition that was readily corrected and, therefore, traceable.

Items included in the above classifications were accepted only if a review of the heat number log showed that the markings on the items were neither (i) traceability numbers nor (ii) potentially traceable to more than one valid traceability number.

Table III-1 presents a distribution of all items with both field markings and stores request documentation categorized by small bore piping, large bore piping and integral attachments. The first column gives the total number of items. The second column gives the number of items with matching marks. This column includes items with identical marks or items which were traceable to the stores request by a heat code or serial number system included in the documentation. The third column gives the number of items which revealed only partial physical identification but for which equivalence was determined, and the fourth column includes those items that had stores requests with minor recording errors. The last column gives the total number of items whose stores request and field markings could not be reconciled.

Having determined the reliability of the Stores Request System, the next section sets forth the results of the evaluation of the 25,815 items to verify that the Stores Request System was implemented effectively and material traceability achieved in fact.

2. VERIFICATION OF MATERIAL TRACEABILITY

As provided in the ASME code, traceability was determined when a valid heat number or spool serial number, or heat code could be identified from either a physical identification on the item or the traceability number recorded on the corresponding stores request. The identification numbers on either the installed items or the stores request were verified by crosschecking the PGCo heat number log or other pertinent documentation to assure traceability. The log is maintained as a controlled document to record heat numbers, Material and Equipment Receiving and Inspection Report (MRR) numbers, material type, grade and class for ASME material. The information in the log or other documentation effectively corroborates the validity of the identification numbers on the stores requests and the installed items, thereby verifying material traceability.

Out of a total of 25,815 items reviewed in the MTV Program, traceability was established with respect to 25,023 items. NCR's were written on 792 items[1] (3%). NCR's were written in each case when material traceability was considered a potential question. In some instances, material traceability was subsequently established through the dispositioning process; nevertheless, these items are shown as nonconforming items. Therefore, the number of items with NCR's written under the MTV Program is not necessarily reflective of the number of items with inadequate material traceability.

The 792 items are categorized in the following manner:

a. For the category of items with both physical identification and stores request numbers (21,167 items), NRCs were written questioning the traceability of 293 items. 219 items has nonmatching identification numbers that could not be reconciled as discussed in Chapter III. The remaining 74 items included some items with matching numbers but which could not be verified by reference to the heat number log or other documentation reviewed at the time. Also included in the 74 items are items for which additional evaluation was necessary to verify partial physical identification and minor recording errors.

b. For the category of items with stores requests only (3,990 items), NCRs were written questioning the traceability of 349 items.

c. For items with physical identification only (577 items), NCRs were written questioning the traceability of 69 items.

[1]A separate Nonconformance Report (NCR) was issued outside the MTV Program with respect to 570 piping spool items that had missing nameplates. Although piping material traceability requirements were confirmed within the MTV Program by reference to identified spool records, additional verifications are being undertaken to provide positive traceability of fabricator's shop welds and to comply with ASME Code procedural requirements concerning removal of nameplates. Review of approximately 500 spools with missing nameplates has been completed at this time. The remaining 70 spools ##?ar still being reviewed.

d. For items with neither stores requests nor physical identification (81 items), NCRs were written questioning the traceability of all of the items.

Table III-2 distributes the above data for small bore piping, large bore piping, and integral attachments. The MTV Program included ASME Class 1, 2 and 3 large and small bore piping and integral attachments. This is the case even though unique heat number traceability is not required by the ASME Code for all these items. The traceability findings in Table III-2 separates those items for which unique heat number traceability is not required, namely: for Class 1 and 2 piping and fittings less than or equal to 3/4-inch in diameter (ASME Code, Section NA-3767.4(B)). Class 2 and 3 integral attachments (Section NC/ND-2130 and 2190), and all Class 3 construction (Section ND-2150). For these items, the ASME Code only requires a system to assure that the design-specified material type, grade and class has been installed.

3. VERIFICATION OF MATERIAL INSTALLATION ACCEPTABILITY

In addition to material traceability, the MTV Program reviewed the acceptability of installed items by comparing them against the installation specification[2] for the item. The purpose of this comparison was to verify correct pipe schedule, correct grade, type and class of material was withdrawn from stroes. In order to determine material installation acceptability, additional documentation checks were made to ascertain that the acceptability of every item checked, regardless of the source of the traceability information, was also acceptable for use as called for in the installation specification. This review required both a documentation review and a field dimensional check, where practical. In all cases where the installation did not conform to the installation specification, a PGCo NCR was written. Not until the NCR was resolved, however, could the acceptability of installation be determined.

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[2]Sargent and Lundy Specification for Piping System Installation (Section III Portion), F/L-2739.

The review of material installation acceptability included dimensional checks of installed piping, when practical, to verify that the installed pipe schedule was as described in Certified Material Test Reports or other material documents. In cases for which a physical identification was not located or was illegible on an item, or for which a PGCo applied field marking was identified without a supporting stores request, digital thickness measurements (DTMs) were taken on the pipe, if possible, for comparison to the applicable installation specification.

Material class is questionable for certain Class 1 items because of possible lack of evidence of non-destructive examination (NDE) on what appears to be Class 1 piping material. This matter was identified by Phillips, Getschow Company as a separate concern unrelated to the Program. However, because of the substantial quantity of piping material to be inspected under the Program, inspection checklists were augmented to include the identification of NDE markings as an attribute. Evidence of NDE is required by the ASME Code unless the Class 1 material has been exempted from this requirement. This evidence can be in the form of markings on the items or in supporting documentation. Results of the review for evidence on NDE for Class 1 piping material are presented in Appendix B of this report.

The 135 items for which material installation acceptability was in question are catalogued below.

a. 24 items were of a greater poundage/schedule than stated in the installation specification;

b. 10 items were of lesser poundage/schedule than stated in the installation specification;

c. 12 items were of different grade/type of material than stated in the installation specification;

d. 46 items were of a lower class material than stated in the installation specification;

e. 18 items had digital thickness measurements less than required by the material specification; and

f. 25 items failed to meet the installation specification for various other reasons.

These results are presented in Table III-3. The disposition of the NCR's covering the 135 items is discussed in Chapter IV.

4. SUMMARY

The Stores Request System has been shown to be reliable based on examination of 21,167 items for which both stores request and physical identification is available.

Out of a total of 25,815 items covered by the MTV program, 792 items are the subject of NCR's because of traceability issues, and 135 items are the subject of NCR's because of material acceptability issues. The distribution of these items by type of item is given in Table III-4.

Figure III-1

Material Traceability Verification (MTV)

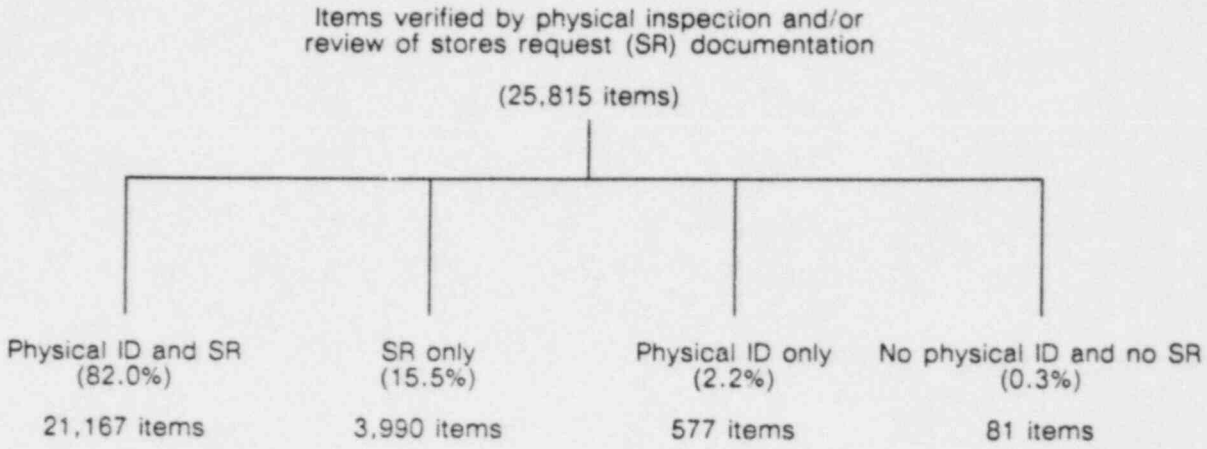

Table III-1

Distribution of Items with Physical Identification Verifying the Stores Request

Item Category	Items with Field Markings and Stores Request	Matching Identification	Partial Physical ID Same Item	Recording Error Same Item	Field Markings and Stores Request Do Not Agree
Small bore	11,471	11,035	179	131	126
Large bore	9,479	8,998	200	197	84
Integral attachments	217	181	11	16	9
Total	21,167	20,214	390	344	219

Table III-2

Distribution of Items by Inspection Category and Traceability Findings

Category	No Physical ID and No Stores Request		Physical ID and No Stores Request		Physical ID but with Stores Request		Physical ID and Stores Request Are Present	
	Items	Traceability NCR*	Items	Traceability NCR*	Items	Traceability NCR*	Items	Traceability NCR*
Small bore	24	24	202	31	2,244	16	11,471	146
Traceability required	7	7	72	15	282	1	--	40
Traceability not required by ASME code	17	17	130	16	1,962	15	--	106
Large bore	44	44	359	37	1,500	303	9,479	137
Traceability required	18	18	171	21	327	62	--	66
Traceability not required by ASME code	26	26	188	16	1,173	241	--	71
Integral attachments	13	13	16	1	246	30	217	10
Traceability required	0	0	5	0	5	0	--	0
Traceability not required by ASME code	13	13	11	1	241	30	--	10
Total	81	81	577	69	3,990	349	21,167	293

*Although NCRs were written whenever traceability was in question, in most cases, they were dispositioned as acceptable.

Table III-3

Distribution of Items with NCRs Because Material Installation Acceptability Was In Question

Category	Total No. of Items	Wrong Sch.		Material or Item Type	Class < S&L Spec.	DTM Questions	Other Questions
		No./Sch. > S&L Spec.	No./Sch. < S&L Spec.				
Small bore	50	20	7	5	5	13	0
Traceability required	13	5	2	4	2	0	0
Traceability not required by ASME code	37	15	5	1	3	13	0
Large bore	55	3	3	5	14	5	25
Traceability required	22	1	2	4	3	0	12
Traceability not required by ASME code	33	2	1	1	11	5	13
Integral attachments	30	1	0	2	27	0	0
Traceability required	0	0	0	0	0	0	0
Traceability not required by ASME code	30	1	0	2	27	0	0
Total	135	24	10	12	46	18	25

Table III-4

Summary Distribution of MTV Item Findings*

	Total Items	Items with Traceability NCRs	Items with Acceptability NCRs
Small bore	13,941	217	50
Large bore	11,382	521	55
Integral attachments	492	54	30
Total	25,815	792	135

*Does not include NDE marking issue discussed in Appendix B.

IV. DISPOSITION OF NONCONFORMING ITEMS

The absence of both physical identification and valid stores request documentation, or the existence of material documentation discrepancies identified as part of the MTV review, resulted in identification of a nonconforming condition requiring further evaluation and disposition. The Braidwood project nonconformance systems was and is used to process and track each of the nonconforming conditions identified through the MTV Program.

One or more of the following actions were undertaken as part of the NCR evaluation process in order that each nonconforming condition could be adequately resolved:

1. Reinspection by another MTV inspector was employed to ensure a physical marking was not overlooked in order to resolve apparent traceability discrepancies.

2. Extensive searches of satellite record files and field document stations were made to locate stores requests which were not initially retrieved in order to resolve apparent traceability discrepancies.

3. Examination of field drawings, Field Change Orders, and as-built drawings was completed in order to identify documents that were appropriate for use in the dispositioning of material traceability questions.

4. In-place material thickness measurements were taken where conflicts in the traceability records prevented verification of material schedule.

5. Engineering review of design parameters and conditions was performed to verify that conditions found not to conform to the installation specification satisfied minimum applicable ASME Code design requirements.

6. Removal and replacement was completed of nonconforming items for which traceability, when required, or acceptability was not established.

In addition to the normal project NCR disposition process applied to the NCRs developed from the MTV Program, a special review board was established. This Board consisted of a representative from the National Board of Boiler and Pressure Vessel Inspectors, the Hartford Authorized Nuclear Inspector, Commonwealth Edison Company Quality Assurance, Project Construction, Project Field Engineering and PGCo. With the exception of the National Board participant and Project Field Engineering who reviewed approximately 85% of the dispositions, the review board reviewed each disposition prior to the nonconformance being finally closed. This board verified for each disposition that documentation was properly utilized and, for each disposition, where no rework was recommended (i.e., use-as-is) that the item was traceable and acceptably installed. A copy of the National Board's final report is provided in Appendix A.

The purpose of the following discussion is to provide a summary of the disposition of all items which received NCRs as part of the MTV Program. The distribution of the nonconforming "traceability" and "acceptability" conditions by item versus the total number of items evaluated was presented in Table III-4.

1. DISPOSITION OF TRACEABILITY NCR ITEMS

This section describes the disposition of items identified as nonconforming for reasons of questionable traceability. The discussion is divided between accept-as-is items and items cut-out and replaced.

Out of a total of 792 items with traceability NCRs, the disposition of items between accept-as-is and cut-out is as follows:

Items with physical identification and stores request -

Total traceability NCR items	-	293
items accepted as-is	-	230
items cut-out	-	63

Items with stores request but no physical identification -

Total traceability NCR items	-	349
items accepted as-is	-	319
items cut-out	-	30

Items with physical identification but with no stores request -

Total traceability NCR items	-	69
items accepted as-is	-	49
items cut-out	-	20

Items with no physical identification and no stores request -

Total traceability NCR items	-	81
items accepted as-is	-	49
items cut-out	-	32

1.A <u>Accept-As-Is Items</u>

Out of 792 traceability NCRs, 647 items were dispositioned "use-as-is." The distribution of these items by type of disposition is given in Table IV-1. The types of acceptable dispositions have been categorized into the following areas.

Column 1 shows the number of items for which a supplemental documentation search located a stores request copy. The stores request copy was then reviewed to assure it was applicable to the installation. Although counted as traceability NCRs, these items were not nonconforming because a valid stores request did exist.

Column 2 shows the number of NCR items which were accepted based on a further investigation of physical identification deficiency. This resolution was accomplished in two ways. First, valid physical identification was verified by

supplemental inspection. Physical identification initially indicated as missing was either found or difficult to read numbers were discerned on a second inspection. These items were not traceability nonconformances because the heat traceability numbers did exist. Second, an item was accepted when the physical identification consisted of an original manufacturers' marking process even though the stores request documentation did not agree. Such markings were traceable to valid material documentation and, therefore, represent primary evidence of traceability.

Columns 3 and 4 show the number of NCR items which, although identified as nonconforming because of either errors on the stores request or in the physical identification which made the item potentially traceable to more than one heat of material, were later accepted based on evaluation. In this evaluation additional inspections of the item, reviews of receipt inspection records, or a detailed look at the installation data package were made to show that the other numbers were not applicable to the installation.

Columns 5 and 6 show the number of NCR items accepted because the evaluation indicated that the specified material type, grade, and class of material was installed. These items were originally identified as nonconforming because the traceability information identified multiple heat numbers. A review of the multiple heat numbers established that each number met the material type, grade and class specified in the installation specification. Therefore, the items were accepted. This action is consistent with the ASME Code (Paragraphs NA-3667.4(B) and ND-2150) which does not require unique heat number traceability for the items in question.

Column 7 shows the number of NCR items for which traceability was established using other Project Quality Assurance documentation. Those items were originally marked as nonconforming because the stores request or physical identification information was inadequate. The traceability information generated by the requirements of Section 5 of the PGCo Quality Assurance Manual was evaluated. This traceability information, which was in

the form of traceability numbers documented in the data package, was evaluated to assure that it was applicable to the installation. Also in this column are NCR items for which additional reviews were done of the PGCo drawing revisions which controlled the modification of large bore piping spools. This review verified that the modifications were accomplished according to the drawing and therefore that the vendor items were traceable to the documentation.

Column 8 shows the number of NCR items found acceptable by reference to other information, including vendor documentation, to establish traceability for the items.

1.B Items Cut-Out

Out of a total of 25,815 items inspected in the MTV program, only 145 items were required to be cut-out due to indeterminate traceability. The distribution of items where traceability could not be established are shown in Table IV-2. As discussed in Chapter V on interpretation of findings, each of those items has been evaluated for design significance.

Column 1 in Table IV-2 shows the number of items cut-out due to multiple heat numbers documented for the same item.

Because supplemental review did not resolve the discrepancy, the items were cut-out and replaced. 25 items were cut-out and replaced for this reason.

Column 2 shows the results of a material usage review performed if the stores request did not indicate sufficient material was issued from stores to cover the length of pipe or number of fittings needed to complete the specific installation in question. 16 items were cut-out and replaced for this reason.

Column 3 gives the number of items cut-out because neither stores requests nor field markings were located and no other pertinent traceability

documentation could be found to verify traceability. 59 items were cut-out and replaced for this reason.

Column 4 shows the items cut-out because the physical identifications and/or stores request could not be identified with either an acceptable heat number from the heat number log or other pertinent traceability documentation. 44 items were cut-out and replaced for this reason.

Column 5 includes 1 item that was cut-out and scrapped due to a piping reroute prior to the disposition of the NCR.

2. DISPOSITION OF INSTALLATION ACCEPTABILITY NCR ITEMS

This section describes the disposition of items identified as nonconforming for reasons of questionable item installation acceptability. The discussion is divided between acceptable items and cut-out and replaced items.

2.A Accept-As-Is Items

Out of a total population of 135 items identified on NCRs dealing with installation acceptability, all items were dispositioned as acceptable. The distribution of the 135 items that were accepted by the dispositioning process are grouped on Table IV-3. Columns 1 through 3 set forth the items originally identified as having material characteristics not meeting the Sargent & Lundy installation specification, namely differences in: class, material or item type, or schedule.

For items originally identified as not meeting the class requirements, acceptable dispositions are categorized as follows:

- The item was later found to be outside the boundary covered by the ASME Code; and therefore, the class designation was not applicable.

- Additional non-destructive testing and/or documentation upgrade was accomplished demonstrating that the material met the class requirements.

- The provisions of paragraph NX-2610 in the Winter 1975 Addenda of the ASME Code and Code Cases 1713 or N-242-1 were utilized to accept materials for the applicable Class requirements. These provisions allow alternate means to accept materials that were not originally procured in total compliance with the quality system requirements of the ASME Code.

All items of the type discussed above are shown in Column 1 of Table IV-3.

Columns 2 and 3 identify items for which material type or item or schedule was substituted for that shown in the installation specification. A Sargent & Lundy review demonstrated that either the item was not actually a nonconformance or the substitution was acceptable and met the applicable ASME Code design requirements.

In cases for which a physical identification was not located or was illegible on an item, or for which a PGCo applied field marking was identified without a supporting stores request, digital thickness measurements (DTMs) were taken on the pipe, if possible, for comparison to the applicable installation specification. Column 4 identifies those items for which the DTM indicated the thickness was less than that required by the material specification. An NCR was written in each instance. In each case, the item was reviewed by Sargent & Lundy to determine whether or not the item could maintain its design function with the measured wall thickness. In a few of those cases, the Sargent & Lundy review indicated that the item was indeed within the minimum acceptable wall thickness and that the NCR need not have been written. For all cases in the "DTM WALL VIOLATION" category, the evaluation resulted in the items being accepted as-is.

The fifth column contains all remaining items that were dispositioned acceptable. All items in this category were dispositioned accept-as-is by

locating necessary documentation including vendor supplied documentation when not supplied with the material. 14 items are thermowells which were dispositioned acceptable with the use of Code Case 1713.

2.B Items Cut-Out

Out of a total of 25,815 items inspected in the MTV program, no item was required to be cut-out for reasons of material acceptability.

Table IV-1

Distribution of Traceability NCR Items by Disposition for Acceptance

Category	1 Stores Request Located	2 Physical ID Located	3 Recording Error Engineering Evaluation	4 Physical ID Engineering Evaluation	5 Class 1&2 ≤ 3/4"**	6 Class 3 Accep.**	7 Suppl. Docu.	8 Other
Small bore								
Traceability required	3	24	1	7	0	0	9	3
Traceability not required by ASME code	6	49 *	5	17	3	3	11	8
Large bore								
Traceability required	9	17	3	12	0	0	66	11
Traceability not required by ASME code	23	28	1	8	0	29	240 *	4
Integral attachments								
Traceability required	0	0	0	0	0	0	0	0
Traceability not required by ASME code	20	2	0	5	0	0	18	2
Total	61	120	10	49	3	32	344	28

* One item from each of these categories was cut out due to a piping reroute, however the items were acceptable.

** Except for items in these columns, even though traceability was not required as indicated, disposition verified unique heat number traceability.

Table IV-2

Distribution of Traceability NCR Items by Disposition for Cutout

Piping Category	1 Multiple HT Nos.	2 Stores Request Footage Incomplete	3 No Stores Request and No Physical ID	4 Stores Request and/or Physical ID Unknown	5 Other
Small bore					
Traceability required	12	2	0	2	0
Traceability not required by ASME code	4	14	13	20	1
Large bore					
Traceability required	6	0	28	15	0
Traceability not required by ASME code	2	0	15	4	0
Integral attachments					
Traceability required	0	0	0	0	0
Traceability not required by ASME code	1	0	3	3	0
Total	25	16	59	44	1

Table IV-3

Distribution of Installation Acceptability NCR Items by Disposition for Acceptance

Piping Category	1 Wrong Class	2 Wrong Material	3 Wrong Schedule	4 DTM Wall Violation	5 Other
Small bore					
Traceability required	2	4	7	0	0
Traceability not required by ASME code	3	1	20	13	0
Large bore					
Traceability required	3	3	4	0	12
Traceability not required by ASME code	11	1	3	5	13
Integral attachments					
Traceability required	0	0	0	0	0
Traceability not required by ASME code	27	2	1	0	0
Total	46	11	35	18	25

V. DESIGN SIGNIFICANCE EVALUATION

In conjunction with the Braidwood MTV Program, 84 NCRs identifying 145 hardware items dispositioned for removal were evaluated for potential design significance. This evaluation was designed to determine whether or not any item removed would have represented a deviation from applicable ASME Code design requirements if it had not been replaced. This determination gives assurance that all safety related functions could have been performed within Code design limits under design loading and conditions.

1. DESCRIPTION OF ITEMS EVALUATED

Except for five items, all 145 items cut-out have been saved for further evaluation. As a conceptual measure of the small magnitude of the total items cut-out, all items could be transported in a 4' x 6' container. These items are stored for future access and examination on three shelves of a 10' x 20' area of a CECo warehouse on site.

The 145 cut-out items were determined to be distributed as shown in Table V-1. This table gives a breakdown by ASME Code Class, item size, and system pressure rating class. The system pressure rating class was determined by the Sargent & Lundy piping design table specified for the particular item. 300-lb Class and less is considered low pressure application; 600-lb Class and greater is considered high pressure application.

Seven of the eight Class 1 cut-out items were 1-inch diameter radiographic access plugs. The remaining item was a section of 2-inch nominal diameter Schedule 160 stainless steel pipe, approximately 45 inches long, located in piping line number 1CVA3B2. This line serves as the header for the reactor coolant hot and cold leg drains to either the excess letdown heat exchangers or the reactor coolant drain tank.

The remaining 137 cut-out items were ASME Class 2 and 3 and together consisted of the following material:

- approximately 130 feet of small bore (2-inch and less) piping pieces

- 19 small bore (2-inch and less) fittings
- 12 1-inch radiographic access plugs
- 80 feet of 3 and 4-inch nominal diameter piping pieces (approximate)
- approximately 16 feet of large bore (greater than 4-inch) piping pieces
- 7 welded attachments out of a total of 492 attachments within the scope of the MTV Program.

These quantities compare to total MTV Program scope of approximately 20,000 feet of large bore pipe and 50,000 feet of small bore pipe.

2. EVALUATION

The design significance evaluation of the MTV cut-out items consisted of three phases. Phase I included an evaluation by Sargent & Lundy of each cut-out item (either "as-installed" prior to removal or after removal) for verification of correctness of critical attributes required by the designer (Sargent & Lundy) in the installation specification. Such critical attributes included item size, wall thickness, rating, dimensional specifications (where appropriate), and material. Data was colleted by inspection for manufacturer's identification markings, physical measurements involving ultrasonic thickness, micrometer and scale measurements, and magnetism testing for crude material evaluation.

Phase II included a review by Sargent & Lundy of the piping analysis stresses, at the locations of the cut-out items in the piping system to assess the design margin available.

Phase III where required included a detailed examination of the material properties of the cut-out items to provide assurance that the material met the requirements of the ASME/ASTM material specifications for the item specified. Each available item

which did not have a readily identifiable manufacturer's mill marking physically located on the item identifying complete ASME/ASTM material specification and grade if required, was subjected to a chemical analysis performed by an independent laboratory, Taussig Associates. Cut-out items later found to have manufacturer's mill markings were considered to be adequately and correctly identified to the material specification and required no further confirmatory testing. The chemical analysis for the remaining items was performed to ensure that the chemical composition of the subject material met material specification requirements.

Additionally, 16 cut-out items (approximately 14% of the cut-out items which did not have manufacturer's mill marking of the material specification), were subjected to mechanical testing.

The mechanical testing was performed to provide further assurance that material tensile strength, yield strength, and percent elongation properties met the applicable ASME/ASTM material specifications. The items which were mechanically tested were selected based on specimen size constraints, ability to retest (if needed), and criticality level of the intended service application.

3. RESULTS AND CONCLUSIONS

From the cut-out item examination, testing and evaluation performed, it can be concluded that the material which had been dispositioned to be removed was adequate for the intended service, and met all applicable ASME Code design requirements. Additionally, nearly all of the cut-out items (136 of 145 items, or 94%) were found to comply with all verified critical attributes as specified by S&L in the installation specification. The remaining 9 items (6%) (seven radiographic access plugs and two pipe stanchion welded attachments) were found to deviate from specification requirements in certain aspects. None of these deviations were found to be significant. Cut-out items found to be lacking in a design attribute were evaluated and found to be acceptable for the intended service, in that pressure boundary integrity was shown to be maintained at stress levels within ASME Code design allowables.

No cut-out items were located in piping regions of high stress. The vast majority of cut-out items (over 97%) exhibited 50% or greater stress margin to the ASME Code design allowable stress, and of the 3% remaining, the minimum available margin was 34%. In consideration of these large margins to ASME Code allowable stress, the precise determination of material tensile strength and yield strength for each cut-out item was not warranted to establish cut-out item adequacy.

It is concluded that all cut-out material could have been safely utilized to perform its intended safety function.

A detailed discussion of the results and evaluation is presented in Appendix C.

Table V-1

MTV Cutout Item Profile

Piping Category	ASME Class 1	ASME Class 2	ASME Class 3	Totals
1. Up to 3/4" diameter				
a. 300-lb class and less	0	7	15	22
b. 600-lb class and greater	0	9	2	11
2. 1" to 2" diameter				
a. 300-lb class and less	0	8	23	31
b. 600-lb class and greater	1	7	0	8
3. 2-1/2" to 4" diameter				
a. 300-lb class and less	0	8	13	21
b. 600-lb class and greater	0	15	1	16
4. 6" to 8" diameter				
a. 300-lb class and less	0	0	2	2
b. 600-lb class and greater	0	1	3	4
5. 10" diameter and greater				
a. 300-lb class and less	0	3	0	3
b. 600-lb class and greater	0	1	0	1
6. Radiographic access plugs	7	12	0	19
7. Attachments	0	2	5	7
Totals	8 items	73 items	64 items	145 items
	6%	50%	44%	100%

VI. SUMMARY OF RESULTS AND CONCLUSIONS

1. 25,815 items were verified under the MTV Program for traceability and acceptability.

   - 21,167 items were determined to have both field identification and stores request identification.

   - 20,214 items (95%) had matching field and stores request identification without resort to supplemental records.

   - 20,604 items (97%) had matching field and stores request identification after reconciliation of partial field identification.

   - 20,948 items (99%) had matching field and stores request identification after reconciliation of minor recording errors associated with either the field or stores request identification.

   - Only 219 items (1%) had field and stores request identification that could not be reconciled based on the initial document review.

   Based on the above results, the Stores Request System is judged to be reliable.

2. Of the 25,815 items reviewed, only 792 items (3%) had apparent identification discrepancies that brought into question the traceability of the item. All such items were documented on NCR's and were further evaluated.

   Of the 792 items documented on NCRs due to apparent discrepancies in the traceability of the item, only 145 items (0.5%) of the total items verified (25,815) were required to be cut-out.

Of the 145 items cut-out all were judged based on analysis and testing to meet ASME Code design requirements and, therefore, to be capable of satisfying their safety-related function.

3. Of the 25,815 items reviewed, only 135 items (0.5%) had apparent acceptability discrepancies that brought into question the acceptability of the item. All items with apparent discrepancies were documented on NCRs and were further evaluated.

   Of the 135 items documented on NCRs due to apparent discrepancies in the acceptability of the item, none of the items were required to be cut-out, and all were shown based on evaluation to meet ASME Code design requirements and therefore, to be capable of satisfying their safety-related function.

4. On the basis of the reliability of the Stores Request System demonstrated in Section 1, above, and the overall traceability of materials demonstrated in Section 2, above, the Phillips, Getschow Company Piping Material Traceability Program (MTV) has been demonstrated to be effective.

5. On the basis of the demonstrated acceptability of materials installed by Phillips, Getschow Company during the period verified within the MTV Program, the Phillips, Getschow Company Piping Material Control Program has been demonstrated to be effective.

6. Although a limited number of apparent discrepancies were identified by the MTV Program, no discrepancy was determined to have design significance in as much as all discrepant items, including those few items (0.5%) cut-out based on irreconcilable records, are judged to be within ASME Code design requirements. No discrepancy was shown after analysis and testing to have more than minor significance. On this basis, all items reviewed under the MTV Program were verified as capable of satisfying their safety-related function.

APPENDIX A

SUPPLEMENTARY REPORT ON MTV PROGRAM BY THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

The National Board of Boiler and Pressure Vessel Inspectors

1919 66 1985
ANNIVERSARY

September 26, 1985

Mr. Cordell Reed, Vice President
Commonwealth Edison Company
P.O. Box 767
Chicago, IL 60690

SUBJECT: National Board Audit of the Braidwood Nuclear Power Station
Units 1 & 2, Braidwood, Illinois

Material Traceability and Verification Program (MTV)
Supplementary Report

Dear Mr. Reed:

Commonwealth Edison Company (CECO), in a letter dated November 9, 1984 to Mr. S. F. Harrison, then Executive Director of the National Board of Boiler and Pressure Vessel Inspectors (NBBPVI), requested the National Board to conduct an independent audit of the Braidwood Station. The purpose of the audit was to address specific Nuclear Regulatory Commission (NRC) concerns about ASME fabrication at the Braidwood site. The National Board Audit Team (NBAT) arrived on the Braidwood Nuclear Power Station site on February 18, 1985.

Of the various ASME concerns which had been identified by the NRC, the one of prime interest to the NBAT was the Material Traceability and Verification Program (MTV). The MTV program was initiated because of concerns raised by the NRC and others about the receipt, release, control and identification of materials used in the construction of the ASME Code piping systems at the Braidwood site. It was their contention that the ASME Code required documented verification of material identification and acceptability for use at the point of installation by quality control personnel. The NBAT was requested to make an evaluation of the adequacy of the Phillips, Getschow Company's (PG-Co) "stores request system" for providing ASME Code required material traceability. The NBAT was also requested by CECO to assess the scope and adequacy of the MTV program as a corrective action method to identify and disposition any items whose traceability was indeterminate.

To accomplish this evaluation, the NBAT initially undertook an assessment of the "stores request system" as described in the current PG-Co quality assurance program manual and all historical revisions. Having completed this evaluation, the NBAT is of the opinion that there is no basis for believing that PG-Co's quality assurance program, as described in the quality assurance manual, did not meet the requirements or intent of the 1974, Winter '75 Addenda of the ASME Code, Section III, Para. NA-4441. This, we believe, is also consistent with the opinions of the several ASME survey teams who have surveyed the PG-Co program for ASME accreditation purposes.

While the NBAT is of the opinion that the PG-Co's Q.A. Program met ASME Code requirements, we also recognized that there were deficiencies in its implementation. These deficiencies were specifically in the areas of:

A) Transfer of material identification after cutting and prior to installation.

B) Loss of control documents which provided material traceability.

To provide the necessary audit and overview activities requested by CECO, the NBAT determined the following activities be carried out:

1) Evaluate MTV procedures and work instructions.

2) Perform an overview of disposition of nonconformance reports (NCR's) which were material traceability related.

3) Conduct an audit of MTV data input, including PG-Co stores requests only.

4) Perform an audit of the current PG-Co Material Identification and Traceability Program.

The following sections of this report describe the NBAT's actions and conclusions of Items 1 through 4 above.

1. MTV PROCEDURES AND WORK INSTRUCTIONS:

PG-Co MTV Procedure B31 and Implementing Work Instruction PGWI-17 were evaluated. The procedures addressed only large and small bore piping materials, including fittings and attachments, as well as stamped piping subassemblies Further, the MTV procedures addressed only large bore items installed prior to January 1, 1983 and small bore items prior to September 6, 1983, as those were the implementation dates of the revised PG-Co quality procedures requiring documented quality control verification of material identification at the time of installation for large and small bore items respectively.

The MTV procedures required a 100% field walkdown of the above described piping systems by quality control inspectors trained to the requirements of the MTV procedures. During the walkdowns all material identification markings were required to be recorded in the MTV packages. The data gathered was then to be compared to the information recorded on the stores requests (material issuance documents) that, by procedure, were required to contain a description of the material issued by specification, grade, type, size, schedule, class, heat/lot or code number and quantity, along with the drawing number against which the items were issued.

The procedures also required that the traceability data gathered be verified to certified material test reports (CMTR's) or Code data reports and procurement documents as traceable items for correct material specification, type, grade, class, size and schedule.

Further, the procedures required that items not traceable to the material certifications through physical markings on the items or documentation (stores requests) traceable to the items be considered unacceptable, and be documented on NCR's and dispositioned in accordance with ASME Code requirements.

NBAT Opinion

The NBAT is of the opinion that the procedures and work instructions contained an effective method of confirming or denying material traceability within the scope of the PG-Co quality program used for installation of items at the Braidwood station.

2. NONCONFORMANCE REPORT OVERVIEW:

It was determined by the NBAT that we take an active part in the review of the disposition of material traceability related NCR's where dispositions were provided jointly by Commonwealth Edison, Sargent & Lundy, and Phillips, Getschow to insure compliance with ASME Code requirements. This commitment was made during the week of May 27, 1985, and our activity began June 3, 1985. The NBAT actively participated in the review for disposition of 85% of all MTV related NCR's. Our records indicate that 366 NCR's were written against 726 individual items. The NBAT provided an independent overview of 310 of these NCR's.

NBAT Opinion

The NBAT is of the opinion that the dispositions approved by the Certificate Holder (PG-Co) and Owner (CECO) and accepted by the Authorized Inspection Agency (AIA) will result in Code compliance for those specific items.

3. AUDIT OF MTV DATA INPUT:

The NBAT prepared an audit plan and checklists designed to confirm the validity of the MTV data input. In order to provide an unbiased audit sample of sufficient size commensurate with the NBAT manpower level, it was determined that it would be necessary to utilize PG-Co's quality control personnel to provide the reverification walkdowns and input data for the NBAT's use. To accomplish this, the NBAT randomly selected 20 small bore and 30 large bore piping MTV packages used by PG-Co. The original MTV files were signed out to the NBAT and locked in our files to preclude PG-Co's quality control personnel access to the original data.

PG-Co was then requested to prepare MTV verification packages in accordance with its MTV procedure QCP-B31 and to reinspect the items in each package as had originally been done. These packages, along with any additional documentation required for validation, were then compared by the NBAT to the data

in the original MTV data packages. This verification was done in accordance with the NBAT's "Verification of MTV Data" instruction and checklist.

The sample size was reduced to 47 MTV packages, in that 3 of the original packages selected were for containment spray piping and at that time were inaccessible. The NBAT determined that if the audit of the reduced sample indicated any problems with the MTV data, the sample size would be increased.

To facilitate the audit, the NBAT required copies of all supporting documentation for the MTV packages. This included MT/PQ logs, material receiving records, and manufacturers' data reports for fabricated subassemblies.

The audit addressed the traceability of approximately 613 individual items based on an average of 13 items per package. The sample size represents 2.3% of the entire population of MTV items.

In addition, the NBAT conducted an audit of 50 installed items whose traceability was established based on a stores request document only. The audit confirmed the integrity of the stores request system.

NBAT Opinion

The NBAT found that the scope and accuracy of the MTV program as implemented and confirmed by our audit verified that all items whose traceability was not confirmed were identified, and removed or dispositioned in accordance with the requirements of the PG-Co quality assurance program and the ASME Code.

4. AUDIT OF CURRENT PG-CO MATERIAL TRACEABILITY:

The NBAT conducted an in-depth implementation audit of the current PG-Co procedures QCP B4.0, B4.1, and B4.2 during the period from June 10 to July 12, 1985. These procedures address the receiving inspection, storage and handling, issue and control of materials.

The intent of this audit was to determine whether the deficiencies which caused the development of the MTV program had been corrected.

The audit specifically addressed material issuance and traceability since January 1, 1983 for large bore piping and since September 6, 1983 for small bore piping. These were the implementation dates for the above procedures.

NBAT Opinion

The NBAT audit conclusion is that the procedures presently in effect contain the necessary controls to insure material traceability and identification. Our audit results also indicate that the procedures are being implemented.

GENERAL CONCLUSIONS

The NBAT has come to the following conclusions after our comprehensive review and audits of the MTV program and related documentation:

... The Phillips, Getschow quality assurance program as written did provide the necessary controls to assure that the work performed by PG-Co at the CECO Braidwood Nuclear Power Station met the requirements of the ASME Code and the certified design specification.

... As noted previously in this report, there were implementation deviations from the PG-Co quality assurance program's requirements.

... These deviations led to the generation of the MTV program and the resulting revisions to the PG-Co quality assurance program and material control procedures.

The NBAT accepts the MTV program as a corrective action. The purpose of corrective action is to:

a) document conditions which are adverse to quality.

b) determine the cause of the problem.

c) take corrective measures which will correct and prevent the recurrence of the problem.

This, we believe, has been done.

Based on our review and audit of data compiled by PG-Co and CECO, the NBAT has found that items where traceability was in question are identified and are being dispositioned in accordance with the requirements of the PG-Co program and the ASME Code.

It is the NBAT's considered opinion that the corrective actions which were taken to correct deficiencies in the material control procedures at the Braidwood site are effective and have identified those instances where material traceability may have been lost. Additionally, we believe that the revisions made to the program and procedures will prevent the recurrence of these deficiencies.

The NBAT wishes to express our appreciation to CECO, PG-Co and others for their cooperation and assistance in the conduct of this audit.

As identified earlier, this is a supplementary report and no response is necessary.

Respectfully submitted,

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APPENDIX B

CLASS 1 NDE MARKINGS

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CLASS 1 NDE MARKINGS

The ASME Code requires that a record of NDE be retained for Class 1 materials, unless it can be shown that one of the following exemptions is satisfied:

1. For piping material less than or equal to 1 inch, Class 2 design rules may be used for Class 1 installation. Class 2 rules do not require NDE. (NB-3630(d))

2. For piping material greater than 1 inch but less than or equal to 2 inches, NDE is not required if the stress level of the installation satisfies a lower stress allowable (NB-2510(a)) than would otherwise be required for Class 1 installations when NDE is performed.

As a consequence of a concern unrelated to material traceability, the MTV Program was used to verify the adequacy of Class 1 materials.

For small bore piping, 1,043 items inspected received NCR's due to inadequate NDE records, approximately 40% of the Class 1 small bore piping items. For large bore piping, 3 items received NCR's due to inadequate NDE records, less than 1% of the Class 1 large bore piping items.

Most of these discrepancies appear to have occurred because of changes in the installation specification that defined the NDE requirements as well as the NDE marking practices employed at that time. Originally, the installation specification did not require NDE for small bore piping in the expectation that the Code allowed exemptions would be applicable. Much of the small bore piping material was purchased and received onsite in conformance with this specification without NDE required. Subsequently, the installation specification was changed to require NDE for small bore piping. At that time nearly half of the small bore piping material had already been installed. The MTV Program was used to locate this material.

Commonwealth Edison sent some of the already purchased materials remaining in stores to be tested in order to satisfy the specified NDE requirements. This material was returned to stores with the proper markings and subsequently disbursed to the field for installation. When Phillips, Getschow Company cut the small bore pipe for installation, the material heat numbers were transferred thus maintaining traceability but the NDE markings may not always have been transferred. The MTV Program was used to locate these items as well.

For each item that the record for NDE on Class I piping materials did not meet the Class I requirements or could not be shown to satisfy the exemption requirements provided in the ASME Code, NDE will be performed and documented.

Approximately 878 items have been successfully dispositioned for use as-is. The acceptable disposition of the remaining 1-1/2 inch and 2-inch fittings is contingent upon successful nondestructive examination. This work has yet to be completed.

APPENDIX C

DETAILED RESULTS OF DESIGN SIGNIFICANCE EVALUATION

APPENDIX C

DETAILED RESULTS OF DESIGN SIGNIFICANCE EVALUATION

A. PHASE I

Of the 145 cut-out items dispositioned to be removed, 133 items were found to meet all verified critical attributes as specified (size, wall thickness, rating, dimensional specifications where appropriate and material specifications where determinate by manufacturer's mill markings).

Three cut-out items of the total of 145 cut-out items could not be physically verified in the Phase I evaluation, since the material was not available for examination (i.e., these three cut-out items were not retained). These items included one ASME Class 3, 2"x3/4", 6000-lb socket-weld reducing insert (PGCo NCR 2516), one ASME Class 2 radiographic access plug (PGCo NCR 3300), and one ASME Class 2, 1/2-inch nominal diameter, 6-inch long schedule 160 stainless steel pipe (PGCo NCR 3992). Each of these items was found to be acceptable, however, using comparative evaluations and excess design margin to Code allowable stress.

The nine remaining cut-out items consisted of seven radiographic access plugs and two pipe stanchions. The results of the Phase I evaluation of these items is detailed below.

Seven radiographic access plugs of the total number of nineteen access plugs in the MTV cut-out population did not completely conform to the dimensional specifications required by the applicable standard, Pipe Fabrication Institute Standard ES-16. The questionable plugs were reported under PGCo NCR's 1742, 1931, 1871, 2177, 2434, and 3275.

All seven plugs were used in ASME Class 2 piping, up to 600-lb Class design (1-600-lb Class, 4-300-lb Class, 2-150-lb Class). All seven access plugs were found to be one-inch diameter access hole plugs, and met specified thread diameter and thread size. However, these seven plugs were found to deviate dimensionally with respect to the machined neck dimensions, which is the unthreaded region on the plug shank

directly below the plug head. The deviations reduce the effective thread engagement of the plug. It is noted that the applicable standard also specifies that the plug must be sealed all around with a 3/8-inch fillet weld to the pipe upon completion of radiography. An engineering evaluation of the discrepant plug dimensions found that all seven plugs were acceptable, in that the reduced effective thread engagement was determined to be adequate, in all cases, to maintain pressure boundary integrity within ASME Code allowable stresses. This evaluation was conservative in that it did not take credit for the 3/8" fillet weld seal which, by itself, would maintain pressure boundary integrity.

Thus, it is concluded that the seven discrepant radiographic access plugs deviated from specified dimensional requirements in minor respects, resulting in no significant degradation from specifications, and resulted in no design-significant deviations.

Two 18-inch diameter pipe stanchions, both welded attachments for pipe support number 1SX02061X, reported under PGCo NCR 3474, were found to have sections of pipe wall slightly below the allowable mill tolerance per the applicable ASME/ASTM material specification. The two pipe stanchions were specified as 18-inch Schedule 40 pipe per SA106 Gr B, ASME Class 3. The required minimum wall thickness per material specification (nominal wall minus 12.5%) is 0.492 inch. Actual measured wall was found to be as low as 0.462 inch, 0.030 inch less than the minimum specified (6.5% reduction). Review of the design calculations revealed, however, that the stanchion design had been qualified based on thinner, standard wall pipe (0.375-inch nominal wall), and therefore, the slight reduction in wall from the as-specified condition has no design significance. No revision to the calculation was required since the hardware was more conservative than initially specified.

The following discussion integrates the results of the Phase II and III evaluation, with the Phase I evaluation, for the nine cut-out items which were found to deviate from specification requirements as previously discussed.

In all nine cases, the discrepant cut-out items were found to be located in piping regions subject to relatively low stress levels, less than 50% of the ASME Code allowable stress values, in the Phase II evaluation. Additionally, all nine cut-out items were subjected to chemical analysis during the Phase III testing program, and were found to meet the chemical composition of the ASME/ASTM material specifications required by design. Because of the small sizes of the nine cut-out items in question, specimens of the proper size could not be obtained to perform testing for mechanical property verification.

Based upon the above, the nine cut-out items which were found to deviate in minor respects from specification requirements were determined to be adequate for their intended service, and met all ASME Code design requirements.

B. PHASE II

Phase II included a review of the analyzed piping stresses in the regions of the cut-out items.

The evaluation of piping stress ratios for the cut-out items was conducted for the following purposes:

1. The piping stress ratio serves as an indicator of the level of performance demanded of the cut-out item.

2. The piping stress ratio determination was required to assess the need to subject cut-out items to extensive mechanical testing, in addition to the chemical composition verifications performed in Phase III, to establish cut-out item adequacy. If considerable margin was found to exist, to the point that mechanical properties (tensile strength and yield strength) could not reasonably vary to the extent necessary to be significant in the determination of the cut-out item's adequacy, then confirmation of correct chemical composition alone would be considered as acceptable evidence demonstrating the cut-out item's conformance to material specification requirements.

The piping stresses extracted from the associated piping analyses reflect the highest theoretical stress levels that could be achieved during design-basis events, as determined by ASME Code stress equations. These values are very conservative, for the following reasons:

1. During normal operation, actual stress levels will be considerably lower than those indicated.

2. Stress values could have been lowered appreciably in many cases by further detailed analysis using analytical input criteria more specific (less enveloping) for the individual piping regions of concern.

3. No attempt has been made to reduce stress values based on recently relaxed analysis damping factor criteria.

The following is a summary of the piping stress conditions existing at the cut-out item locations:

Number of Cut-Out Items	% Code Allowable Stress
141 (97.2%)	less than or equal to 50%
2 (1.4%)	51 to 60%
2 (1.4%)	61 to 70%
0	greater than 70%
145 TOTAL	

97.2% of the cut-out items were found to be subjected to stresses less than or equal to one-half of the ASME Code allowable stress levels, and are characterized as low stress items. 2.8% of the cut-out items were found to be subjected to mid-range stress levels (51-70% range). Actual stresses in this group were found to vary from 56% to 66% of ASME Code allowables. No cut-out items were found to be subjected to high stress levels. It is noted that the ASME Code design allowable stresses themselves include an inherent safety factor of 4 to 1 (tensile strength to allowable stress ratio for ASME Class 2 and 3 systems).

Due to the large margin available (minimum margin of 34%, and 50% or more in the vast majority of cases), it was deemed adequate to establish material specification conformance on the basis of chemical composition tests, where required, and 100% testing for cut-out material tensile property verification was not warranted to establish cut-out item adequacy. This assessment was further substantiated through a search of other ASTM piping materials for which the chemical analysis results of Phase III could have applied. No materials were found to exhibit minimum tensile strengths low enough to result in the subject material's inability to perform intended safety functions if it had been inadvertently installed. Mechanical testing was performed, however, on a specially selected sample to provide further assurance that material tensile properties were acceptable. The mechanical testing sample selection and results are discussed in the Phase III section of this appendix.

The following discussion focuses on the four cut-out items found to be in the mid-range stress level.

Two cut-out items were determined to be in piping regions experiencing stress levels in the range of 51 to 60% of allowable stress. These two items are summarized below:

<u>PGCo NCR 2073</u> MTV Item 3, 3-inch nominal diameter, Schedule 160 stainless steel piping spool, approximately 1 foot long, ASME Class 2. This pipe is located in piping line number 1CV10AA3, in the Regenerative Heat Exchanger 1A (Eqt No. 1CV03AA) discharge, downstream of check valve 1CV8320A. Maximum piping analysis stress level, 56% of allowable.

<u>PGCo NCR 3318</u> MTV Item 3, a 3x3/4-inch 3000-lb sockolet located on piping line number 1CV03B3, a 3-inch Schedule 40S stainless steel line; ASME Class 3. This 3-inch line serves as supply line from the mixed bed and cation bed demineralizers to the reactor coolant filter. Maximum piping stress level is 56% of allowable.

Two cut-out items were determined to be in piping regions experiencing stress levels in the range of 61 to 70% of allowable stress. These two items are summarized below:

PGCo NCR 2505 MTV Item 9, a 2x3/4-inch 6000-lb socket-welded reducing insert located on piping line number 1CC54AA2, a 2-inch Schedule 160 carbon steel line, ASME Class 3. This line serves as a component cooling water return line for Reactor Coolant Pump 1A. Maximum piping stress level is 64% of allowable.

PGCo NCR 2511 MTV Item 2, a 3-inch nominal diameter Schedule 160 stainless steel piping spool approximately 10-inches long; ASME Class 2. This pipe is located in piping line number 1CV01CC3, which is one of three lines in the Regenerative Heat Exchanger discharge to the Letdown Heat Exchangers. Maximum piping analysis stress level is 66% of allowable.

The following discussion integrates the results of the Phase I and Phase III evaluations with the Phase II evaluations, for the four identified items of mid-range stress.

Two of the above four cut-out items are small fittings. In the Phase I evaluation, both of these fittings were found to carry as specified manufacturer's mill markings identifying ASME/ASTM material specifications and fitted rating, thus providing confidence that the materials were correct. The remaining two items were short spools of pipe, which did not exhibit manufacturer's markings. These two items were chemically analyzed during the Phase III testing program and were found to meet the chemical composition of the ASME/ASTM material specifications required by design. Because of the small size of these pipe spools, specimens of the proper size could not be obtained to perform additional testing for mechanical property verification, and these items were not included in the tensile testing sample. However, based on the satisfactory results obtained from the samples which did undergo mechanical property tests, and the stress margin available, it was judged that the use of the properties associated with the as-specified ASME/ASTM material

was appropriate, in the Phase II piping stress evaluation. On this basis, these pipe spools were determined to be adequate for their intended service.

C. PHASE III

Phase III consisted of a detailed material evaluation, where required, to verify that certain cut-out items met the requirements of the applicable ASME/ASTM material specifications.

For 34 of the 145 cut-out items, ASME/ASTM material specification was confirmed as follows:

- 31 items were found to be physically marked, by the manufacturer, with ASME/ASTM material specification and grade.

- 1 item was found to be physically marked, by the manufacturer, with a neat number that was the same as a similar cut-out component which also had manufacturer's marking of ASME/ASTM material specification, as well as heat number.

- 2 items which were not available for physical examination in Phase I, as they were not retained in storage, were found to be acceptable by further evaluation and need not have been cut-out. ASME/ASTM material specifications were confirmed for both items (PGCo NCR's 2516 and 3300), as described in the results of the Phase I evaluation.

For these 34 cut-out items, material type/grade was considered established, and no further testing was warranted. In each case, the as-found material matched the as-specified ASME/ASTM material specification.

As discussed in the Phase II results, the confirmation of correct chemical composition was considered to be acceptable evidence demonstrating that the materials of the subject cut-out items were adequate for their intended service. This criteria is further validated in that, project-wide, very few types of carbon

steel and stainless steel piping materials have been specified. The types of piping materials that are specified are commonly used materials which are readily available. More exotic, restrictive carbon and stainless steel piping materials are not used on the project. Thus, if material can be established to meet the chemical properties of the specified carbon or stainless steel, it is unlikely to be anything else.

Of the remaining 111 cut-out items which did not physically identify material specification by the manufacturer, 108 cut-out items were subjected to chemical analysis in accordance with ASTM A751 by an independent laboratory (Taussig Associates, Inc.) under S&L Consultation Specification 121. The results of the chemical analysis of these 108 cut-out items are presented in Taussig's Report No. 64188-1, dated October 8, 1985. The independent laboratory found that all of the 108 cut-out items conform to the applicable ASME/ASTM material specifications, and that no evidence of any unusual alloying elements was identified.

Two of the three remaining cut-out items of the total 111 items for which ASME/ASTM material specification could not be confirmed by manufacturer markings, reported under PGCo NCR 3492 (ASME Class 2, 3/4-inch Schedule 40S pipe, approximately 3 inches long) and PCGo NCR 4756 (Item 128) (ASME Class 2 1-inch Schedule 40S pipe, approximately 6 inches long) could not be subjected to chemical analysis, in th these cut-out items were inadvertently lost after removal. Prior to removal, Phase I examination had found both pieces of pipe to be non-magnetic, a trait characteristic of the specified material, SA312 TP304, in each case. However, in PGCo NCR 5572, additional data was presented which would have established traceability for these two items, prior to their removal, had it been revealed earlier. Thus, based on this additional data, ASME/ASTM material specification was established.

The one remaining cut-out item of the above described 111 cut-out items, reported under PGCo NCR 3992 (ASME Class 2, 1/2-inch Schedule 160 instrument sensing line pipe approximately 6-inch long), could not be subjected to chemical analysis, in that this cut-out item was scrapped after removal, as discussed in the Phase I results. For this item, ASME/ASTM material specification could not be confirmed in Phase I

or Phase III. However, due to the extremely low stress levels for this cut-out item, as determined in the Phase II evaluation, this cut-out item was found to be acceptable in that it could have adequately performed its intended safety function.

For additional assurance that materials of the cut-out items were as specified, 16 of the 108 cut-out items which had been subjected to chemical analysis were subjected to tensile testing by the same independent laboratory. This represented approximately 14% of the total cut-out items for which material specifications were not identified by manufacturer's marking.

The selection of the cut-out items for tensile testing was based on the following criteria:

1. Size constraints - Due to the small physical size of many of the cut-out items, standard specimens for testing could not be obtained. To eliminate potential uncertainty in the interpretation of results, such cut-out items were not considered for tensile testing. The independent laboratory required minimum pipe specimen lengths of 18 inches for full-pipe testing, which was limited to 2-inch and smaller nominal diameter piping. Additionally, reduced section tensile test specimens a minimum of 10 inches long were required for testing of pipe over 2-inch nominal pipe size (section of material extracted from the pipe wall of the subject cut-out item). Many of the cut-out items did not meet these size criteria.

2. Retest capability - To ensure that adequate quantities of material would be available for retest in the event that the first tensile test performed was found to be invalid (i.e., machining flaws found, specimen breaking at elongation scribe mark, etc.), selections were generally made from cut-out items which were physically large enough to yield more than one test specimen.

3. Criticality of service - Consideration was made to ensure that selections for tensile testing included cut-out items removed from piping systems experiencing the most demanding service requirements, when possible. Eleven of the sixteen cut-out items were large bore piping. Three of these eleven

cut-out items represented the highest pressure rating/pipe size combinations from the entire cut-out population (6-inch Schedule 80 pipe under PGCo NCR 3226, 24-inch Schedule 40 pipe under PGCo NCR 3291, 6-inch Schedule 120 pipe under PGCo NCR 3422). Four of the sixteen cut-out items were small bore piping; three of the four were Schedule 160 piping. Also included in these four small bore specimens was the only Class A cut-out item in the entire population (other than radiographic access plugs), under PGCo (NCR 4756 Item 68).

4. Items to be tensile tested were collectively selected by representatives of CECo, S&L, and the NRC.

Specimens were prepared for the selected sixteen cut-out items, and tensile tests were conducted in accordance with ASTM A370 to establish yield strength, tensile strength and elongation for each specimen. The results of the tensile testing are also presented in Taussig's Report No. 64188-1. The independent laboratory found that all tensile test specimens met the tensile test requirements of their applicable ASME/ASTM specification.