

APPENDIX B

U. S. NUCLEAR REGULATORY COMMISSION
REGION IV

Inspection Report: 030-28641/94-04

License: 42-23539-01AF

Licensee: Department of the Air Force
USAF Radioisotope Committee
HQ AFMOA/SGPR
8901 18th Street
Brooks AFB, Texas 78235-5217

Facility Name: McClellan Air Force Base

Inspection at: McClellan Air Force Base, California
USAF Permit No. 04-10117-2AFP

Inspection Conducted: March 10, 16, 31 and April 8 and 11, 1994

Inspector: Kent M. Prendergast, Radiation Specialist
Materials Branch, Walnut Creek Field Office

Approved by:

Charles L. Cain

for Frank A. Wenslawski, Chief
Materials Branch
Walnut Creek Field Office

5/9/94

Date

Inspection Summary

Areas Inspected: Special unannounced inspection of licensed activities associated with the March 7, 1994, unsuccessful transfer of three neutron radiography sources from their carrier to their storage well. The inspection consisted of examinations of records and reports concerning the incident, discussions with individuals involved, and independent measurements.

Results: There were no significant personnel exposures resulting from the unsuccessful source transfer. The sources remain safely contained within the shielded bunker pending transfer to the storage well. This event was preceded by a similar event on November 17, 1993. These events indicate significant deficiencies in the management and control exercised over radiographic operations. On April 10, 1994, the Air Force Radioisotope Committee amended the McClellan permit to allow only storage of the neutron sources.

Based on the results of this inspection, five violations were identified as described below (Section 6):

- A violation was identified involving failure to maintain operating and emergency procedures to meet 10 CFR 34.32.
- A violation was identified involving failure to perform daily checks of radiographic equipment prior to use pursuant to 10 CFR 34.28(a).
- A violation was identified involving failure to perform quarterly inspection and maintenance of radiographic equipment pursuant to 10 CFR 34.28(b).
- A violation was identified involving failure to calibrate a neutron survey meter quarterly as required by 10 CFR 34.22.
- A violation was identified involving failure to affix a tag to the californium-252 sources to meet the requirements in 10 CFR 34.25(e).

Summary of Inspection Findings:

- Five violations were opened.

Attachment:

- Persons Contacted and Exit Meeting

DETAILS

1 PURPOSE OF SPECIAL INSPECTION

This special unannounced inspection was conducted in response to telephonic notification pursuant to 10 CFR 34.30 by the Department of the Air Force Radioisotope Committee (RIC) Secretariat, on March 7, 1994. On March 7, 1994, the Air Force RIC reported that during an attempted source transfer on March 3, 1994, three californium (Cf-252) sources, containing about 20 curies, failed to retract into their shielded position. The sources had been dislodged from their carrier and were discovered laying in a tray within the shielded bunker located in Building 248 at McClellan AFB, California. The root cause of the incident has not been determined. The licensee expected to retrieve the sources in mid to late April 1994. The root cause analysis and final report will then be submitted to the NRC.

2 BACKGROUND

Possession of byproduct material at McClellan AFB, Sacramento, California, is authorized by USAF Permit 04-10117-2AFP, under the auspices of NRC Master Materials License 42-23539-01AF. The permit authorizes the use of radioactive materials for industrial radiography at McClellan AFB. The californium-252 sources are used in the licensee's Maneuverable Neutron Radiography System (MNRS). The MNRS is a unique, one of a kind, custom device that employs advanced robotics and Cf-252 sources to perform neutron radiography of aircraft wings and fuselages. The MNRS is located in Building 248 at McClellan Air Force Base (AFB) in Sacramento, California, and is housed in a 8,000 square foot bay comprising the Northwest section of the Non Destruction Inspection (NDI) facility. The MNRS is comprised of two separate radiographic systems, the Programmable Overhead Positioner (POP) and the Programmable Underside Positioner (PUP). The POP is a wall mounted overhead robot used for neutron radiography of aircraft wings and stabilizers. The PUP is a floor-mounted robot used for neutron radiography of aircraft engine bays. Both devices use three neutron sources, containing about 20 curies of Cf-252, for neutron radiography.

There are numerous organizations involved with the operation of the MNRS. The facility is under the responsibility of the Commanding General at McClellan Air Force Base as part of the McClellan Air Force Base Nuclear Operations Organization. The radiographers are part of the Robotics and Imaging Systems group (TIMSNR) and support is also provided by Equipment Parts and Maintenance and Contract Support group (TIME). Both TIMSNR and TIME report to the Manufacturing Division (TIM). The Manufacturing Division Reports to the Technology and Industrial Support Directorate (TI). The Office of Nuclear Licensing and Operations (TIR) supports the organization with the Health Physics Branch (TIRH) and the Operations Branch (TIRO). The TIR reports to the TI Directorate for operations and to the Commanding General for nuclear

licensing. Recently, TIR became responsible for providing engineering support for the specialized MNRS radiographic equipment. Under a December 3, 1993, agreement, TIR was responsible to establish a Quality Assurance Program to ensure the continued operation and maintenance of the MNRS. This licensee's Quality Assurance Program (QA) was not complete as of April 10, 1994. Further information regarding the licensee's QA program is provided in Section 3 of this report.

3 DISLODGED SOURCES

3.1 Previous Events

The inspector examined two recent events involving the MNRS. Both events involved equipment malfunctions and were identified by the licensee to indicate failures in the quality control of MNRS equipment. A brief description of the two events is provided below:

- On September 3, 1993, during removal of the (POP) source carrier from the Moderator Collimator Shield (MCS) the licensee discovered the source carrier face plate had separated from the source carrier. The function of the face plate is to lock the source carrier into the MCS. The root cause of the problem was determined to be that the wrong type of polyethylene material was used to manufacture the new source carrier. The source carrier had been manufactured on the base and was constructed of low density polyethylene and not high density polyethylene as required. The carrier was also damaged (cracked) during the installation of new inserts. The damaged carrier was no longer usable, consequently, the licensee modified the back-up PUP carrier to be used in the POP. Based on conversations with the RSO, it appears that a formal review of these modifications was not performed. The source carrier was stated to have been tested with dummy sources, by the radiographers, by being loaded and unloaded about 20 times successfully on September 20, 1993, prior to resuming operations.
- On November 16, 1993, following problems with the bunker door, one source was dislodged from the carrier and discovered laying in the tray within the shielded bunker by a Health Physics Technician (HPT). The root cause of this problem was attributed to the source carrier making contact with the rotation mechanism of the shielded door causing the source carrier's inner cylinder to rotate. When the source carrier was rotated from the MCS load position, the carrier was inadvertently rotated 180 degrees allowing the source to drop out of the loading orifice onto the tray.
- Following the November incident, the licensee recognized they had significant quality control problems involving the MNRS equipment. To improve this situation, the licensee determined that a QA Program was necessary to ensure the continued operation and maintenance of the MNRS. Consequently, on December 3, 1993, an agreement was signed giving TIR the responsibility for engineering and technical support of the MCS, source

handling equipment, and bunkers. As an interim measure, the Air Force allowed the TIR to utilize its Reactor Quality Assurance Plan with the understanding that as a starting point to establish specific documents and plans for the MNRS will be established. The specific engineering functions entailed in the QA Program included development and implementation of the following: a Preventive Maintenance Schedule; a Training Plan; a Quality Assurance Plan; a System Modification Procedure; and a Drawing Configuration Plan. However, as of the time of this inspection, April 10, 1994, according to the engineer in charge of developing the plans, only the Drawing Configuration Plan had been completed. The other plans were 25 to 50 percent complete as of April 10, 1994, and there had been no implementation of the other plans.

3.2 March 7, 1994, Event

On March 3, 1994, as part of their new Drawing Control Plan, TIR was in the process of updating their engineering drawings to reflect modifications that had been made on the PUP carrier. TIR engineers were preparing to remove the sources from the carrier, using procedure No. MNRS-0013-DOC, and place them in their shielded storage well. The HPTs had surveyed the area and found all readings were normal. The carrier was in the removal position in the bunker with the door down. After encountering problems engaging the upper rod, the engineers raised the door within the shielded bunker to check the carrier rotating plate. Everything appeared normal, and the door was lowered and several more attempts were made without success. The carrier was then disengaged from its locked position, and the rotating plate was rotated slightly to engage the carrier. The engineers had to rotate the carrier 180 degrees to get the gears to engage. The source carrier was finally engaged to the rotator plate. However, the rotator rod was in a different position than normal. According to the lead engineer, the only problem with this position, that he was aware of, was that the operator did not know exactly which of the three sources was being retrieved. The teleflex cable with the magnetic end was attached and inserted into the source carrier to a reading of 14.3 inches. The teleflex was retracted, and the rotator rod was rotated to the next detent. The teleflex was inserted and a reading of 14.6 was obtained. A reading of 14.6 was indicative that the source loading orifice was empty in that position. The carrier was rotated again, and several more attempts were made to retrieve the sources without success. After the sources could not be retracted, the engineers decided to return the source carrier to its original position and check the bunker equipment. The source transfer was aborted, and the bay was locked and secured. The engineers still thought the sources were in the carrier. The radiographers loaded the carrier into the MCS, and placed the MCS in its storage position in the bunker. The HPT stated that all equipment was put back to normal, and he removed his two chirpers from the top of the bunker. The chirpers are used to indicate that the sources have moved through the transfer tube. There were no further surveys performed on March 3, 1994.

On March 4, 1994, the HPT and a robotics technician unlocked the carrier into the MCS and moved the MCS to the Southwest corner of the bay to allow the

short lived activation products to decay. The robotics technician, according to the RSO, was also a Level 1 radiographer. The robotics technician stated that she noticed the lower than expected readings on her area monitors but did not realize the low readings were because the sources had dropped out of the carrier during the source transfer and remained in the bunker. The robotics technician did not discuss the low readings with the HPTs. There were no further entries into the bay on March 4, 1994, and surveys were stated to be a priority before going into the bay on Monday.

On March 7, 1994, the HPT opened the bay and detected elevated radiation levels in the entry way. The initial survey revealed an elevated gamma exposure of 4.5 mrem/hr and a neutron exposure of 20 mrem/hr in the entry way. The HPT performed a survey, for entry into the bunker, which revealed an elevated gamma exposure of 40 mrem/hr and a neutron exposure of 500 mrem/hr on the top of the bunker. According to the Health Physics (HP) Log, the HPT sighted three neutron sources on the source carrier platform, notified TIR, and secured the bay. Following the discovery of the dislodged sources, the TIR group contacted the Radioisotope Committee (RIC) and made appropriate notifications to NRC Region IV.

3.3 Corrective Actions

The licensee's immediate corrective actions were to cease all operations in the MNRS and to restrict access to the facility to only those involved in the recovery operation. Presently, operations have been discontinued, and as of April 10, 1994, the RIC has amended the McClellan radiography permit for storage only. The licensee's surveys outside the shielded facility indicate background radiation levels and that the sources are safely shielded within the bunker. TIR is presently in the process of fabricating the equipment that will be used for the source retrieval. A source retrieval plan and procedures will be submitted and approved by the RIC, prior to retrieving the sources.

3.4 Radiation Exposure

The inspector examined the radiation monitoring records for the individuals involved in the March 7, 1994, event. The personal dosimeters were sent for emergency processing, and the records indicate the highest exposure was 38 millirem whole body exposure.

4 CONCLUSIONS

Based on the inspection findings, the sources are in a safe location within the POP bunker, and the licensee is carefully planning their retrieval to maintain exposures as low as reasonably achievable. The root cause of the incident will be determined following the retrieval of the sources and reconstruction of the conditions that allowed the sources to drop out. The inspector noted that the failure to employ adequate engineering controls to prevent the carrier from being rotated to an unsafe position, along with the inability to observe the activities inside the bunker during source transfer, may have significantly contributed to this incident.

The inspector examined the permittee's program to meet 10 CFR Part 34 and identified five violations involving compliance with the provisions of 10 CFR Part 34, "Licenses for Radiography and Radiation Safety Requirements for Radiographic Operations." The root cause of the violations was a failure to recognize that the radioactive materials permit required compliance with the requirements of 10 CFR Part 34. This resulted in the failure to establish and implement a program to assure that all the provisions of 10 CFR Part 34 were addressed. The inspector recognized the uniqueness of this specialized neutron radiography equipment and that there were some areas where requirements in Part 34 might not apply; however, the licensee had not requested exemptions. The following violations of 10 CFR Part 34 were identified during the review of the licensee's radiography program:

- 4.1 10 CFR 34.32, Operating and Emergency Procedures requires the licensee to retain a copy of current operating and emergency procedures ... these procedures must include instruction in at least the following: ...
(j) the inspection and maintenance of radiographic exposure devices and storage containers.

A review of the radioactive materials permit, the permittee's Safety Program, and its Quality Assurance program was performed. The inspector noted that although the licensee's procedures address quality assurance, the licensee's procedures do not address equipment maintenance and inspection. Specifically, the licensee's procedures failed to address daily inspection of radiographic equipment required by 10 CFR 34.28(a) and quarterly maintenance of radiographic exposure devices and source changers required by 10 CFR 34.28(b). The failure to establish operating and emergency procedures to fully meet 10 CFR Part 34 was identified as a violation of NRC requirements (94-04-01).

- 4.2 10 CFR 34.28 inspection and maintenance of radiographic exposure devices, storage containers, and source changers, requires the licensee to check for obvious defects in radiographic exposure devices, storage containers, and source changers prior to use each day the equipment is used.

According to the statements by the RSO, engineers, and radiographers during March 10 and 11, 1994, there were no routine checks of the radiographic device or source changers prior to use since operation began during October 1989. Since the licensee has not requested an exemption under 10 CFR 34.51, the failure to establish a program for daily checks of radiographic exposure devices was identified as a violation of NRC requirements (94-04-02).

- 4.3 10 CFR 34.28(b) requires a program of inspection and maintenance of radiographic exposure devices and source changers at intervals not to exceed three months or prior to the first use thereafter to ensure the proper function of components important to safety.

According to the Lead Radiographer, other than a recent check about 3 months ago for which no records were available, the licensee had not performed any preventive maintenance on the carrier, or the source handling equipment in the bunker, since October 1989. Although recognizing a need for a Quality Assurance Program to ensure the continued operation and maintenance of the MNRS, the licensee had not identified the fact they were required to comply with 10 CFR Part 34 and had not established a program as of March 10, 1994, to provide for quarterly maintenance of MNRS equipment to meet 10 CFR Part 34. The failure to establish a program to perform quarterly checks and maintenance on components important to safety during 1994 was identified as a violation of NRC requirements (94-04-03).

- 4.4 10 CFR 34.24, Radiation Survey Instruments, requires the licensee to maintain sufficient calibrated and operable radiation survey instruments to make physical radiation surveys as required by Part 34 and 10 CFR Part 20. Each radiation survey instrument shall be calibrated at intervals not to exceed three months.

The licensee has numerous gamma survey meters that are calibrated on a quarterly calibration schedule. However, the licensee also used a portable neutron survey meter (NRC-Model NP-2) to determine the neutron radiation levels. The inspector noted during this inspection that this meter had been last calibrated in March 1993. The inspector reviewed survey reports that indicated the meter was used for neutron radiation levels on February 16, 24, and March 9, 1994. The neutron survey meter is necessary to determine the contribution from neutrons to the exposure rate since the neutron to gamma ratio may vary dependent on the configuration of the equipment. The licensee stated they were unaware of this requirement in 10 CFR Part 34. Consequently, they had only been calibrating their neutron meter on an annual frequency and not quarterly as required. The failure to calibrate the neutron survey meter on a quarterly frequency was identified as a violation of NRC requirements (94-04-04), since they had not been granted an exemption from the requirement pursuant to 10 CFR 34.51.

- 4.5 10 CFR 34.25(e), Leak Testing ... Tagging, requires that a sealed source which is not fastened to or contained in a radiographic exposure device shall have permanently attached to it a durable tag at least (1) inch square bearing the caution symbol in conventional colors, magenta, or purple on a yellow background, and at least the instruction: "Danger-Radioactive Material-Do Not Handle-Notify Civil Authorities-if Found."

The inspector observed documentation indicating that the licensee's SR-CF-3000 californium-252 sources are engraved with the word "Radioactive" and have the radioactive trefoil and the model number. However, the sources are not attached to the device and were not tagged to meet the requirements above. The inspector also considered that the tag may be impractical and interfere with the operation of the device. However, there has been no exemption requested under 10 CFR 34.51 to relieve the

licensee of this requirement. Consequently, the failure to tag with the information stated above was identified as a violation of NRC requirements (94-04-05).

The inspector also discussed with the licensee the requirements of License Condition 16 which requires the licensee to adhere to statements and representations contained in their application dated April 12, 1985. The application dated April 12, 1985, Section 10.c, states that: "All sealed sources or devices authorized for use by the USAF Radioisotope Committee will be listed in the NRC catalog of approved sources and devices. Sources or devices not listed will be submitted to the NRC for evaluation and approval before use except as specified in NRC policy directives."

NRC Policy Directive 84-22, dated December 6, 1984, addresses what source and device designs require an evaluation. The inspector reviewed the directive for applicability to the licensee's custom radiographic device.

The inspector discussed this Directive with RIC representatives, and they explained that they had interpreted it to allow operation because their sources were registered and that they had determined the permittee was qualified by training and experience and had adequate facilities to safely use the radioactive material. It was their opinion that submittal of information related to their custom radiographic equipment for review and approval was not necessary.

The inspector also noted that 10 CFR 30.32(g) requires that applicants for a specific license to use byproduct material in the form of a sealed source or in a device that contains the sealed source must either identify the device by manufacturer and model number as registered with the Commission pursuant to 10 CFR 32.210 or provide the information identified in 10 CFR 32.210(c) in its application.

Based on the review of the license, application, and Guidance Directive 84-22, it was determined that there was no clear requirement for the licensee to submit the device for review.

ATTACHMENT

1 PERSONS CONTACTED

1.1 Licensee Personnel

*Lt. Colonel Joseph Donnelly, Chief, Radioisotope Committee Secretariat
Wade Richards: Director, Technology and Industrial Support Directorate
Jeffrey Ching, Radiation Safety Officer
Steve Walaski, Alternate Radiation Safety Officer
Chuck Heidell, Operations Supervisor
Chet Friday, Engineer, In-Charge
Captain Paul Feeser, Base Radiation Safety Officer
Kevin Kiger, Senior Reactor Operator
Rocky Allmond, Chief, Neutron Radiography Section
Gerald Talbot, Robot Technician

1.2 NRC Personnel

*Charles Cain, Branch Chief, Nuclear Materials Inspection Branch
*Gregory Yuhas, Branch Chief, Radioactive Materials Safety Branch
*Kent Prendergast, Radiation Specialist
*Linda McLean, Radiation Specialist

*Denotes personnel present at the exit briefing.

2 EXIT MEETING

An exit briefing was conducted via telephone on March 31, 1994, with those individuals noted above. The inspector reviewed the specific findings as noted in the report. On April 8, 1994, the inspection findings were also discussed with Mr. Jeff Ching, the MNRS RSO, who was not available for the earlier exit debriefing and with Mr. Wade Richards on April 11, 1994. Other items discussed during these briefings are described in Sections 1 through 4 of this report.