



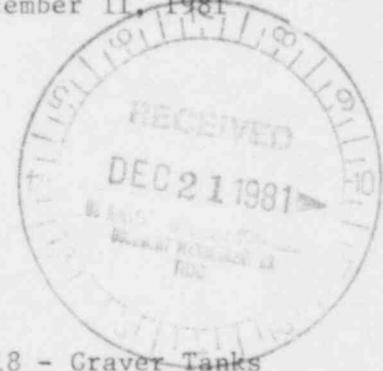
Duquesne Light

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December 11, 1981

Director of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Attn: Mr. Steven A. Varga, Chief
Operating Reactors Branch No. 1
Division of Licensing
Washington, DC 20555



Reference: Beaver Valley Power Station, Unit No. 1
Docket No. 50-334, License No. DPR-66
Followup Report - Immediate Action Letter 80-18 - Graver Tanks

Gentlemen:

The enclosed report was prepared to document the Graver Tank inspections and repairs that were initiated in response to the subject letter.

We have completed these inspections and repaired the penetrations and seams that were considered deficient in accordance with Engineering and API 650 requirements.

This problem was originally reported to you with the issuance of LER 80-025/OIT dated April 30, 1980, and LER 80-037/OIT dated June 20, 1980. A subsequent investigation by the Office of Inspection and Enforcement was documented by Report Number 50-334/80-17 and forwarded to us September 2, 1981.

This information is being forwarded to close out this issue, should you have any further questions in this regard, please contact my office.

Very truly yours,

J. J. Carey
Vice President, Nuclear

Enclosure

cc: Mr. D. A. Beckman, Resident Inspector
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I. INTRODUCTION

This report provides the details, corrective action and final conclusions resulting from investigations performed subsequent to the issuance of LER-80-025/01T dated April 30, 1980 and LER-80-037/01T dated June 20, 1980.

II. FIELD FABRICATED STORAGE TANKS

These tanks were fabricated and erected to the requirements of Engineering Specification BVS-183, Purchase Order BVC-198, which invoked API-650. The prime QC/QA functions were the responsibility of Graver. Stone & Webster, as the agent for the Duquesne Light Company, was responsible for surveillance during the erection/fabrication of the tanks.

A. Refueling Water Storage Tank - QS-TK-1

Subsequent to the initial finding of lack of fusion in one tank nozzle/shell penetration, other nozzle/shell penetration welds were examined and found not to be in accordance with the approved Engineering and Graver drawings. With the exception of two (2) roof penetrations, all other penetrations (total 16) were excavated and rewelded to meet the requirements of a full penetration weld as required by the Engineers. Since the as-found weld condition did not conform to the Engineering requirements, several calculations were performed. These calculations confirmed that, prior to repair, the 12" penetration examined would have been adequate under normal operating conditions plus seismic loadings imposed by the connecting piping. Calculations were also performed for specified roof penetrations and, although not in accordance with the drawings, these penetrations are capable of withstanding the design conditions without repair. A copy of these calculations has been submitted to the USNRC Resident Inspector.

During the weld repair of the tank nozzle/shell penetrations, a linear indication was observed in a vertical seam weld made by Graver. This indication, lack of fusion, was removed by grinding, rewelded and inspected for acceptance. The Graver seam weld radiographs were reviewed and reinterpreted by a DLC Level III examiner. Based on this review, three (3) radiographs previously accepted by Graver, were rejected. Additional radiography was performed to verify several previously taken Graver radiographs and other random locations were also radiographed. These additional radiographs were acceptable; however, the weld areas shown on the three (3) Graver radiographs that were rejected by DLC could not be re-radiographed as they were below the concrete line and, therefore, not accessible for radiography. These three (3) areas were repaired from inside the tank by surface grinding and were determined to be acceptable by ultrasonic inspection.

All necessary weld repairs have been satisfactorily completed on QS-TK-1 and the tank has been returned to service.

B. Demineralized Water Storage Tank - WT-TK-10

As a result of the as-found condition of the nozzle/shell penetrations welds on QS-TK-1, a drawing review was performed to ascertain if the same weld joint configuration, full penetration, was specified for the other Category I tanks erected by Graver. This review showed that the full penetration weld requirements and details were typical for all Category I tanks listed in the Engineering specification and shown on the Graver drawings. Information radiography performed on a segment of three (3) randomly selected penetrations in WT-TK-10 confirmed that lack of fusion existed and that repairs were necessary. Engineering instructions were issued and, with the exception of the two (2) roof penetrations, all remaining ten (10) penetrations were ground and rewelded to full penetration welds as required by the Engineers. An analysis of the safety implications involving the roof penetrations was performed which confirmed that no repairs were necessary. A copy of this analysis has been submitted to the USNRC Resident Inspector.

Concurrent with the weld repairs of the tank nozzle/shell penetrations, the Graver radiographs for the tank seam welds were also reviewed and re-interpreted by a DLC Level III examiner. This review disclosed that three (3) radiographs, originally accepted by Graver, contained code rejectable defects and were rejected by the DLC examiner. Areas previously radiographed by Graver were re-radiographed in addition to other randomly selected areas. This radiography confirmed the DLC re-interpretation of the Graver radiographs and also showed that additional code rejectable indications were present in two horizontal seams. A second set of additional radiographs was taken to determine the extent of the unacceptable condition in the two horizontal seams. These additional radiographs also contained rejectable indications and it was apparent that both entire seams were unacceptable. Both horizontal seam welds, made by Graver, were removed, repaired and meet the code requirements.

All weld repairs on WT-TK-10 have been completed and examined by the non-destructive techniques required by API-650, 5th Edition, 1973 and the tank has been returned to service.

C. Review of QS-TK-1 and WT-TK-10 Documents

As a result of the as-found conditions of the nozzle/tank shell penetrations, the following Engineering and Graver documents were reviewed:

- . Erection Control Sheets (Travelers)
- . Drawings
- . Weld rod issue slips
- . Engineering specification
- . Graver Q.A. Manual

This review disclosed that the as-found condition was not always in agreement with the Engineering requirements. The Travelers were signed indicating acceptance of inspection points; however, the as-found condition on nozzle/shell penetrations welds leads to the conclusion that certain inspection points had not been properly verified. Travelers were signed off on one day and had the appearance of being signed after the work had been performed rather than while the work was in process. As such, it appeared that the signed Graver Travelers were not representative of work actually done or inspections actually performed.

D. Primary Grade Water Storage Tanks - BR-TK-6A and 6B

Re-interpretation of the Graver radiographs, by DLC, resulted in rejecting one (1) radiograph of a seam weld, in each tank, which had previously been accepted by Graver. Engineering instructions were issued to re-radiograph the rejected weld area in each tank and to take one (1) information radiograph of the tank nozzle/shell penetrations in each tank.

1. BR-TK-6A

The results of the re-radiography showed that the seam weld had apparently been ground and the defect had been removed. The re-radiograph was acceptable; therefore, no repairs were required for any seam weld on BR-TK-6A.

Of the ten (10) penetrations in the tank, nine (9) information radiographs were taken. The vent penetration in the outer roof was inaccessible because of the floating roof inside the tank. The radiographs showed that five (5) penetrations were acceptable and that four (4) require investigation and repair. These four (4) nozzles have been repaired in accordance with instructions issued by the Engineers, and the tank meets the code and engineering requirements.

2. BR-TK-6B

Engineering instructions were issued for performing information radiography on all nozzle/shell penetrations and for re-radiographing a previously accepted Graver radiograph which was subsequently rejected by DLC. Four penetration welds (reference penetrations N1, N2, N5, N6) and one seam weld had rejectable defects and were repaired.

E. Boron Recovery Test Tanks

1. BR-TK-2A

Six penetration welds (reference penetrations NIA, NIB, N2, N3, C1, C3) and three seam welds were found to have rejectable defects and required repairs to be made. These repairs have been made and the tank was returned to service.

2. BR-TK-2B

Five penetration welds (reference penetrations NIA, NIB, N3, C1, C2) and one seam weld were found to have rejectable defects. These repairs have been made and the tank returned to service.

F. Coolant Recovery Tanks1. BR-TK-4A

Five penetration and one seam weld had rejectable defects and were repaired.

2. BR-TK-4B

One seam weld was required to be repaired on this tank.

III. REACTOR CONTAINMENT LINERA. General

The shop fabrication and field erection of the Reactor Containment steel plate liner was performed in accordance with Engineering Specification EVS-136, Purchase Order BVC-65. All shop and field welding was specified to be random radiographed in accordance with Paragraph UW-52 of Section VIII of the ASME Code for Pressure Vessels. The ASME III Code was used as a guide for the selection of materials and fabrication as described in the FSAR. As such, the Liner is not ASME Code stamped. The prime QC/QA responsibilities were Graver tank. Stone & Webster, as the agent for the Duquesne Light Company, was responsible for surveillance and auditing during erection.

A review was performed of the available Graver Tank Company construction and inspection records. The purpose of this review was to determine if these records contained irregularities similar to those previously encountered and described during review of the Graver records for the Refueling Water Storage Tank (QS-TK-1) and the Demineralized Water Storage Tank (WT-TK-10) as described in Mr. Grier's letter to Mr. Dunn dated June 26, 1980. The review of the containment liner records was conducted by a

team of personnel representing DLC-QA, the DLC On-Site Engineering Group and S&W. The following records/documents were reviewed:

- Engineering Specification for Shop Fabrication and Field Erection of Reactor Containment Steel Plate Liner, BVS-136, Purchase Order No. EVC-65.
- ASME Boiler and Pressure Vessel Code, Pressure Vessels, Division I Section VIII dated 1968 through and including Summer Addenda 1970.
- Graver Q.A. Manual
- Graver Erection Drawings
- Graver Travelers (Erection Control Sheets)
- Graver NDE Procedures and Records
- Graver Spot weld X-ray MAPS
- Graver Spot radiographs (Total 447)
- Graver Radiographic Interpretation and Techniques Sheets.
- Construction photographs

B. Anomalies Noted In Graver Records

The types of irregularities detected in the tank erection record review were not detected in the record review of the reactor containment liner; however, other anomalies were found. These anomalies are categorized and described in the following paragraphs.

1. Review of the Graver Radiographs

All available Graver Spot radiographs (447) were re-interpreted, by two (2) Level III examiners to the requirements of ASME Section VIII, Paragraph UW-52. The results of this review have been consolidated into three (3) categories:

a. Apparent Duplication of Radiographs

- (1) Three (3) sets (a set consists of 2 radiographs to the same weld area) of radiographs, appear to be the same with the exception of the weld identification number. Identifying characteristics such as the weld surface, weld contours, marks in the plate materials, slag and porosity in the weld appeared to be identical on both radiographs. This left little doubt that the radiographs were duplicated. It appears that certain radiographs were missed

during erection. Duplicate films were made of subsequent weld joints and substituted for the radiograph which had not been taken. The substitution (or duplication) was apparently achieved by taking a second radiograph on the same date at the same location. The equipment set-up and film location were unchanged, only the weld identification number was changed. It did not appear to the reviewers that the film substitution was done to subvert the process control, but was an attempt, by the Graver radiographic crew, to log a sufficient number of radiographs to meet the spot radiography requirements. A review was made of the Travelers to identify the dates the welds in the affected area were made and the dates on which the radiographs were taken. In addition, construction photographs were reviewed to determine the erection sequence. Reducing this data leads to the postulation that the radiographer determined he had missed a radiograph at a lower elevation which apparently could not be taken because of rework required to remove the leak chase channel which had been installed and a radiograph at the higher elevation was substituted for the lower elevation. The apparent duplicate radiographs are:

- ① H7P3T1 and H8P8
- ② H8P4 and H9P8
- ③ R9V10R and R10V12R

- (2) An apparent duplication of radiographs, identified as Item ④ on Attachment 1, was also noted on radiograph H11P1, but the scenario of its cause is significantly different than described above. The original radiograph, H11P1 was taken on June 3, 1971 and rejected by Graver. The radiograph of the weld repair, H11P1R was taken on June 23, 1971 and was accepted by Graver. In addition, as required by code, two (2) Tracer radiographs were taken on June 23, 1971 and were rejected by Graver. Subsequent record review identified that the rejected weld seam was cut-out and rewelded. The repaired area was qualified by radiograph H11P1R1 taken on July 6, 1971 and accepted by Graver. Radiographs H11P1R1 and H11P1R are duplicates. The duplication indicates that the repair excluded the seam area originally repaired (H11P1R) and the repair was qualified by a radiograph (H11P1R1) of a known acceptable area.

These radiographs (total of 20 films) were officially transmitted and given to the NRC Region I Investigator, Mr. R. K. Christopher on July 3, 1980. See Attachment 1 for the location of these radiographs.

b. Repair of Weld Seams

Two (2) sets of radiographs contained film of weld areas which did not appear to be representative of a repaired weld. The radiographs of repaired welds were compared to the original radiographs. The general appearance of the repair radiographs was similar to the original radiograph which led the reviewers to question whether a repair had actually been made since a weld which has been repaired normally exhibits a weld seam that is wider than the original weld and has a different appearance. Subsequent investigation of records available showed that the weld seam had been cut out and rewelded. Consequently, the weld repair radiograph represents a new weld which should be similar in width to the seam weld observed on the original radiograph.

c. Disagreement with Graver Radiographic Interpretations

Of the 447 radiographs reviewed and re-interpreted by DLC, the examiners identified only four (4) cases of disagreement with the original film interpretation made by Graver. This disagreement is not surprising when consideration is given to the number of radiographs involved, the qualifications and experience of the DLC reviewing team. The four cases of disagreement, radiographs R1V8, KR1P4, DV19T1 and H4P6, are considered minor in nature and have been evaluated as acceptable by the engineers and the evaluation is available.

d. Independent Review

An independent review of the preceding three (3) anomalies was performed and confirmed by a Level III examiner from the Hartford Steam Boiler Inspection and Insurance Non-Destructive Test Engineering Division.

2. Correlation of Graver Radiographs and Associated Records

- a. An investigation was conducted to relate the 447 available radiographs and the Graver Records of Radiographs with the Graver Spot X-Ray Maps. The areas examined were the cylindrical shell, rings 1 through 12, and the dome assemblies. The list of reviewed radiographs was compared with the Record of Radiographs and the Spot X-Ray Maps. This resulted in the

identification of: 445 radiographs per the Record of Radiographs having been taken and interpreted; 447 radiographs were reviewed by the DLC review team; 372 radiographs reviewed were traceable to both the Record of Radiographs and the Spot X-Ray Maps. Additionally, the Record of Radiographs indicate six (6) weld areas which were rejected and subsequently repaired; however, no records exist which indicate that the required tracer radiographs were taken.

- b. It was observed that there were numerous changes in the radiograph numbering systems used by Graver on the radiographs, on the Record of Radiographs and on the Spot X-Ray Maps. These differences made 100% correlation of all information impossible, e.g: Vertical welds for the dome were identified with the same numbers for two differing areas, the only difference being the welder's symbol noted on the Spot X-Ray Map. To determine which radiograph pertained to a specific location, it was necessary to obtain the welder's symbol from each radiograph and then correlate this radiograph to the Spot X-Ray Map. The results of this correlation are summarized as follows:

- 95% of the radiographs matched the Spot X-Ray Map.
- 83% of the radiographs were traceable to both the Spot X-Ray Maps and the Record of Radiographs.
- Ten out of the eleven radiographs for Ring 1 of the cylindrical shell are missing. This is noted on a drawing contained in a Graver documentation package.
- Errors were noted in identification between radiographic film and locations noted on the Spot X-Ray Maps.

3. Construction and Inspection Record Comparison

a. Data Comparison

A comparison of similar data, i.e. dates, procedures, personnel, of Graver construction and inspection records was made. An attempt was also made to correlate information from this comparison with the results of the 447 radiographs re-interpreted as previously described. A total of twenty-two (22) areas were reviewed: Ten (10) from the dome portion of the liner and twelve (12) from the cylindrical shell portion.

b. Document Comparison

The Erection Control Sheets (Travelers) and Record of Radiographs covered large segments of work (generally an entire ring). Individual records covered days or weeks

of an activity. It was not possible to pinpoint exactly when an activity occurred. Based upon the results of the 22 areas reviewed, the dates recorded for activities were generally consistent. The dates on repair radiographs were exceptions since the Travelers recorded the date of the original radiograph rather than the date of the repair radiograph.

c. Observations

The Graver "Record of Radiographs" identified the following:

- (1) R. Welch, of Graver, was the machine operator and processor for the entire shell.
- (2) C. W. Funkhouser, of Graver, was the interpreter and reviewer for the entire shell.
- (3) A. Hollid, of Stone & Webster, signed Record of Radiograph forms for the cylindrical shell. There were no S&W signatures for the dome portions of the liner.
- (4) The Authorized Nuclear Inspector up through Ring 8 was J. Gall of Factory Mutual.
- (5) The Authorized Nuclear Inspector from Ring 9 through the remainder of the shell liner and dome was an inspector, using the symbol Al, from Lumberman's Insurance Company. ₁
- (6) On two (2) horizontal dome seams, the machine operator was L. Bruder of Graver. For the remaining dome seams the machine operator and processor was B. Welch of Graver.
- (7) Interpretation and review of the dome radiographs changed with different joints; however, the interpretation and review was performed by either B. Welch or C. W. Funkhouser of Graver.
- (8) The results of the data suggest that, except for a change in the ANI organizations around the time of the apparent radiographic duplication, the personnel involved in the erection of the cylindrical shell region were the same.

d. Code Applicability

The review of Graver documents was initially inconclusive relative to the acceptance criteria applied by Graver for interpretation of radiographs. The Engineering Specification required random radiography of seam welds to ASME Section VIII, Paragraph UW-52. The review of Graver records identified the following:

- (1) The record copy of the Graver "Quality Assurance and Control Manual for Shop Fabrication and Field Erection of Reactor Containment Steel Plate Liner" (copy assigned to C. W. Funkhouser of Graver) identified Radiographic Examination Procedure No. RT-2, Rev. 1, dated 9/12/72, in the index. Another document in the Manual dated 1/22/70 (which appears to be a change authorization to Graver drawing B30799-4), states that "All shop and field welding shall be random radiographed in accordance with paragraph UW-52 (Spot Examination of welded joints) of Section VIII of the ASME Code for Pressure Vessels and Graver's Radiographic Examination Procedure No. RT-1." The procedure contained in the Manual is "Examination Procedure No. 1 Radiographic Examination for ASME Section III, Class A & B Construction." However, the procedure in the Manual contains two (2) different interpretation sheets. One sheet is "Record of Radiographs ASME III, Class A & B Vessels" and certifies that the radiographs meet N624 of ASME III, Appendix IX of Section III and Radiographic Examination Procedure No. 1. A second sheet is "Record of Radiographs for use with Procedure RT-2" and certifies that the requirements of Paragraph UW-51 of the 1968 Edition of the ASME Boiler and Pressure Vessel Code, Section VIII, Division I.
- (2) A review of the erection control sheets showed that the words "ASME VIII RT-2" was manually changed on erection control sheets for vertical seam welds to read "ASME III, RT-1." The radiographic interpretation sheets are consistent with the manual changes. The following data has been extracted from the Travelers:

<u>Ring Location</u>	<u>Vertical Welds</u>	<u>Horizontal Welds</u>	<u>Note</u>
1	VIII, RT2	VIII, RT2	
2-12	III, RT1	VIII, RT2	*
C1	III, RT1	III, RT1	
Roof Subassemblies	--	III, RT1	*
Connect Roof Subassemblies	VIII, RT2	VIII, RT2	
Install Top Plate	--	III, RT1	

- * Manually changed from "ASME VIII, RT-2" to "ASME III, RT-1" for vertical seam welds.

The majority of the "Record of Radiograph" forms certify that radiographs meet N624 of ASME Section III, Appendix IX of Section III and Radiographic Examination Procedure No. 1. A total of four (4) Record of Radiograph forms certify to ASME VIII, but identify paragraph UW-51 which deals with 100% radiography rather than UW-52 for spot radiography.

- (3) The quality of the Graver radiographs was judged satisfactory.
- (4) Revision 4 of the Engineering Specification BVS-136 requires radiography to be performed and evaluated in accordance with paragraph UW-52 of ASME VIII, Division 1. This was achieved by Graver using their RT-2 procedure, qualified to UW-51 of ASME VIII, Division 1 for the horizontal seams and their RT-1 procedure, qualified to ASME III, Division 1. These two procedures resulted in radiographic film that meets or exceeds the requirements of UW-52 of ASME VIII, Division 1.

The Record of Radiographs for these procedures contain statements of certification to ASME III and/or UW-51 which are incorrect and by the specification, invalid. The DLC re-interpretations confirmed that the Graver evaluation and acceptance was in accordance with UW-52 of ASME VIII, Division 1 and satisfied the Engineering Specification.

C. Evaluations Performed To Resolve Liner Record Anomalies

1. The applicable code per the Engineering Specification at the time of liner erection, ASME Section VIII, Paragraph UW-52 states in part that "spot radiography in accordance with these rules will not insure a fabrication product of predetermined quality throughout. It must be realized that an accepted vessel under these spot radiography rules may still contain defects which might be disclosed on further

- examination." Spot radiography is used as a means to prove the welding process, not the quality of the vessel. The code also acknowledges and accepts weld defects as stated in UW-52 Paragraph (d) evaluation and tests, subparagraph (a) which states in part that "The defective welding disclosed by the first of the three radiographs may be removed and the area repaired by welding, or it maybe allowed to remain in the weld joint, at the discretion of the inspector."
2. Regardless of the anomalies of the applicable code as relating to the Graver Record of Radiographs, all 447 Graver radiographs were re-interpreted to UW-52 of section VIII by two (2) Level III examiners, and with the exception of four (4) radiographs, described in paragraph III, B 1 c, the remainder of the radiographs were determined to be acceptable and meet the code requirements.
 3. The integrity of the seam welds has also been proven by non-destructive examination on 100% of the weld surfaces during erection.
 4. Halogen leak rate testing on 100% of the seam welds was performed during erection after leak chase channels were installed.
 5. The integrity of the Reactor Containment Liner has also been demonstrated by performance of an overpresurization conducted prior to initial operation and has subsequently been periodically re-verified by the performance of leak rate tests in accordance with 10CFR50, Appendix J.