



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

APR 13 1982

MEMORANDUM FOR: C. Z. Serpan, Jr., Chief
Materials Engineering Branch
Division of Engineering Technology

FROM: A. Taboada
Materials Engineering Branch
Division of Engineering Technology

SUBJECT: TRIP REPORT NEUTRON PRODUCTS, INC
MARCH 26, 1982

At the request of State Programs, I visited Neutron Products, Inc. of Dickerson, Maryland, with Mr. Richard Brisson of the State of Maryland (DHMH) on March 26, 1982. The purpose of the visit was to investigate a problem of cracking in welds in containers of sealed irradiator (cobalt) sources and to develop information for the Radiological Health Section of the Arkansas Department of Health concerning the integrity of these containers.

The sealed sources are being fabricated at Neutron Products for Process Technology, Inc. of West Memphis, Arkansas, and have been licensed by the State of Arkansas (license number ARK-628-BP-6-83). Drawings numbered 200234 for the sealed source are enclosed.

Problem

Microcracks were found at the root of TIG fusion welds attaching end plugs to container tubes during metallographic examinations of quality control samples for production welding of the sealed sources. These were single cracks which initiated on the inside surface between tube and end plug, progressed in the axial direction with some minor variations at the tip of the crack and appeared to be associated with the region where the weld was overlapped. The in-house neutron product specifications to which these containers were fabricated permit no visible cracks on a cross section of the weld examined at 8X magnification. The procedure calls for every 10th weldment to be examined. End plugs and tubing were made of Type 321 stainless steel.

Neutron Products hired Mr. Julius Heuschkel, Welding Engineering Consultant, to review the metallurgical problem and O'Donnell and Associates to analyze the potential for cracks propagation.

General Observations

The microcracks are of the notch extension hot tear type, a condition commonly observed in Type 321 stainless steel but also found less frequently in other grades of austenitic stainless steel weldments. Automatic inert gas shielded arc welding process with no filler metal was used for making these weldments. The welds observed were of a consistent, good quality with the exception of the root cracks. The joint designs for the inner and outer containers, shown in the enclosed drawing, are typical joints used for tube plugging and considered by O'Donnell and Associates to be acceptable designs to minimize stresses resulting from temperature gradients and structural discontinuities. Inherent in these designs are mechanical notches between the tube and end plug. The root cracks observed are extensions of these mechanical notches and differ only in the sharpness of the notch. There appears to be good operating experience with these designs.

O'Donnell and Associates conducted a crack propagation analysis to evaluate the potential for failure of the containers as a result of the microcracks at the root of the weldments. They concluded that the only possible mode of failure that might be influenced by the presence of the root cracks would be crack propagation due to thermal fatigue caused by transient thermal stresses generated when the containers are moved in or out of a water filled storage tank. Heating results from gamma heating.

O'Donnell and Associates performed a finite element analysis of the capsule end plug-tube connection, including transient thermal analysis and structural discontinuity stress analysis. Conservative assumptions were used in the treatment of heat flow and direction of loading. They determined that the thermal stresses were approximately 9,000 psi and that more than 5,000,000 cycles would be required to propagate a crack from a depth of 25% of the tube wall to a location of 50% of the tube wall. This equates to a life of over 2,000 years when the expected service for these containers is 39,000 cycles in 15 years. Further, the analysis showed that for this material the cracks will not reach a self propagating or critical size indicating no potential for a brittle break. As a result of this analysis, O'Donnell and Associates concluded (1) that the containers of the sealed sources will maintain their integrity for all expected service conditions; (2) that extension of cracks through the entire wall of the container is considered unlikely; and (3) that even if the container was cycled to failure, the container would leak rather than break.

Conclusion

The root cracking observed was due to the inherent susceptibility of Type 321 stainless steel material to such cracking rather than improper welding procedures or uncontrolled welding variables. Except for the root cracking, the welds appear to be of acceptable quality. The crack propagation analyses conducted by O'Donnell and Associates applies conventional procedures typically used for nuclear reactor application. Assumptions used are conservative. In view of the low stresses and extremely slow crack growth rate resulting, it would appear that a very low probability exists that the sealed sources would fail and leak as a result of the microcracks observed in the root of the tube-to-end plug welds. Also, the double containment design and lower thermal stress expected on the inner container further lower the likelihood that the sealed sources would leak.



A. Taboada
Materials Engineering Branch
Division of Engineering Technology

Enclosure: As stated

cc: J. O. Lubenau, SP

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555



8/30/82

Bernie:

OFFICE OF
STATE PROGRAMS



Please revise and resubmit this

according to the new format. Copy

of sample enclosed. The first page

should be identical to the sample so

that it can go on to the computer.

Please use the following code # in

the upper left corner of the page:

No: AR-

and include the custom users name and

address.

Please let me know if you have any questions.
L.B.

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE.

NO:

DATE:

PAGE 1 OF 4

DEVICE TYPE:

MODEL:

MANUFACTURER/DISTRIBUTOR:

MANUFACTURER/DISTRIBUTOR:

ISOTOPE:

MAXIMUM ACTIVITY:

LEAK TEST FREQUENCY: 6 months

PRINCIPAL USE:

CUSTOM DEVICE: YES NO

Custom User: Name
Address

1315 West Markham Street
Little Rock, Ark. 72201

Ben N. Saltzman, M.D.
Director

Frank White
Governor

September 11, 1981

Mr. Robert Buckley, General Manager
Process Technology, Inc.
Post Office Box 2265
West Memphis, Arkansas 72301

Dear Mr. Buckley:


Thank you for your letter dated September 3, 1981, requesting an amendment to Process Technology, Inc.'s Arkansas Radioactive Material License Number ARK-628-BP-6-83 to allow the possession and use of Cobalt-60 sources manufactured by Neutron Products, Inc., Drawing Numbers NPI 200227 and NPI 200226.

The following are items which will require additional information:

1. Please provide the sealed source model numbers for the sources you are requesting to be added to your license.
2. Please provide the Nuclear Regulatory Commission's certification of the requested sealed sources (i.e., the sealed source evaluation sheets).
3. Please provide sealed source drawings and technical descriptions on these sources.

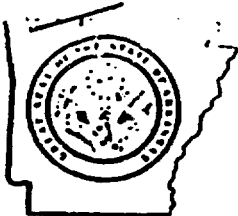
Upon receipt of the information requested above, the review of your amendment request will continue. If you have any questions concerning this matter, please contact us.

Sincerely,



Bernard Bevill
Acting Chief of Licensing and Compliance
Radiological Health Section

BB:ef



FRANK WHITE
GOVERNOR

Arkansas DEPARTMENT OF HEALTH

4815 WEST MARKHAM STREET • LITTLE ROCK, ARKANSAS 72201
TELEPHONE AC 501 661-2000

BEN N. SALTZMAN, M.D.
DIRECTOR

from

[Handwritten signature]

February 18, 1982

Mr. Robert Buckley, Manager
Process Technology, Inc.
Post Office Box 2265
West Memphis, Arkansas 72301

Dear Mr. Buckley:

Please find enclosed Amendment Number 3 to Process Technology, Inc.'s Arkansas Radioactive Material License ARK-628-BP-6-83. This authorizes the possession and use of Neutron Products, Inc.'s Cobalt-60 sealed source drawing number A220234-D. No sealed source will be greater than 22,000 curies:

During the Department's evaluation of Neutron Products, Inc.'s custom sealed source, (drawing number A200234-D), questions regarding corrosion were raised. Mr. Marvin Turkanis, Neutron Products, Inc., responded to the Department with the manufacturer's recommendations regarding conditions to be avoided in the use of sealed sources within irradiator facilities. Mr. Turkanis has forwarded to you a copy of his February 17, 1982 response letter.

The Department believes that many of these manufacturer's recommendations should be incorporated into general operating practices. The license will be amended to reflect the additional practices:

1. Please verify that the irradiator's sealed sources will not be stored for prolonged periods in water with a resistance lower than 10,000 ohm-centimeters.
2. Please verify that the irradiator's sealed sources will not be used or stored in "still" or stagnant air for prolonged periods.
3. Please verify that the irradiator's sealed sources will not be stored in the proximity of mild steel, brass or any other dissimilar metals.

Mr. Robert Buckley, Manager
Process Technology, Inc.
Post Office Box 2265
West Memphis, Arkansas 72301

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Upon receipt of this information, Process Technology, Inc.'s license will be amended to incorporate these practices.

If you have any questions or comments regarding this matter, please feel free to call me at 661-2142.

Sincerely,



Bernard Bevill
Chief of Licensing and Compliance
Radiological Health Section

Enclosure

BB:egm

RADIOACTIVE MATERIAL LICENSE
Supplementary Sheet

License Number ARK-628-BP-6-83
AMENDMENT NO. 3

Process Technology, Inc.
North Airport Road
Post Office Box 2265
West Memphis, Arkansas 72301

In accordance with amendment request dated September 3, 1981, Arkansas Radioactive Material License ARK-628-BP-6-83 is amended as follows:

Item 8 is changed to read:

Sealed Sources

- A. AECL Model C-188
- B. Neutron Products, Inc. Model 12-S-3
- C. Neutron Products, Inc. Model 12-C-3
- D. Neutron Products, Inc. Model 10-S-3
- E. Neutron Products, Inc. Model 10-C-3
- F. Neutron Products, Inc. Model 12-CC-5
- G. Neutron Products, Inc. Model 24-CC-5
- H. General Electric Model CEP-916
- I. Neutron Products, Inc. Drawing Number A200234-D

Item 9 is changed to read:

2,250,000 curies total.

No single source to exceed 22,000 curies.

Date February 18, 1982

by Bernard Beville
~~XXXXXX~~ Bernard Beville
Chief of Licensing and Compliance