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81-12

6 January 1981

Office of Inspection and Enforcement
Region I, USNRC
631 Park Avenue
King of Prussia, Pa. 19406

Attn: Mr. John Kinneman

Subject: Report of Incident, 18 December 1980

Reference: NRC License No. 37-19104-01
Attachment: Failure Analysis Report 2-010208

Action Manufacturing Company had an incident on 18 December 1980, involving the release of approximately 1.2 curies of Tritium (^3H), in gaseous form, to the atmosphere, at their plant location, 2829 Cedar St., Philadelphia, Pa. 19134. A report of this incident was made via telephone to Dr. John Glen, at the Region I, USNRC, who recommended that this written report be generated and directed to Mr. John Kinnerman.

Action Manufacturing Company has a number of contracts with the U.S. Army to produce various ordnance devices incorporating the use of radio-luminous lamps. These lamps contain propriatary phosphors and tritium gas in sealed borosilicate glass ampules of various shapes and activities.

These radio-luminous lamps are purchased by Action completely sealed and tested at the manufacturer's facility. To insure the integrity of the lamps, the testing at the manufacturer is witnessed and certified by a U.S. Govermant source inspector prior to shipment to Action. As such, they present no hazard when handled with reasonable care and prudence. Action has implemented numerous checks for leakage at every level of assembly to assure that if any leakage occurs, it will be promptly detected, and exposures kept well within safe limits.

Ordnance materials used by the U.S. Army are exposed to severe handling and environments in field use. To assure the safety of the delivered product, these are tested in harsh environments exceeding their anticipated field exposures. These environments include:

1.- Low temperature at -80° F.
2.- High Temperature at +160° F.
3.- Vibration.
4.- Shock at 300 g's (0.5 ms.)

On 18 December 1980, one (1) lamp was found to have developed a severe crack in the glass after exposure to a low temperature test. All of the activity of up to 1.2 Curies was released within the fume hood and carried up the stack, through the building roof, to the outside atmosphere.

The following steps were taken to determine if there was any discernable activity released within the restricted manufacturing area, and what, if any exposure was incurred by personnel working in proximity to the failed item.

1.- A Tritium Air Monitor (manufactured by Wm. B. Johnson) was used to sample the air in the sealed, 30 cubic foot temperature chamber. No activity above normal background could be discerned.
2.- Wipe test were taken inside the chamber, and there was no discernable activity above normal.
3.- Wipe testswere taken on various work benches along the path that the test items were carried, from the temperature chamber to the fume hood, and no activity above normal could be detected.
4.- A second fume hood, exhausting air from the restricted manufacturing area, and containing another Tritium Air Monitor, showed no activity above normal.

5.- A urine sample for bioassay for Tritium was taken on 19 December 1980 from ALL persons who were in the restricted area, at any time during the day of the incident. These samples were submitted to Radiation Management Corporation, Philadelphia, Pa. for analysis. The bioassay report shows no tritium intake above normal levels.

From the above, it is apparent that there was no measureable exposure to any of our personnel.

Repeating, up to 1.2 Curies of Tritium gas was released to the atmoshere above our plant on 18 December 1980. The gas was released via a fume hood and stack through the plant roof. The fume hood manufacturer states that the hood fan moves 720 cubic feet of air per minute. After 24 hours of exhausting, the Tritium Air Monitor, that checks the air passing through the hood, showed no activity above background levels.

Additional information describing the incident is included in the attached Failure Analysis Report. If you have any question or need additional information regarding this incident or the operation at Action Manufacturing Company, please do not hesitate to contact the writer. Also, any suggestions you might have regarding your handling of this incident, and for the future, are earnestly solicited.

Sincerely yours,

Joseph L. Gross
Asst. to the R.P.O.

P.S. This is the first incident of leakage to occur at Action Manufacturing Company

QDR NO. 2-010209	Analysis by: J.L. Gross		Date of Analysis 12-22-80
Part Name Scale Assembly	Lab or Location AMC - Plant #2		Address 2829 Cedar St.
Dwg. No. 11733751	Item No. # 18	Serial No. N/A	Manufacturer: AMC

HISTORY:

This assembly is made up of three (3) parts, Holder (11733750) to which is assembled the Radioluminous Lamp (11733737) with adhesive. Although not required, a contamination (wipe) test was performed at this stage, with no evidence of contamination. Then the Scale (11733740) was assembled (with adhesive) and another contamination (wipe) test performed (as per SOAP CD 105). Again, no contamination was evident. This item, one of a lot of 3, plus other assemblies, was subjected to cold temperature test (CD 301). It is noted that all assemblies are contained in individual plastic boxes when subjected to temperature test.

This test lot was subjected to -80°F (10° below requirement) for eight Hours. The rise and fall time between ambient and low temperature was in excess of six (6) hours

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ANALYSIS:

It should be noted that:

1.- The other Tritium Air Monitor sampling air from the area did not show contamination.
2.- Wipe tests performed on benches along the path from the temperature chamber to the fume hood did not show contamination.
3.- The temperature chamber checked with both a Tritium Air Monitor and via wipe test, showed NO contamination.

The presumed surface contaminated items were cleaned and contamination tests performed. They all had levels contamination at approximately background.

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CONCLUSION:

There are at least four (4) possible causes of failure, none of which can be proven conclusively without a controlled experiment, to failure, to demonstrate. Nevertheless, they will be discussed, and corrective action taken to preclude at least 3 of them.

1.- Lamp not properly centered, end to end, in the holder. Since one end had only 0.015 inch clearance (versus 0.090 inch on the other end), it is possible that differential contraction/expansion rates of the aluminum holder versus the glass may have resulted in compression of the glass at low temperature.

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RECOMMENDATIONS:

1.- Both assemblers and inspectors have been cautioned to:
   a.- Assure the lamps are carefully centered in the holders, and NOT limit acceptable clearance to the 0.005 in. requirement of the drawing.
   b.- Maintain circumferential RTV coverage of the lamp to 180° or less.
2.- New cams have been cut for low temperature cycle to assure that temperature does not go below -80° F.
3.- In addition to the plastic boxes, the test items will be placed in "Zip-Lok" type plastic bags to minimize probability of chamber contamination in case of future failure.

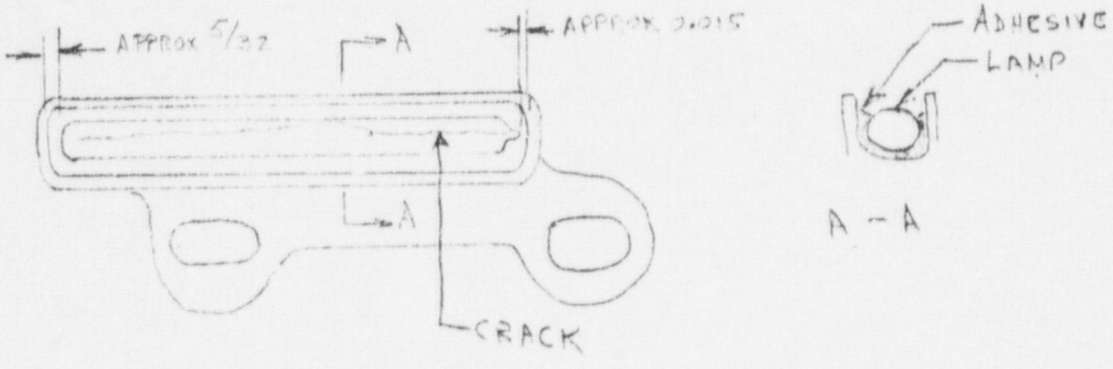
HISTORY: (cont'd)

After return to ambient, the chamber door was opened, and the mixed lot carried to the fume hood. Each plastic box (not hermetically sealed) was opened and the lid placed aside. A contamination (wipe) test of each item was taken. The Liquid Scintillation Counter showed contamination of all nine (9) items in the lot (including a "dummy" lamp) with levels ranging from 5000 DPM to in excess of 4,000,000 DPM. The Tritium Air Monitor mounted in the fume hood exhaust showed levels of 60 uCi/cubic meter, or approximately 10 times acceptable levels for a "restricted" area.

The fume hood was left on to continually exhaust for 24 hours, until the Tritium Air Monitor showed acceptable levels of contamination. The wipe test was repeated, and the results showed contamination levels ranging from about 90 DPM to 2500 DPM, excepting one item at about 60,000 DPM. It was reasonably assumed that this last mentioned item was the "leaker" with the other items being contaminated by proximity to the failed item.

ANALYSIS: (cont'd)

The scale was carefully removed from the "leaker", and the holder and lamp visually examined. See sketch.



Three possibly significant observations were made.

1.- The lamp had a longitudinal crack, running the length of the lamp.
2.- The lamp was not carefully centered in the holder, with the clearance at the pointed end being approximately 0.015 inch, and 5/32 inch at the other end.
3.- The PTV adhesive covered approximately 230° around the circumference of the lamp.

It is also worth repeating here, that about 16 hours expired between the time that the chamber reached -20°F to removal from the chamber, and that there was no contamination in the chamber.

CONCLUSIONS: (cont'd)

2.- Greater than 180° circumferential coverage of the lamp, coupled with loss of some flexibility at low temperature, would have also contributed to the failure, if the premise of interference is correct.

CONCLUSIONS: (cont'd)

3.- Testing at -90°F rather than -80°F could also be a contributing cause. This additional 10° would further reduce the flexibility of the RTV adhesive, increasing the probability of failure when coupled with premises 1 and 2 above. If the RTV became sufficiently hard, the greater than 180° circumferential coverage might also produce circumferential compression of the glass tube.

4.- A last possibility is that a latent defect existed in the glass. If this were true, then this defect coupled with any or all of the previously discussed potential causes would have resulted in the failure.

It was fortuitous that there was no leakage in the temperature chamber itself. The plastic boxes containing the test items have only snap on lids. It is unlikely they would have completely contained any tritium leakage. A more likely explanation is that the glass cracked sometime during test but a complete rupture did not occur until the items were "jarred" in handling under the fume hood.