

MEMORANDUM

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
FOOD AND DRUG ADMINISTRATION

B977157

TO : Files

DATE: June 26, 1979

FROM : Medical Radiation Physicist
Radiologic Imaging Section, MPB, DEP, BRH

SUBJECT: TMI Photographic Film Dosimetry Project

After the Three Mile Island (TMI) incident, the BRH contacted the Eastman Kodak Company regarding an appropriate photographic film for retrospective dosimetry of the 3MI incident. Kodak recommended the use of Kodacolor 400 film in 35 mm format and offered the company's assistance in processing any films obtained and in interpretation of results.

Our first action was to visit shops and stores in the TMI vicinity on May 2 and 8 and search for Kodacolor 400 film which was present in shops and stores during the first 3 days of the incident. Six film samples per site were obtained from Elizabethtown, Manchester, Steelton and New Cumberland, PA and from a discount store 2.5 miles east of Middletown, PA. Other towns and villages (including Middletown, Royalton, Highspire, and Goldsboro) were visited, but no appropriate film was found. Either the proper film was placed in the store after the critical 3 day period or no Kodacolor 400 film was stocked.

For reference, samples having similar expiration dates as those collected in Pennsylvania were obtained on May 8 in Rockville and Frederick, MD.

To provide calibrations, groups of films were exposed to x radiation and also to Xenon 133 gas in an 8 m³ tent, (2 π geometry).

All films were taken by automobile to Rochester, NY on May 8 and processed by Eastman Kodak in two batches (May 9 and May 17). Eastman Kodak provided control strips for each batch of film obtained in Maryland or Pennsylvania. These controls were being held in the Eastman Kodak film vaults at 0^oF and were used to provide information on the extent of thermal and radiation fogging undergone by the films from Pennsylvania and Maryland.

Results

The sensitivity of the Kodacolor 400 (CG-135) film to Xenon gas exposure is .05 increase in optical density per 10 mR of exposure to the film cassette. CG 135 is 35 mm film in a metal cassette. The sensitivity of this film to x ray is an 0.1 increase in optical density per 10 mR of x radiation (5.05 mm HVL, 100 kVep).

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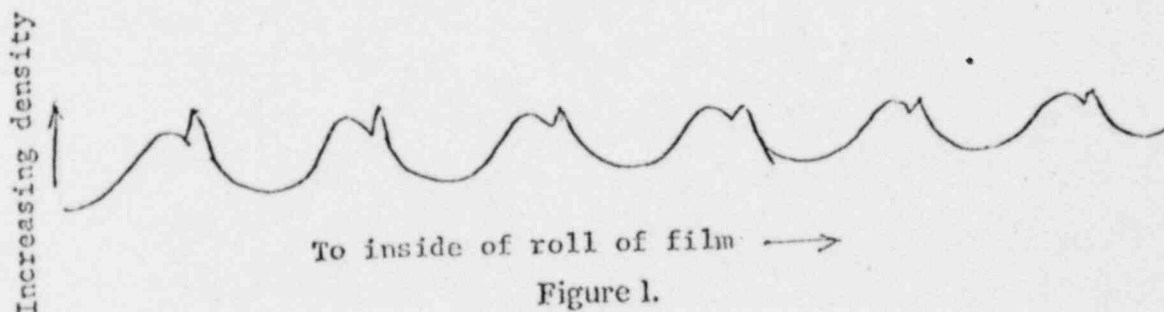
Films obtained in Maryland had, on the average, the same increase in fog above the 0°F control films as did those from Pennsylvania. In fact, a film sample obtained from Rockville having the same batch number as the sample obtained from New Cumberland had a higher fog level than the New Cumberland sample. None of the fog levels observed on the films were judged to be larger than expected from normal aging of the product.

For the Pennsylvania samples, all fog levels except the Middletown sample were .02 OD or less above the 0°F reference for that batch. The Middletown sample fog level was .025 above the 0°F reference.

If a roll of film is irradiated by a directional source of x radiation, a cyclic density pattern will be produced on the strip of film. One of 6 of the Middletown samples possibly had such a pattern. This pattern and the density increase of 0.025 would correspond to 5 mR of x- or gamma-ray exposure to Xenon 133.

However, it is possible for physical effects induced by winding the film on the spool to cause a cyclical pattern such as was seen on the Middletown film.

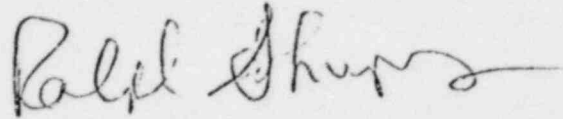
Films exposed to Xenon 133 gas in a tent (2π geometry) exhibited a cyclical pattern with a sharp spike superimposed on the pattern (See figure 1). The spike is caused by low energy x rays (which are strongly attenuated by the steel cassette) penetrating the film port on the side of the cassette. Of the films exposed to Xenon gas, the lowest exposure was 6.5 mR. For this exposure level, the cyclical pattern and the spike were distinct. The pattern on the Middletown sample was much less distinct than this and no evidence of a spike was seen.



The films obtained from Pennsylvania, with the exception of Middletown, present no evidence of Xenon or other radiation exposure to the site at which the films were obtained.

Fog levels measured on all Pennsylvania samples were consistent with one another, with fog levels found on Maryland samples and with the expected fogging of Kodacolor 400 film. If all fogging of the Pennsylvania samples were due to radiation, exposure to the film cassette would be less than 5 mR. One film of the 6

from Middletown possibly had a cyclic pattern (which could be attributed to either radiation or a physical effect). The fog level on this film was the same as the other 5 from Middletown, about 0.025 above the 0°F control film.



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