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SUBJECT: Examination of 6" Diameter "O" Ring From
HRT Mockup. Metallography Report (Y-12) No. 39

TO: R. E. Wacker

FROM: T. M. Kegley, Jr.

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Introduction:

A 6-inch diameter "O" ring from the HRT Mockup was received for metallographic examination. The "O" ring had been exposed 2452 hours to 10 g u/l uranyl sulfate solution at 300°C. There was also a possibility of exposure to fluorides and chlorides, since desposits found in pitted areas elsewhere in the Mockup system were shown to contain 2000 ppm fluoride and 25 ppm chloride. It was suggested that fluoride was introduced through the use of impure solids in the solids separation loop of the HRT Mockup.

Procedure:

Four transverse sections were taken in the 6-inch diameter "O" ring at places at which there were pits or other defects on the surface of the ring. These sections were mounted, polished and examined metallographically. In the discussion which follows, no attempt is made to indicate from which of the four sections the photomicrographs were taken. Only the locations of the photomicrographs relative to the gasket cross section are given as indicated in Fig. 1.

Results:

The positions A and B, shown in Fig. 1, represent regions in which seating took place between the "O" ring and the flange.

The surface defects, except for cold work defects, were found only in areas which were exposed to uranyl sulfate. The types of defects found were (1) pits, (2) transgranular cracks running from surface (3) surface cracks parallel to surface (4) preferential grain attack, and (5) pits or surface defects due to cold work. These defects are illustrated in Figs. 2 to 7. The portions of the "O" ring surface, which were not exposed to uranyl sulfate, did not contain the first four defects; so that it is reasonable to assume, with the exception of defects due to cold work, that these defects occurred as the result of exposure to the uranyl sulfate environment.

As may be seen in Figs. 3, 4, and 5, some transgranular cracking has occurred at the surface of the "O" ring. This cracking occurred in cold worked metal as illustrated particularly in Fig. 5. The cracking extended to a depth of 2 to 3 mils from the surface.

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The transgranular cracks observed in the "O" ring were somewhat different from the usual stress-corrosion cracks found in stainless steel in that these cracks are shallow and rather broad in appearance. However, these cracks may very well be stress-corrosion cracks which are in an initial stage of formation. Apparently the combination of residual stress (from deformation) with the corrosion environment was sufficient to cause stress-corrosion cracking. The pitting possibly results from a form of contact corrosion in which there is oxygen depletion at the seat between the "O" ring and the flange.

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Atts.

Fig. 1. Diagram of Transverse Section From 6-Inch Diam. "O" Ring Showing Positions of Surface Defects.

T-11016

50X

T-11047

250X

Fig. 2. Pit on 6-Inch "O" Ring From HRT Mockup. Position A.

T11054

50X

T11055

250X

Fig. 3 Cracks at Surface of "O" Rings. Position B.

T11049

50X

T11048

500X

Fig. 4. Cracks at Surface of "O" Ring. Position B.

T11053
250X

Fig. 5. Cracks Parallel to Surface. Position A'. Note Worked Metal at Surface.

T11059
250X

Fig. 6. Worked Metal Region at Position D.

T11044
250X

Fig. 7. Preferential Grain Attack. Position A.

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