

Engineering Research Institute  
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REPORT

ON

EXAMINATION FOR GRAPHITIZATION  
OF WELD-PROBER SAMPLES 1SA, 2SA, 3SA, AND 4SA  
FROM THE STEAM LINES TO NUMBER 3 TURBINE  
AT THE SCHUYLKILL STATION  
OF THE PHILADELPHIA ELECTRIC COMPANY

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## INTRODUCTION

Weld-prober samples from four welds in the main steam lines to Number 3 turbine of the Schuylkill Station of the Philadelphia Electric Company were examined for the presence of graphite. The samples were removed during July and August, 1954. Three of the samples were from casting to casting welds which were not replaced at the time the C Mo steel piping was replaced with 1 Cr - 0.5 Mo steel piping during 1950. The fourth sample was taken from a weld between the new pipe and a C Mo steel cast valve. The C Mo steel valves and fittings were not replaced at the time the new piping was installed.

## FINDINGS

No graphite was found in the four samples submitted, even though three of the welds between C Mo steel castings had been in service for approximately 127,000 hours. This checks previous findings that the cast C Mo steel valves and fittings in the Schuylkill Station are resistant to graphitization.

## DESCRIPTION OF SAMPLES

The locations of the four weld-prober samples submitted are shown by Figure 1, together with the pertinent data as to service life and types of steel involved.

In the summer of 1950, the piping to the Number 3 turbine was replaced with 1 Cr - 0.5 Mo steel (ASTM - A315) pipe. The C Mo steel

(ASTM - A157-39 Grade C-1) valves and fittings were not replaced. The following three samples were taken from welds which were not replaced when the new pipe was installed.

1SA: Between the connection from Number 24 boiler and the cast non-return valve. In service 127,400 hours.

2SA: Between the cast tee to the desuperheater line and the valve just downstream in the line from Number 23 boiler. In service 126,800 hours.

3SA: Between the cast "Y" and the throttle valve to Number 3 turbine. In service 126,800 hours.

The fourth sample was from a new weld between an 8-inch by 10-inch reducer swaged from 1 Cr - 0.5 Mo pipe and an original cast C Mo steel pressure-reducing valve in the line to the desuperheater from Number 24 boiler. The weld had been in service for only 33,100 hours, although the cast valve had been in service for 127,400 hours.

## RESULTS AND DISCUSSION

All four samples were examined under the microscope for graphite. No evidence of graphite was observed in any part of the samples. Plates 1 through 4 show typical photomicrographs of the heat-affected zones of the welds. The photographs show areas in which graphite usually occurs if it forms during service.

The photographs of the castings show inclusions which at the magnification of X100D cannot be distinguished from graphite. In every case, however, these were examined at high magnification and found to be inclusions or voids. In examining the valve side of the weld of Sample 4SA, a condition

was found near the inside surface which resembled graphite in many respects. Careful examination indicated, however, that small voids were present rather than graphite, as is shown by Plate 5. It appeared that microscopic porosity was present in the cast metal near the inside surface and that it was happenstance that it was located in the heat-affected zone of the weld.

The cast C Mo steel valves and fittings in the Schuylkill Station appear to be unusually resistant to graphitization. No case of graphitization in the casting side of welds has yet been observed. The weld between the C Mo pipe in the 8-inch line to the pressure-reducing and cast valve showed no graphite on the casting side, although graphite was present on the pipe side when it was examined in 1945 (Report No. 18). The cast "Y" to the throttle valve (Report No. 50) and the weld on the turbine side of the throttle valve (Report No. 51) showed no graphite when examined in 1949. Ten pipe to casting welds were examined in 1949 after solution treatment (Report No. 53) with no evidence of damage from graphitization (such as was found on the pipe sides of some of the welds). Nine welds between pipe and cast valves did not show graphite in 1953 (Report No. 69) when the service life on the welds was 23,000 hours and the casting proper had been in service approximately 113,000 hours.

Five mounted picture pages follow here.

Also one bruned figure.

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