SAFETY EVALUATION REPORT
FOR RENEWAL OF
SOURCE MATERIAL LICENSE NO. SUA-1534

CROW BUTTE RESOURCES, INC.
CROW BUTTE URANIUM PROJECT
DAWES COUNTY, NEBRASKA

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U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards
Division of Waste Management

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ABBREVIATIONS

ALARA	As low as is reasonably achievable
CBR	Crow Butte Resources, Inc.
CRSO	Corporate Radiation Safety Officer
DAC	Derived Air Concentration
EA	Environmental Assessment
FEN	Ferret Exploration Company of Nebraska, Inc.
HPT	Health Physics Technician
ISL	*in situ* leach
IX	ion exchange
LRA	license renewal application
MU	mine unit
NRC	U.S. Nuclear Regulatory Commission
PBLC	Performance-Based License Condition
PM	Plant Manager
QA	quality assurance
R&D	research and development
RWP	Radiation Work Permit
SER	Safety Evaluation Report
SERP	Safety and Environmental Review Panel
SOP	standard operating procedure
TLD	thermoluminescent dosimeter

1.0 INTRODUCTION

On December 20, 1995, Crow Butte Resources, Inc. (CBR) submitted a License Renewal Application (LRA) (CBR, 1995) for Source Material License SUA-1534 for the Crow Butte Uranium Project, which is located in Dawes County, Nebraska. In response to comments and requests for additional information from the U.S. Nuclear Regulatory Commission staff, CBR provided supplementary information by letters dated April 1, June 25, and October 31, 1997 (CBR, 1997e, 1997d, and 1997b). By letter dated July 28, 1997 (CBR, 1997c), CBR also requested several amendments to SUA-1534; the NRC staff decided, with CBR's approval, to address these requests as part of the overall license renewal process.

The information and discussion in this safety evaluation report (SER) are based on information contained in the LRA and supplements, NRC licensing actions approved since December 1995, annual "as low as is reasonably achievable" (ALARA) audit reports, and NRC inspection reports generated during the period of commercial operations at the Crow Butte site. The inspection history, conclusions, and license conditions presented here are based on NRC staff evaluations and reviews in support of performance-based licensing for the proposed license renewal.

With this license renewal, NRC will be authorizing the continuation of commercial operations under the performance-based license condition (PBLC) format. Under a performance-based license, the licensee has the burden of ensuring the proper implementation of the PBLC. The licensee may:

- Make changes in the facility or process, as presented in the application,
- Make changes in the procedures presented in the application, or
- Conduct tests or experiments not presented in the application, without prior NRC approval, if the licensee ensures that the following conditions are met:

  (1) The change, test, or experiment does not conflict with any requirements specifically stated in this license (excluding material referenced in the PBLC), or impair the licensee's ability to meet all applicable NRC regulations.

  (2) There is no degradation in the essential safety or environmental commitments in the license application, or provided by the approved reclamation plan.

  (3) The change, test, or experiment is consistent with the NRC conclusions regarding actions analyzed and selected in the accompanying environmental assessment (EA).

If these conditions are not met, the licensee is required to submit an application for a license amendment to NRC. The licensee's determinations whether the above conditions are satisfied will be made by a Safety and Environmental Review Panel (SERP).

The SERP shall consist of a minimum of three individuals employed by the licensee, with one of these designated as the SERP chairman. One member of the SERP shall have expertise in management and shall be responsible for managerial and financial approval changes; one member shall have expertise in operations and/or construction and shall be responsible for implementation of any changes; and one member shall be the corporate radiation safety officer (CRSO) or equivalent. Additional members may be included in the SERP as appropriate, to address technical aspects in several areas, such as health physics, groundwater hydrology, surface water hydrology, geology, geochemistry, and others. Temporary members, or permanent members other than the three identified above, may be consultants.

The licensee shall maintain records until license termination of any changes made pursuant to the PBLC. These records shall include written safety and environmental evaluations, made by the SERP, that provide the basis for determining that the change complies with the requirements referred to in the above conditions. The licensee shall furnish an annual report to NRC that describes such changes, tests, or experiments, including a summary of the safety and environmental evaluation of each. In addition, the licensee shall annually submit any pages of its license application that have been revised to reflect changes made under this condition.

By letter dated October 31, 1997, CBR submitted draft standard operating procedures (SOPs) for operation of the SERP. Based on its review, the staff considers that the procedures specified in these SOPs, when finalized, will provide reasonable assurance that the SERP and the PBLC process will function as NRC intends

The inspection role of NRC remains unchanged with the administration of performance-based licensing. Operational changes, regulatory commitments, and record keeping requirements implemented by CBR through the PBLC are subject to NRC inspection and possible enforcement actions.

1.1 Description of the Proposed Action

The proposed action is to renew Source Material License SUA-1534 for the continued commercial operation of the Crow Butte Uranium Project. The renewed license would authorize the facility to be operated such that the plant throughput does not exceed a maximum flow rate of 18,930 liters per minute (lpm) [5000 gallons per minute (gpm)], exclusive of restoration flow. Yellowcake production will not be authorized to exceed 907,185 kilograms (2 million pounds) annually.

1.2 Background Information

By letter dated December 20, 1995, CBR applied for a license renewal to authorize continued commercial operations at its Crow Butte *in situ* leach (ISL) facilities, located approximately eight kilometers (five miles) southeast of Crawford, Nebraska. CBR submitted page changes to the LRA by letters dated April 1, June 25, and October 31, 1997. In addition, by letter dated July 28, 1997, CBR requested several amendments to SUA-1534; the NRC staff decided, with CBR's approval, to address these requests as part of the overall license renewal process.

SUA-1534 was issued initially to Ferret Exploration Company of Nebraska, Inc. (FEN) on December 29, 1989, for the commercial operation of the Crow Butte Uranium Project. FEN operated the project until May 1994 when the company name was changed to Crow Butte Resources, Inc.. This change was only a name change and did not involve a change in ownership. CBR conducts its operations within a permit area that encompasses all or portions of Sections 11, 12, and 13 of Township 31N, Range 52W and in Sections 18, 19, 20, 29, and 30 of Township 31N, Range 51W, Dawes County, Nebraska. The process plant is located in Section 19 of Township 31N, Range 51W.

Since 1989, CBR has used *in situ* methods in a commercial operation to leach and recover uranium contained in the Basal Chadron Sandstone, at depths ranging from 122 to 244 meters (400 to 800 feet) over the permit area. The overall width of the mineralized area varies from approximately 305 to 1525 m (1000 to 5000 ft). The orebody ranges in grade from less than 0.05 to greater than 0.5 percent U_3O_8 and 0.31 percent chemical U_3O_8. The permit area covers approximately 1130 hectares (ha) (2800 acres), while the surface area to be affected over the projected life of the project is estimated at 200 ha (500 acres). Figure 1-1 is a regional location map. Figure 1-2 is a map of the project area.

1.3 Review Scope

The safety review of CBR's request for license renewal included evaluations of (1) the renewal application dated December 20, 1995; (2) supplementary information submitted by letters dated April 1, June 25, July 28, and October 31, 1997; (3) the compliance history for the Crow Butte facility since the issuance of SUA-1534 in December 1989; and (4) the monitoring data required under SUA-1534.

CBR's proposed programs were evaluated also against NRC regulations, as specified in 10 CFR Parts 20 and 40, and applicable NRC staff guidance.

2.0 AUTHORIZED ACTIVITIES

Currently, CBR is authorized to recover uranium from the orebody, at a maximum rate of 18,930 lpm (5000 gpm), exclusive of restoration flow, using a lixiviant composed of native groundwater, with added sodium carbonate/bicarbonate and oxygen or hydrogen peroxide. CBR's yellowcake production is limited to 907,185 kg (2 million pounds) per year.

2.1 Facility Description

The CBR facility and associated wellfields are located in west-central Dawes County, Nebraska, just north of the Pine Ridge area, approximately eight km (five mi) southeast of the town of Crawford, via Squaw Creek Road. Research and development (R&D) operations were conducted between July 1986 and December 1988. Commercial operations commenced in December 1989, and to date, five mine units (MUs) have been developed, with a sixth constructed and ready to operate. The surface area of the project site is approximately 1130 ha (2800 acres), of which an estimated 200 ha (500 acres) will be disturbed during the life of the project.

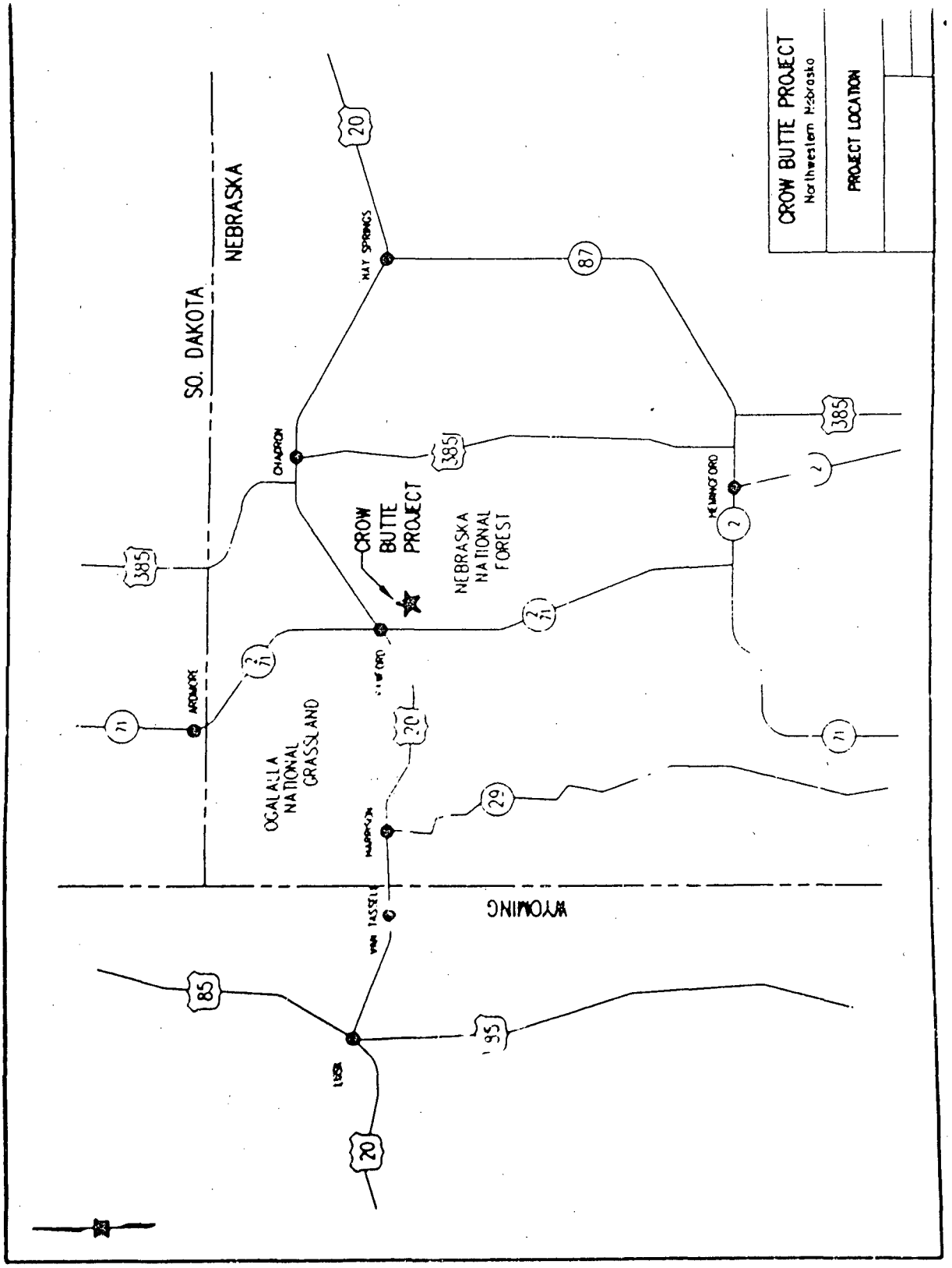

Figure 1-1. Location of the Crow Butte uranium *in situ* leach project (from CBR, 1995)

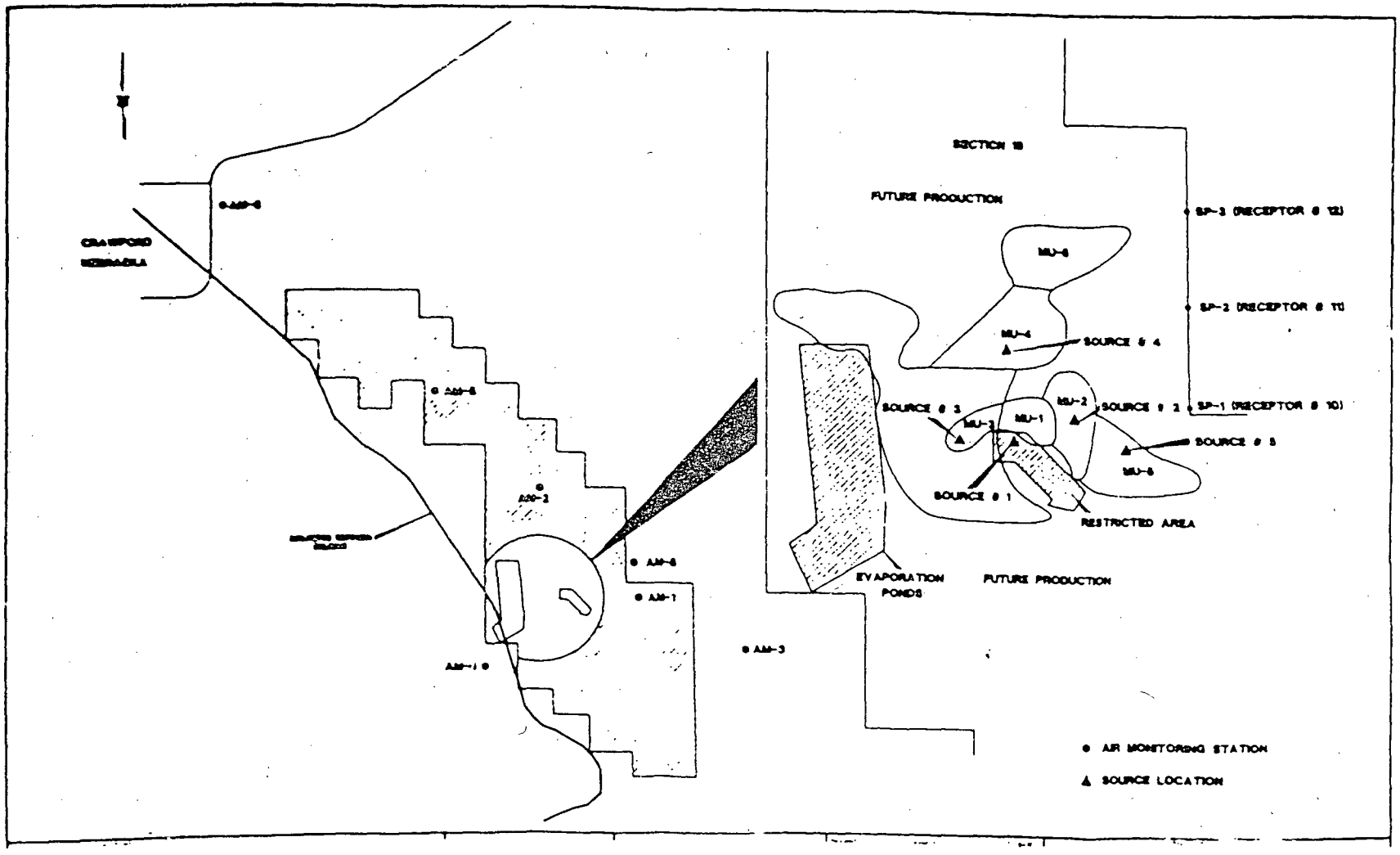

Figure 1-2. Locations of mine units 1 through 5 at the Crow Butte uranium *in situ* leach project (from CBR, 1995)

Liquid wastes produced by operations may be disposed by any of three approved methods: (1) in solar evaporation ponds, (2) through land application, or (3) down a deep injection well. Solid wastes (e.g., piping, valves, filters) are decontaminated, if possible, and released for unrestricted use, or, if unable to be decontaminated, sent to a facility licensed to accept 11e.(2) byproduct material for disposal.

2.2 Operations

During commercial operations, injection, recovery, and monitoring wells are installed in the ore zone. Within an MU, the geometric arrangement of the injection and recovery wells depends on the orebody configuration, aquifer permeability, and operator preference. The ore is extracted typically through the use of a series of five- or seven-spot patterns installed over the mineralized section of the formation. A single five-spot pattern is roughly rectangular in shape and consists of four injection wells surrounding a single central recovery well. The distance between the wells in any five-spot pattern will range from 12 to 36 m (40 to 100 ft), depending on the topography and ore characteristics. Each MU contains a number of wellfield houses (from two to seven per MU) where trunklines from the processing plant and injection and recovery solutions are distributed to the wells.

CBR injects local groundwater, with an added oxidant (oxygen or hydrogen peroxide) and a complexant (sodium carbonate/bicarbonate), into the mineralized zone through the injection wells. With slight pH adjustments, the uranium in the formation is oxidized and dissolved by complexation with the carbonate, and the resultant uranium-rich solution is drawn to the recovery wells, where it is pumped to the surface and transferred to the processing plant. In the plant, the uranium is removed from the solution by adsorption onto ion exchange (IX) resin, which is contained in IX columns. The now barren solution is recharged with oxidant and carbonate and reinjected into the ore zone for additional uranium recovery.

Once the majority of the IX sites on the resin have been filled with uranium, the column is taken off-stream. The loaded column is then stripped of uranium through an elution process in which the uranium-carbonate complex is eluted from the resin beads using a concentrated chloride solution. After the uranium has been stripped, the resin is rinsed with a sodium bicarbonate solution to convert the resin to a carbonate form and to control the chloride buildup in the processing circuit. The product of elution is a so-called "pregnant" (i.e., uranium-rich) eluant that is discharged into a holding tank. When a sufficient volume of pregnant eluant is held in storage, it is acidified to break down the uranyl carbonate complex ion that has been created. The solution is agitated to remove the resulting carbon dioxide gas (CO_2), and then hydrogen peroxide is added to precipitate the uranium. The precipitated uranyl peroxide slurry (yellowcake) is pH-adjusted and allowed to settle. The yellowcake is further dewatered and washed using a vacuum belt filter, and then dried in a vacuum dryer and packaged in 208-liter (55-gallon) drums for future shipment.

The general process circuit configuration is shown in Figure 2-1. The general layout of the processing plant is shown in Figure 2-2. The configuration of this process circuit has been reviewed by the NRC staff, and it represents a typical circuit for this type of operation.

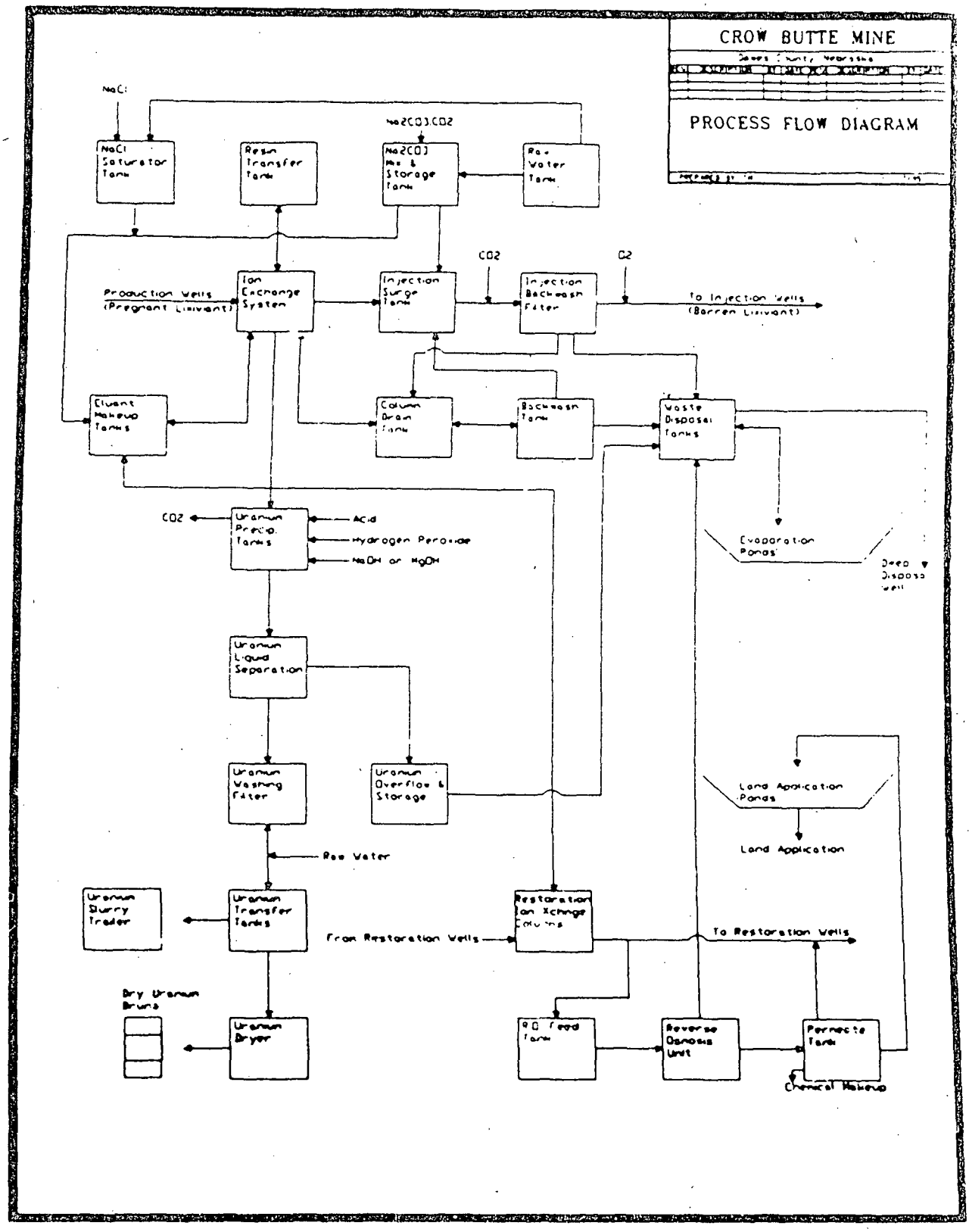

Figure 2-1. Process flow sheet (CBR, 1995)

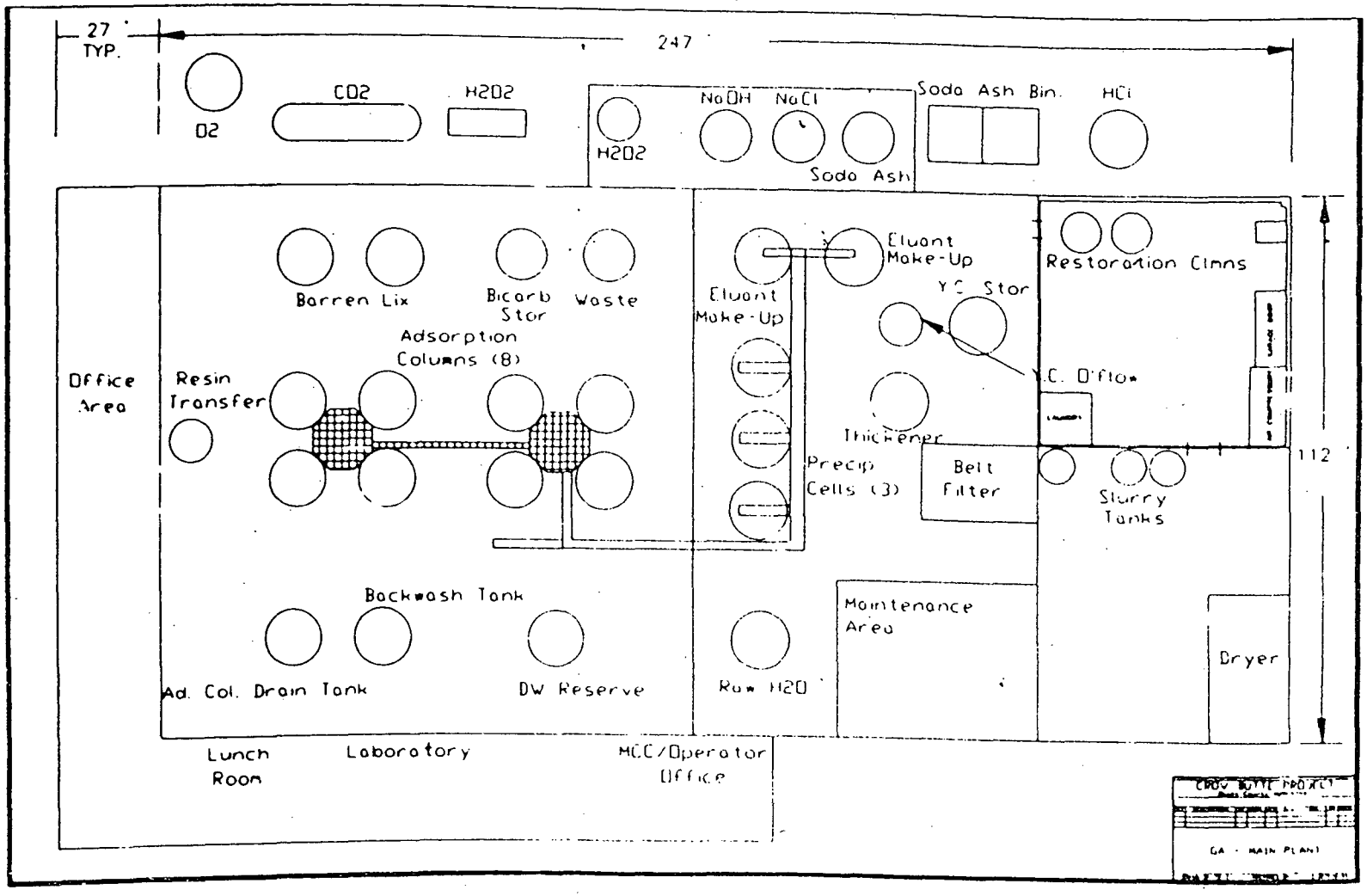

Figure 2-2. General arrangement: main processing facility (CBR, 1995)

CBR may make changes to the process circuit in accordance with the PBLC, as long as the changes do not degrade the essential safety commitments made in the LRA and do not impair CBR's ability to meet all applicable NRC regulations.

3.0 FACILITY ORGANIZATION AND ADMINISTRATIVE PROCEDURES

3.1 Organization

A partial organization chart of CBR which depicts the relationships of the organizational components responsible for operations, environmental protection, and radiation safety at the Crow Butte site is shown in Figure 3-1.

The overall responsibility for the radiation protection, environmental, and safety activities at the Crow Butte facility, as well as for all company commercial production facilities, resides with the president of CBR. This individual also is responsible for license development and modifications.

The CBR vice president is responsible for all uranium production activity at the project site. The vice president reports directly to the president, and will perform the duties of the president in the event of absence or disability of the president.

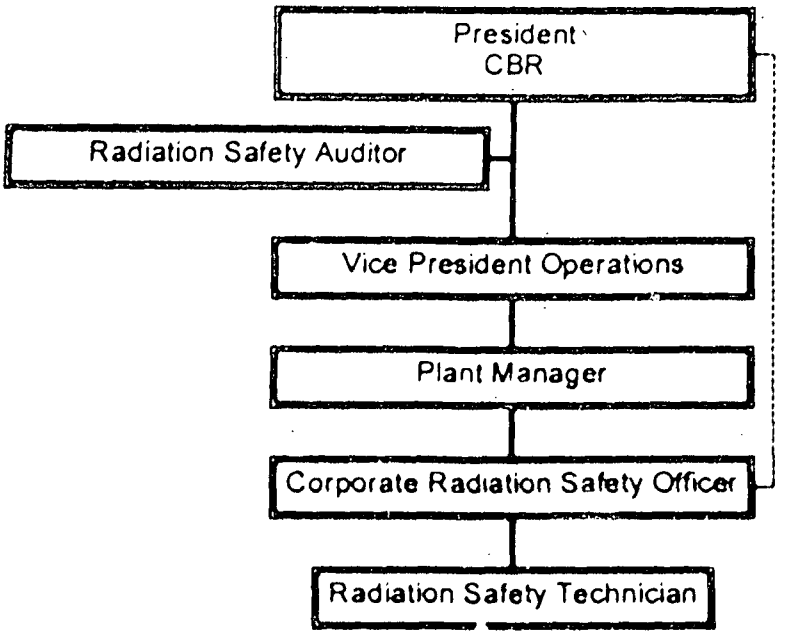

Figure 3-1. Crow Butte Resources organizational chart (CBR, 1997b)

The plant manager (PM) has direct oversight of the facility operations, including yellowcake handling procedures. The PM also is responsible for ensuring that any procedures or actions implemented by the Corporate Radiation Safety Officer (CRSO) or the vice president to correct or prevent radiation hazards are carried out. The PM supervises the CRSO to ensure that radiation safety programs are conducted in a manner consistent with regulatory requirements.

The CRSO is responsible for the development, administration, and enforcement of all radiation safety programs and the implementation of all on-site environmental and safety programs, including emergency procedures. This individual also makes recommendations to improve any and all radiological safety-related controls. The CRSO reports to the PM, but also has the responsibility to advise the President on matters involving radiation safety and to implement changes and/or corrective actions involving radiation safety, which have been authorized by the President.

The staff previously reviewed this organizational structure and found it to be in accordance with 10 CFR Part 20 and within the staff's recommendations in Regulatory Guide 8.31 (NRC, 1983a) (see Amendment 26 to SUA-1534; December 29, 1994). The staff will continue to require, by license condition, that any organizational change that affects assignments or reporting responsibilities of the radiation safety staff conform to the staff's recommendations in Regulatory Guide 8.31.

3.2 Radiation Safety Staff and Responsibilities

As stated above, the CRSO is responsible for the development, administration, and enforcement of all radiation protection programs and the implementation of all on-site environmental and safety programs, including emergency procedures at the Crow Butte site. In addition, the CRSO is authorized to conduct inspections and to immediately order any change necessary to preclude or eliminate radiation safety hazards and/or maintain regulatory compliance. The CRSO has overall responsibility for the collection and interpretation of employee exposure-related monitoring data, which includes data from both the radiological and industrial safety monitoring programs. The CRSO also makes recommendations to the PM to improve safety-related controls. The CRSO has no direct production-related responsibilities.

The Health Physics Technician (HPT) assists the CRSO with implementation of the radiological and industrial safety programs. The HPT is responsible for the collection and interpretation of data related to the environmental and radiological safety monitoring programs. The HPT assists the CRSO in the regular inspections of the facility as part of the radiation safety monitoring program. The HPT reports to the CRSO.

The staff finds that the radiation safety staff positions and responsibilities are in accordance with guidance in Regulatory Guide 8.31 and are therefore acceptable. However, due to the importance of these positions, the staff will continue to require, by license condition, that the CRSO and HPT meet initial specified qualifications and receive appropriate refresher training.

3.3 Minimum Technical Qualifications for Radiation Safety Staff

CBR proposes the following minimal qualifications and experience for personnel engaged in developing, conducting, and administering the Crow Butte Uranium Project radiation safety program.

3.3.1 Corporate Radiation Safety Officer

CBR states that the CRSO will meet certain minimum qualifications. The qualifications identified by the licensee are identical to those recommended by NRC in Regulatory Guide 8.31. RSO qualifications in Regulatory Guide 8.31 include: (1) a bachelor's degree in the physical sciences, industrial hygiene, or engineering, or an equivalent combination of training and relevant experience in uranium mill radiation protection; (2) appropriate health physics experience; (3) specialized classroom and biannual refresher training; and (4) appropriate specialized knowledge.

3.3.2 Health Physics Technician

CBR proposes that HPTs have either of two specific combinations of education, specialized training, and appropriate work experience. As with the required qualifications for the CRSO, the combinations identified by CBR are consistent with the staff's recommended combinations of education, training, and experience for HPTs in Regulatory Guide 8.31.

The staff finds the above qualifications for the CRSO and the HPT to meet its recommendations in Regulatory Guide 8.31, and to be, therefore, acceptable.

3.4 Administrative and Operation Procedures

Process activities, including those involving radioactive materials, are conducted in accordance with written standard operating procedures (SOPs). SOPs have been developed also for non-process activities addressing environmental monitoring, health physics procedures, emergency procedures, and general safety. SOPs are revised as necessary to meet changes in operations or regulatory requirements. The CRSO and appropriate management supervisors review and approve all SOPs prior to their implementation, with the CRSO's focus specifically on the radiological protection aspects of the proposed SOP. In addition, the CRSO reviews all SOPs on an annual basis. Up-to-date copies of the applicable SOPs are kept in the plant areas where they are used for easy access by company employees.

Due to the importance placed on SOPs, NRC will continue to require, by license condition, that CBR establish and follow written SOPs for all operational process activities involving radioactive materials that are handled, processed, or stored, and for non-operational activities which address in-plant and environmental monitoring, bioassay analyses, and instrument calibrations. The CRSO will continue to be required to document the review of all existing operating procedures on at least an annual basis.

The CRSO, or an appropriately trained designee, will issue Radiation Work Permits (RWPs) whenever non-routine work or maintenance activities to be carried out involve the potential for

radiation exposure. The RWP will specify the necessary radiological safety precautions, equipment, and/or specialized clothing, and any radiological surveys required for performing the activity. CBR's current license also requires that the RWP describe the scope of the work to be performed, and that all RWPs be accompanied by a breathing zone air sample or an applicable area air sample. Due to the potential health and safety hazards associated with non-routine operations, NRC will retain these conditions in the renewal license.

During 1996, CBR issued 16 RWPs, with the majority issued for maintenance of the yellowcake dryer or for repairs to the manifold systems in the IX columns.

The staff finds that CBR's commitments regarding administrative and operating procedures, as well as RWPs, are in accordance with Regulatory Guide 8.31, and are therefore acceptable.

3.5 Audits and Inspections

3.5.1 Inspections

On a daily basis, CBR proposes that the CRSO, HPT, or a qualified designated operator, conduct a visual walk-through inspection of the plant facility to check for compliance issues and any other problems. The results of this inspection are reviewed with the PM. Monthly, the CRSO will document in a report a review of all monitoring and exposure data for the month, a summary of all pertinent radiation survey records, a discussion of any trends in the ALARA program, and a review of the adequacy of the implementation of the NRC license conditions. In addition, the CRSO will make recommendations for any corrective actions or improvements in the process or safety programs. An audit of the ALARA program (see Section 3.5.2) and of the Quality Assurance/Quality Control program will be conducted on an annual basis.

In addition to the inspections and reviews proposed by CBR, the staff, in Regulatory Guide 8.31, recommends weekly inspections by the CRSO and plant superintendent to observe general radiation practices and to review required changes in procedures and equipment. All daily and weekly inspections should be documented, and the monthly summaries should review the results of the weekly, as well as the daily, inspections. Therefore, the NRC staff will require, by license condition, that CBR conduct these inspections, in addition to its proposed program, and document them as discussed above. CBR agreed to this condition, by telephone, on February 20, 1998.

In addition, NRC will continue to require, by license condition, that the results of sampling, analyses, surveys and monitoring, reports on audits and inspections, and investigations and corrective actions all be documented. All such documentation will continue to be required to be maintained for a period of at least five years.

The staff finds that CBR's proposed in-plant inspection program, as modified by the staff, is in accordance with Regulatory Guide 8.31. Therefore, the program is acceptable to the staff.

3.5.2 ALARA Audit

CBR commits to conducting an annual audit of the radiation protection and ALARA program, in accordance with the recommendations in NRC Regulatory Guide 8.31. This audit may be performed by an outside radiation safety auditing service. The auditing service will be qualified in radiation safety procedures as well as the environmental aspects of ISL mining operations. The results of the audit will provided to corporate management, who will implement recommendations in the audit report, as necessary, after consultation with the auditor and the CRSO. The CRSO may accompany the auditor, but will not participate in the audit.

Currently, CBR is required, by license condition, to submit a copy of the annual ALARA audit to NRC. In the renewal license, NRC will require instead that a copy of the audit be retained on-site for NRC inspection. However, NRC will continue to require, by license condition, that the audit report contain a summary of the daily walk-through inspections.

Therefore, the staff finds CBR's proposed annual ALARA audit program, as modified, to be in accordance with Regulatory Guide 8.31; and therefore acceptable.

3.6 Radiation Safety Training

All site employees and contracted personnel (when present at the Crow Butte Uranium Project) are administered a training program based upon the CBR radiation safety training plan covering radioactive material handling and radiological emergency procedures. Topics identified in the LRA as being addressed in this training program are generally consistent with the topics recommended by the staff to be covered in Regulatory Guide 8.31. The training will address topics in the areas of facility-provided protection, health protection measurements, radiation protection regulations, and emergency procedures. However, CBR did not identify appropriate fundamentals of health protection topics to be included in the training program. As recommended in Regulatory Guide 8.31, these should include (1) the radiologic and toxic hazards of exposure to uranium and its daughter products, (2) the ways in which uranium and its daughters can enter the body, and (3) the reasons why exposures to uranium and its daughters should be kept ALARA. Because these topics are essential to a radiation safety training program, the staff will require, by license condition, that CBR's training program address the topics identified in Regulatory Guide 8.31. CBR agreed to this license condition, by telephone, on February 20, 1998.

The technical content of the training program is the responsibility of the CRSO. Training is conducted by the CRSO or by a qualified designee. All new workers, including supervisors, are given specialized instruction on the health and safety aspects of the specific jobs they will perform. This instruction is done in the form of individualized on-the-job training. Retraining is done annually and is documented. Every two months, all workers attend a general safety meeting. Additionally, the licensee is required to document all training and maintain the records on file for a period of at least five years.

The staff finds CBR's radiation safety training program, as modified, to be in accordance with Regulatory Guide 8.31, and is therefore acceptable.

4.0 RADIATION SAFETY CONTROLS AND MONITORING

4.1 Ventilation and Effluent Control

At the Crow Butte site, radon from the production solutions is the only radioactive gaseous effluent. Radon gas will be released primarily from solution in the IX columns and in the injection surge tanks. At the processing facility, radon-222 is vented from recovery surge tanks and the IX columns into a manifold that is exhausted to the atmosphere outside the plant via an induced draft fan. In addition, the plant building is equipped with general area exhaust fans to avoid the buildup of radon gas in working areas. Radon exposures in working areas are monitored (see Section 4.2) to ensure exposures are in compliance with 10 CFR Part 20 limits. No uranium particulate emissions are expected from drying operations, because CBR uses vacuum dryer technology.

The staff considers the in-plant ventilation and effluent control systems to be acceptable for maintaining employee exposures ALARA.

4.2 In-Plant Monitoring Data

Area airborne sampling for uranium particulates is conducted, on a monthly basis, at the four locations shown in Figure 4-1. In addition, samples are taken in the dryer room during dryer operations and when RWPs are issued for this area. Average annual and maximum monthly gross alpha activity results from 1990 to 1996 were below 25 percent of the Maximum Permissible Concentration or the Derived Air Concentration (DAC) (after January 1, 1994) specified in 10 CFR Part 20.

Currently, CBR is required, by license condition, to increase the sampling frequency to weekly in any area that meets the definition of an "airborne radioactivity area" as defined in 10 CFR 20.1003, to investigate the cause of the elevated uranium levels, and to report the results of the investigations to NRC. The only area that presently meets this definition at the Crow Butte processing facility is the dryer room during yellowcake packaging operations. Due to consistently low airborne radioactivity levels in the plant over the period of commercial operations, NRC will drop this condition from the renewal license.

CBR conducts radon daughter surveys on a monthly basis at 11 in-plant sampling locations (Figure 4-1) and at an additional location in the reverse osmosis building. During commercial operations, the action level of 0.08 WL has been exceeded on several occasions. CBR conducted appropriate investigations and corrective actions to address these situations. Average monthly and annual radon daughter activities during the period of commercial operations have been less than 25 percent of the maximum permissible exposure limit or the DAC (after January 1, 1994).

4.3 Personnel Monitoring Data

CBR's calculation of its employee's internal exposure to radon or its daughters and to uranium is based on a time-weighted exposure calculation incorporating a consideration of both occupancy time and average airborne concentration. Occupancy factors are determined from

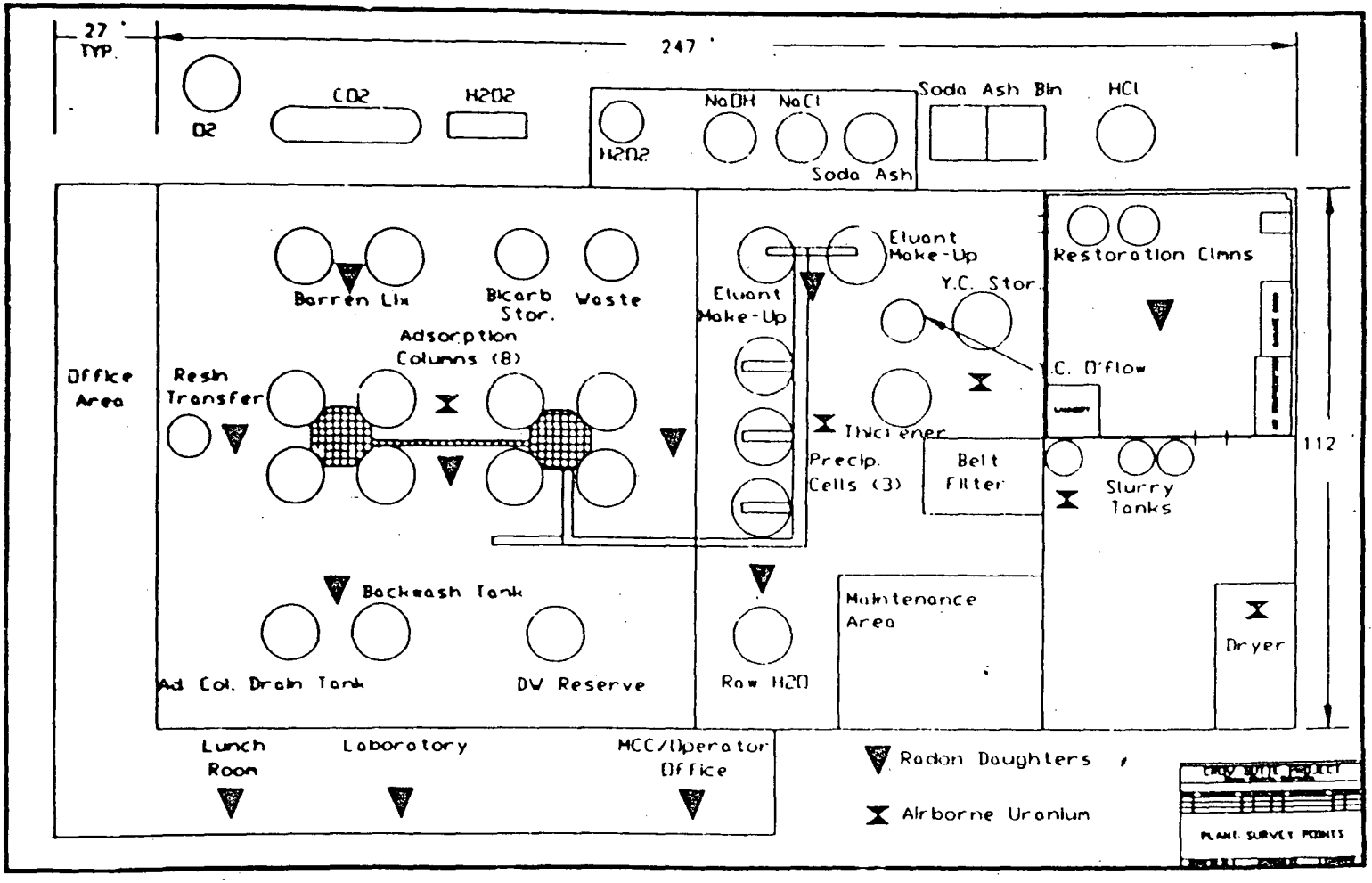

Figure 4-1. Proposed survey and sampling locations (CBR, 1997d)

actual time card data or may be based upon a time study approach. CBR assumes 100 percent occupancy times in determinations of routine worker exposures, and exposures during non-routine work are based on the actual time spent in completing the work. As described in Section 4.2, average airborne concentrations of uranium and of radon or its daughters will be determined based upon monthly air samples.

The licensee currently is required, by license condition, to perform and document internal occupational exposure calculations within one week of the end of each monitoring period, as specified in 10 CFR 20.1201. Furthermore, routine radon daughter and particulate samples were to be analyzed in a timely manner to allow exposure calculations to be performed. Finally, non-routine samples were required to be analyzed and results will be reviewed by the CRSO within two working days after sample collection. With this license renewal, NRC will drop these conditions as the requirements concerning internal occupational dose calculations are specified in 10 CFR Part 20.

CBR is required currently, by license condition, to have the HPT investigate an employee's work record and exposure history to identify the source of an exposure that reaches or exceeds 25 percent of the maximum permissible exposure limits specified in 10 CFR Part 20. CBR also is required to take the necessary corrective actions to the ensure reduction of future exposures to ALARA, to maintain records of these investigations, and to furnish the results to NRC in the annual ALARA audit report. With this renewal, NRC will drop this condition from the license, as licensees are required already under 10 CFR 20.1101 to implement a program that maintains occupational doses ALARA.

The staff finds that CBR's program to assess personnel internal exposures is acceptable for maintaining exposures ALARA and demonstrating compliance with the exposure limits in 10 CFR Part 20, Subpart B. CBR's exposure calculation methodologies are in accordance with Regulatory Guide 8.30, "Health Physics Surveys in Uranium Mills" (NRC, 1983b), and are therefore acceptable.

4.4 External Radiation Control Program

4.4.1 External Radiation Surveys

Gamma surveys are performed quarterly in designated radiation areas and semiannually in all other areas of the plant. A radiation area is established if results of the gamma survey exceed an action level of 5.0 mR/hr for worker-occupied stations. If this action level is exceeded, an investigation is performed to determine the source of the radiation, and the gamma survey frequency is increased to quarterly. Access to radiation areas is limited, and the areas are posted as required in 10 CFR 20.1902. Currently, within the processing plant and the reverse osmosis building, there are a total of five areas that are designated as radiation areas.

The staff finds that CBR's gamma survey program is in accordance with Regulatory Guide 8.30 and is therefore acceptable.

4.4.2 Exposure to External Radiation

Until the end of 1995, all full-time employees working in the process facility or wellfield operations were issued thermoluminescent dosimeters (TLDs) for determination of personal gamma exposure. However, based on operational data since 1990, which indicated that maximum individual annual exposures were less than 10 percent of the limits in 10 CFR 20.1201(a), CBR discontinued issuing TLDs to employees who do not regularly enter the process facility, while continuing to issue TLDs to process workers. TLDs are exchanged and read on a quarterly basis.

10 CFR 20.1502(a)(1) requires licensees to monitor occupational exposures to radiation and to supply and require the use of individual monitoring devices by adults likely to receive, in one year from sources external to the body, a dose in excess of 10 percent of the limits in 10 CFR 20.1201(a) (i.e., a limit of 0.005 Sieverts (Sv) [500 millirems (mrem)] per year). Operational data from 1990 to 1996 indicates that the highest annual external occupational exposure at the Crow Butte Uranium Project was 0.00495 Sv (495 mrem), which is just below the 10 percent limit. CBR proposes to continue monitoring workers in the process plant who are likely to receive higher doses than wellfield construction workers and other employees who do not enter the process plant regularly.

The staff finds that CBR's program to monitor external radiation exposures to personnel is in accordance with 10 CFR 20.1502(a)(1) and Regulatory Guide 8.30 and therefore is acceptable.

4.5 Internal Radiation Control Program

4.5.1 Airborne Radiation Surveys

As discussed in Section 4.2, area airborne sampling for uranium particulates is conducted, on a monthly basis, at the four locations shown in Figure 4-1. In addition, samples are taken in the dryer room during dryer operations and when RWPs are issued for this area. CBR collects samples in accordance with an applicable SOP using a regulated air sampler, which is calibrated every six months. Measurements are made by performing gross alpha counting of a glass fiber filter. CBR also takes breathing zone samples using an MSA pump or equivalent, to assess individual exposures to airborne uranium during certain operations. The sample results are compared with the DAC for soluble natural uranium (classification D). CBR has instituted an action level of 25 percent of the DAC, such that if sample results exceed this value, an investigation is implemented.

CBR conducts radon daughter surveys on a monthly basis at the 11 in-plant sampling locations shown in Figure 4-1, and at an additional location in the reverse osmosis building. Samples are collected using a low-volume air pump and analyzed with an alpha scaler using the Modified Kusnetz method (ANSI-N 13.8-1973). The samplers are calibrated every six months. CBR has established an action level of 25 percent of the DAC, or 0.08 Working Levels, for the in-plant locations. Survey results in excess of the action level will result in an investigation of the cause and an increase of sampling frequency to weekly until radon daughter levels do not exceed the action level for four consecutive weeks.

The staff finds that CBR's program for airborne particulate monitoring is in accordance with Regulatory Guide 8.25, "Air Sampling in the Workplace" (NRC, 1992), and therefore is acceptable.

4.5.2 Exposure to Internal Radiation

Radiation exposures at the various work stations are primarily a function of the time spent at the station and the concentration of radioactive material present. As previously discussed, the licensee has provided venting of the facility and uses a vacuum dryer to significantly reduce the concentration of airborne radioactivity. A vacuum dryer has the advantage that the product is isolated from the operator, as well as from the environment, through the utilization of a negative pressure chamber that is not connected with a heat source. As discussed in Section 4.2, CBR has proposed monthly sampling for uranium particulates in the processing plant. Additionally, general air sampling and breathing zone samples are taken during operations in the dryer room and the packaging area to estimate possible internal radiation exposure.

Exposure calculations are made using the intake method given in Section 2 of Regulatory Guide 8.30. Historical data taken during the period of commercial operations (1990-1996) indicate that the maximum annual individual internal exposure from airborne natural uranium and, separately from radon and its daughter elements, were less than five percent and fifteen percent, respectively, of the applicable regulatory limits.

The staff finds that CBR's internal radiation control program is in accordance with Regulatory Guide 8.30, and is therefore acceptable.

4.5.3 Respiratory Protection Program

CBR has implemented a respiratory program in accordance with the staff's guidance provided in Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection" (NRC, 1976) and has developed a series of implementing SOPs which address, among other things: (1) respirator selection, (2) fit testing, and (3) maintenance, cleaning, decontamination, and storage of respirators. The program is administered by the CRSO. RWPs for non-routine work or maintenance also may require the use of respirators.

The staff finds that CBR's respiratory protection program is in accordance with Regulatory Guide 8.15 and is therefore acceptable.

4.6 Bioassay

CBR has implemented a bioassay program to meet the staff's guidance provided in NRC Regulatory Guide 8.22 (Rev. 1), "Bioassay at Uranium Mills" (NRC, 1988). The primary purpose of the bioassay program is to detect uranium intake by employees who are exposed regularly to uranium. CBR's program involves: (1) the collection of baseline urinalysis samples from all new employees; (2) the quarterly collection and analysis of urine samples from workers whose routine work assignments require them to enter areas where there is a potential for yellowcake inhalation; (3) the analysis of samples collected from workers who have the potential for exposure to dried yellowcake on a monthly basis; (4) annual sampling of wellfield

construction and operations personnel with little or no potential for exposure to airborne uranium; and (5) an exit bioassay upon termination of employment.

The samples are analyzed by an outside analytical laboratory, with blank and spiked samples submitted along with the employee samples as part of CBR's quality assurance (QA) program. CBR has committed to using the action levels for urinanalysis specified in Table 1 of Regulatory Guide 8.22.

CBR is required currently to perform all *in vivo* measurements in accordance with Revision 1 of Regulatory Guide 8.22. Because CBR did not address these measurements in the LRA, NRC will retain this condition in the renewal license.

Currently under SUA-1534, CBR is required to document the corrective actions taken if urinanalysis or *in vivo* action levels have been reached or exceeded, and to submit this documentation to NRC within 30 days of reaching or exceeding the action level. With this renewal, NRC will drop this condition. Instead, the staff will review bioassay results and any follow-on actions during site inspections.

Historical bioassay data taken during commercial operations show that all but five samples were below the detection limit of 5 µg/L; the highest value of 13.9 µg/L was recorded in 1994. Followup resamples for those exceeding the detection limit were below 5 µg/L.

The staff finds that CBR's bioassay program, as modified by the staff, is in accordance with Regulatory Guide 8.22, and is therefore acceptable.

4.7 Contamination Control

4.7.1 Personnel Contamination

CBR requires all employees leaving the restricted area to monitor themselves for alpha contamination, in accordance with NRC Regulatory Guide 8.30. Employees are trained in the methods for performing surveys of skin and clothing. As currently required under SUA-1534, employees are required to decontaminate themselves and re-survey, if monitor results indicate that alpha levels are above 1000 disintegrations per minute per 100 square centimeters (dpm/cm^2). In addition, if decontamination to below 1000 $dpm/100\ cm^2$ cannot be accomplished, the employee is required to report the incident to the CRSO for investigation. CBR did not specifically address the current conditions in the LRA. Therefore, the staff will retain these conditions in the renewal license.

In accordance with Regulatory Guide 8.30, CBR also conducts and documents quarterly unannounced spot checks of personnel to verify the effectiveness of the personnel contamination program.

The staff finds that CBR's proposed personnel contamination control program is in accordance with Regulatory Guide 8.30, and is therefore acceptable.

4.7.2 Surface Contamination

CBR states that it conducts surveys for surface contamination in operating areas, designated eating areas, change rooms, and office areas, in accordance with NRC Regulatory Guide 8.30. In addition, CBR has set action levels for non-operating areas at 25 percent of the limits specified in Table 1 of Regulatory Guide 8.30.

Because the staff recommends in Regulatory Guide 8.30 that operating areas with surface contamination levels exceeding specified limits be cleaned promptly and CBR has committed to conducting its surveys in accordance with the regulatory guide, the staff will drop from the renewal license a current license condition requiring CBR to initiate and document cleanup efforts within 24 hours in the event that action levels are exceeded.

The staff finds that CBR's surface contamination control program is in accordance with Regulatory Guide 8.30, and is therefore acceptable.

4.7.3 Disposal of Contaminated Equipment

With the exception of small hand-carried items, which are surveyed during personnel surveys, CBR conducts surveys of all items leaving the restricted area. These surveys are performed by the CRSO, the radiation safety staff, or by properly trained employees. As specified in the LRA, release limits for all items from the restricted area are set in accordance with "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct or Source Materials" (NRC, 1984). This guidance document was updated in May 1987 (NRC, 1987), and therefore, the licensee will be required to follow this more recent version, or a suitable alternative procedure approved by NRC prior to any such release. CBR agreed to this license condition, by telephone, on November 10, 1997.

Records of equipment and corresponding contamination levels will be maintained for all items released from the site. Any item having contamination levels that exceed regulatory limits will be disposed of at a site licensed to receive byproduct waste materials. Transportation of all material to the byproduct disposal facility will be handled in accordance with U.S. Department of Transportation and NRC regulations (49 CFR 173.389 and 10 CFR Part 71, respectively).

The staff finds that CBR's program for release of contaminated equipment is in accordance with NRC guidelines and is therefore acceptable.

4.8 Quality Assurance and Calibration

By license condition, CBR is required currently to calibrate all radiation and environmental monitoring, sampling, and detection equipment (1) following any repairs, and (2) as recommended by the manufacturer or semiannually whichever is more frequent. With this renewal, the licensee has proposed modifying the second part of this requirement to allow recalibration on an annual basis, rather than semiannually. The staff finds CBR's proposal to be consistent with the staff's guidance provided in Regulatory Guide 8.30, and therefore, acceptable. CBR will continue to be required, by license condition, to have all radiation survey instruments operationally checked with a radiation source each day when in use.

CBR also will continue to be required, by license condition, to establish and follow written SOPs for instrument calibration, and separately, to document and maintain records of radiation detection and environmental monitoring equipment calibration for a period of at least five years

The CBR QA and instrument calibration program proposes procedures and policies for the effluent and radiological monitoring programs. The QA program is based on guidance provided in Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs (Normal Operations)—Effluent Streams and the Environment," Revision 1 (NRC, 1979).

The staff finds that the CBR QA and instrument calibration programs are in accordance with Regulatory Guides 4.15 and 8.30, and are therefore acceptable.

5.0 RESTRICTED AREA MARKINGS AND ACCESS CONTROL

CBR controls access to the site by way of fences, posted warning signs, and gates. The gate along the access route to the plant can be locked, and the site perimeter is posted in accordance with 10 CFR 20.1902(e). Security for the site is provided by personnel working at the facility, with access to the restricted area limited to authorized personnel only. All plant personnel are instructed to immediately report any suspected unauthorized persons to their supervisors. The supervisors are responsible for verifying that the person(s) have been authorized for entry, and unauthorized persons are escorted off the site.

All visitors entering the restricted area are required to register at the main office and are not permitted inside the plant area without authorization from designated supervisory personnel. Visitors who have not received formal training will be escorted while on-site by properly trained personnel. The current boundaries of the restricted area are shown in Figure 5-1.

The licensee will continue to be exempted, by license condition, from the requirements of 10 CFR 20.1902(e) for areas within the facility, provided that all entrances to the facility are conspicuously posted in accordance with 10 CFR 20.1902(e) with the words, "ANY AREA WITHIN THE FACILITY MAY CONTAIN RADIOACTIVE MATERIAL."

6.0 EMERGENCY PROCEDURES AND PREVENTATIVE MEASURES

CBR has established emergency procedures for natural disasters, significant equipment or facility damage, uncontrolled plant shutdowns, yellowcake spills, loss or theft of yellowcake or sealed sources, employee overexposure, and unauthorized discharges of radioactive materials. The procedures to be followed specify appropriate individuals to contact, health and decontamination procedures, and area cleanup methods.

Accidents involving the uncontrolled discharge of waste solutions would be unlikely. CBR conducts daily inspections of the solution disposal system and of the other areas of the facility.

The staff finds that the CBR emergency procedures and preventative measures are acceptable for maintaining employee and public exposures ALARA as required by the requirements of 10 CFR 20.1101.

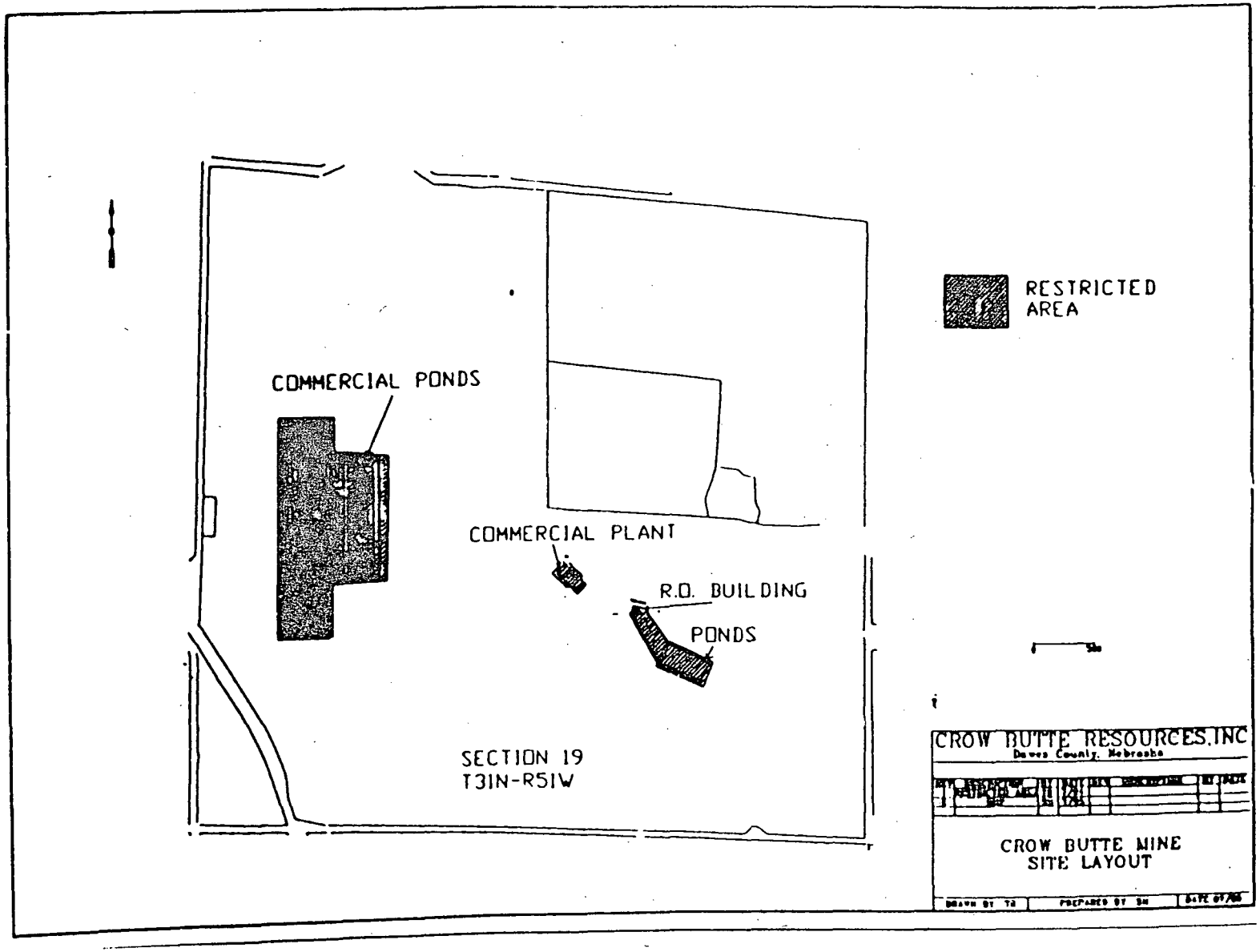

Figure 5-1. Restricted area boundaries at the Crow Butte uranium *in situ* leach project (from CBR, 1996)

7.0 EVAPORATION POND EVALUATION

CBR employs solar evaporation ponds as one disposal option for liquid wastes generated by its process operations. NRC has approved two other disposal options for these wastes: land application and deep well injection. A complete discussion of these disposal methods is contained in the accompanying EA.

8.0 DECOMMISSIONING AND RECLAMATION

CBR will continue to be required, by license condition, to decommission and reclaim the site to meet applicable radiation protection standards. Currently applicable standards include limits for reclamation of soil contamination consistent with those in Appendix A to 10 CFR Part 40, and the decommissioning requirements of 10 CFR 40.42. Additionally, the wellfields will be abandoned in accordance with the State of Nebraska's standards. Additional site decommissioning, reclamation, and aquifer restoration information is contained in the accompanying EA.

CBR will continue to be required, by license condition, to submit a final site decommissioning plan for NRC review and approval at least 12 months prior to a planned final shutdown of mining operations.

9.0 SURETY REQUIREMENTS

Under 10 CFR Part 40, Appendix A, Criterion 9, licensees are required to establish a financial surety arrangement adequate to cover the estimated costs, if accomplished by a third party, for completion of the NRC-approved site closure plan including: decommissioning and decontamination of the aboveground facilities, the cost of offsite disposal of radioactive solid process or evaporation pond residues, soil and water analyses, and groundwater restoration as warranted. The surety is based on an estimate which must account for the total costs that would be incurred if an independent contractor were contracted to perform the work. The surety estimate must be approved by NRC and based on an NRC-approved decommissioning and reclamation plan. The licensee must also provide the surety arrangement through a financial instrument acceptable to NRC. The licensee's surety mechanism will be reviewed by NRC annually to ensure that sufficient funds are available to complete site decommissioning and reclamation. Additionally, the amount of the surety should be adjusted to recognize any increases or decreases in liability resulting from inflation changes, engineering plan changes, or other conditions affecting costs.

CBR has maintained an acceptable surety mechanism throughout the course of commercial operations at the Crow Butte Uranium Project. The current surety level to cover aboveground decommissioning and decontamination, offsite disposal of radioactive solid process wastes or evaporation pond residues, and groundwater restoration is $8,950,827, held as an Irrevocable Standby Letter of Credit issued by Colorado National Bank, in favor of the State of Nebraska. This surety amount was reviewed and approved by NRC on January 7, 1998. CBR will continue to be required, by license condition, to maintain a financial surety arrangement in accordance with the requirements of 10 CFR Part 40, Appendix A, Criterion 9. The surety

requirements will be reviewed at least annually by NRC to ensure that the funds and surety arrangements are acceptable.

10.0 INSPECTION HISTORY

The NRC has conducted routine announced, routine unannounced, and reactive inspections of the Crow Butte Uranium Project since commercial operations commenced in late 1989. NRC has cited CBR for a total of five violations, each of Severity Level IV, during the 18 inspections which have been conducted to date. A discussion of inspection and enforcement actions, including severity of violations is provided in NUREG-1600 (NRC, 1995). Minor violations are cited at Severity Level IV, and major violations are cited at Severity Level I. Typically, Severity Level IV violations are cited for not performing required surveys or for incomplete documentation. All cited violations have been acceptably addressed and corrective measures have been enacted by the licensee. A summary of the inspection history for the facility during commercial operations is provided in Table 10-1.

On July 2, 1996, the Commission approved increasing the license term for qualified uranium recovery licensees from the current five-year period to a ten-year period. As discussed in SECY-96-112 (issued on May 21, 1996), the criteria to be used in determining whether a licensee is "qualified" are as follows:

(1) the licensee must have performed well;

(2) the licensee must have a successful inspection record, with no violations more serious than Severity Level IV;

(3) the licensee must have had no serious operational problems or reports during the previous two years; and

(4) the license in question must currently have a specific term of renewal (uranium mills currently undergoing reclamation would not meet this criteria).

Based on its review, the staff finds that CBR is a qualified licensee, and therefore, a ten-year license term is appropriate.

Table 10-1. Summary of NRC inspections of the Crow Butte Uranium Project

Date	Type*	Number of Violations	Severity Level	Comments/Results
5/17/90	U	None	–	
4/4/91	R	None	–	Inspection prompted by potentially significant solution spill from a production well. Water and soil samples indicated that contamination of an unrestricted area was unlikely.
6/3–6/91	U	1	IV	Soils used for evaporation pond construction routinely placed at moisture contents below levels required by license condition. Violation Closed.
6/16–18/92	U	None	–	
9/28–29/92	A	None	–	
10/14/92	U	None	–	
11/17/92	A	None	–	
1/14/93	R	2	IV, IV	Inspection prompted by pipeline failure and subsequent release of 23,000 gallons of lixiviant from the process circuit. Unknown amount of lixiviant escaped offsite. CBR cited for lack of SOPs to address construction, testing, operation, and maintenance of pipelines. Violations Closed.
8/10–12/93	A	None	–	
8/26–27/93	A	None	–	
3/18/94	A	None	–	
5/23–26/94	A	None		
4/25–27/95	A	1	IV	Failure to assign TLDs to plant personnel at all times while working in the plant, as required by license condition. Violation Closed.
9/12–14/95	A	None	–	
4/8–11/96	A	1	IV	Failure to establish written SOPs for some environmental monitoring activities, and failure to keep current copies of applicable SOPs in certain areas, as required by license condition. Violation Closed.
9/23–25/96	A	None	–	
4/14-17/97	A	None	–	
8/12-14/97	A	None	–	

* A = Routine, Announced; R = Reactive; U = Unannounced

11.0 CONCLUSION INCLUDING SAFETY LICENSE CONDITIONS

Upon completion of the safety review of CBR's license renewal application, the NRC staff concludes that the continuation of commercial operations at the Crow Butte Uranium Project, in accordance with the following license conditions, is protective of health and safety and fulfills the requirements of 10 CFR Parts 20 and 40. The NRC staff, therefore, recommends renewal of Source Material License SUA-1534, subject to the following conditions:

1. A. The licensee may, without prior NRC approval, and subject to the conditions specified in Part B of this condition:

(1) Make changes in the facility or process, as presented in the approved application.

(2) Make changes in the procedures presented in the approved application.

(3) Conduct tests or experiments not presented in the approved application.

B. The licensee shall file an application for an amendment to the license, unless the following conditions are satisfied:

(1) The change, test, or experiment does not conflict with any requirement specifically stated in this license (excluding information referenced in the approved license application), or impair the licensee's ability to meet all applicable NRC regulations.

(2) There is no degradation in the essential safety or environmental commitments in the license application, or provided by the approved reclamation plan.

(3) The change, test, or experiment is consistent with the conclusions of actions analyzed and selected in the accompanying EA.

C. The licensee's determinations concerning Part B of this condition, shall be made by a "Safety and Environmental Review Panel" (SERP). The SERP shall consist of a minimum of three individuals employed by the licensee, and one of these shall be designated as the SERP chairman. One member of the SERP shall have expertise in management and shall be responsible for approval of managerial and financial changes; one member shall have expertise in operations and/or construction and shall have responsibility for implementing any operational changes; and one member shall be the site corporate radiation safety officer (CRSO) or equivalent, with the responsibility for assuring changes conform to radiation safety and environmental requirements. Additional members may be included in the SERP as appropriate, to address technical aspects such as health physics, groundwater hydrology, surface-water hydrology, specific earth sciences, and other technical disciplines. Temporary members or permanent members, other than the three above-specified individuals, may be consultants.

D. The licensee shall maintain records of any changes made pursuant to this condition until license termination. These records shall include written safety and environmental evaluations, made by the SERP, that provide the basis for determining that changes are in compliance with the requirements referred to in Part B of this condition. The licensee shall furnish, in an annual report to NRC, a description of such changes, tests, or experiments, including a summary of the safety and environmental evaluation of each. In addition, the licensee shall annually submit to NRC page changes to the approved license application to reflect changes made under this condition.

2. Written standard operating procedures (SOPs) shall be established and followed for all operational process activities involving radioactive materials that are handled, processed, or stored. SOPs for operational activities shall enumerate pertinent radiation safety practices to be followed. Additionally, written procedures shall be established for non-operational activities to include in-plant and environmental monitoring, bioassay analyses, and instrument calibrations. An approved, up-to-date copy of each written procedure shall be kept in the process area to which it applies.

   All written procedures for both operational and non-operational activities shall be reviewed and approved in writing by the CRSO before implementation and whenever a change in procedure is proposed to ensure that proper radiation protection principles are being applied. In addition, the CRSO shall perform a documented review of all existing SOPs at least annually.

3. Any corporate organization changes affecting the assignments or reporting responsibilities of the radiation safety staff as described in Section 5 of the approved license application shall conform to Regulatory Guide 8.31.

4. The licensee shall have a training program for all site employees as described in Regulatory Guide 8.31 and as detailed in the approved license application. The training program shall cover the topics identified in Section 2.5 of Regulatory Guide 8.31.

   The Site Corporate Radiation Safety Officer (CRSO), or their designee, shall have the education, training and experience as specified in Regulatory Guide 8.31. The CRSO shall also receive 40 hours of related health and safety refresher training every two (2) years.

   Individuals designated as the Health Physics Technician (HPT) shall report directly to the CRSO on matters dealing with radiological safety. In addition, the CRSO shall be accessible to the HPT at all times. The HPT shall have the qualifications specified in Regulatory Guide 8.31, or equivalent. Any person newly hired as an HPT shall have all work reviewed and approved by the CRSO as part of a comprehensive training program until appropriate course training is completed, and at least for six (6) months from the date of appointment.

5. The licensee is hereby exempted from the requirements of Section 20.1902(e) of 10 CFR Part 20 for areas within the facility, provided that all entrances to the facility

are conspicuously posted in accordance with Section 20.1902(e) and with the words, "ANY AREA WITHIN THIS FACILITY MAY CONTAIN RADIOACTIVE MATERIAL."

6. The boundaries of the licensee's restricted area shall be those identified in the submittal dated April 22, 1996.

7. The licensee shall be required to use a Radiation Work Permit (RWP) for all work or non-routine maintenance jobs where the potential for significant exposure to radioactive material exists and for which no standard written operating procedure exists. All RWPs shall be accompanied by a breathing zone air sample or an applicable area air sample. The RWP shall be issued by the CRSO, or designee qualified by way of specialized radiation protection training, and RWPs shall include, as a minimum, the information described in Section 2 of Regulatory Guide 8.31.

8. The licensee shall conduct the in-plant radiological inspection program described in Section 5.3 of the license renewal application, with the following modifications:

   A. The licensee shall document problems observed during the daily visual walk-through inspections in writing; and

   B. The CRSO and plant manager, or qualified designees, shall perform weekly inspections to observe general radiation control practices and to review required changes in procedures and equipment.

9. In-plant radiological monitoring for airborne uranium and radon daughters shall be conducted at the locations shown in Figure 5.7-1 in the approved license application.

10. Employees shall monitor themselves with an alpha survey instrument prior to exiting the restricted area. Should the results of monitoring exceed an action level of 1000 dpm/100 cm^2, employees shall decontaminate themselves to less than the action level. If decontamination cannot be accomplished, the employee shall report the incident to the CRSO for investigation.

11. In addition to the bioassay program discussed in Section 5.7.5 of the approved license application, the licensee also shall perform *in vivo* measurements in accordance with the recommendations contained in Revision 1 of Regulatory Guide 8.22.

12. The licensee shall maintain effluent control systems as specified in Sections 4.1 and 5.7.1.1 of the approved license application, with the following exceptions:

   A. If any of the yellowcake emission control equipment fails to operate within specifications set forth in the standard operating procedures, the drying and packaging room shall immediately be closed-in as an airborne radiation area and heating operations shall be switched to cooldown, or packaging operations shall be temporarily suspended. Packaging operations shall not be resumed until the vacuum system is operational to draw air into the system.

B. The licensee shall, during all periods of yellowcake drying operations, assure that the negative pressure specified in the standard operating procedures for the dryer heating chamber is maintained. This shall be accomplished by either (1) performing and documenting checks of air pressure differential approximately every four hours during operation, or (2) installing instrumentation which will signal an audible alarm if the water flow or air pressure differential falls below the recommended levels. If an audible alarm is used, its operation shall be checked and documented at the beginning and end of each drying cycle when the differential pressure is lowered.

13. All radiation monitoring, sampling, and detection equipment shall be recalibrated after each repair and as recommended by the manufacturer, or at least annually, whichever is more frequent. In addition, all radiation survey instruments shall be operationally checked with a radiation source each day when in use.

14. An annual ALARA audit of the radiation safety program shall be performed in accordance with Regulatory Guide 8.31 and Section 5.3 of the approved license application. The CRSO shall accompany the audit team. A report of this audit shall be retained on-site for NRC inspection. The report also shall summarize the results of the daily walk-through inspections.

15. The results of the following activities, operations, or actions shall be documented: sampling; analyses; surveys and monitoring; survey/monitoring equipment calibrations; reports on audits and inspections; all meetings and training courses required by this license; and any subsequent reviews, investigations, or corrective actions. Unless otherwise specified in the NRC regulations, all such documentation shall be maintained for a period of at least five (5) years.

16. The licensee shall maintain an NRC-approved financial surety arrangement, consistent with 10 CFR 40, Appendix A, Criterion 9, adequate to cover the estimated reclamation and closure costs, if accomplished by a third party, for all existing operations and any planned expansions or operational changes for the upcoming year. Reclamation includes all cited activities and groundwater restoration, as well as off-site disposal of all 11e.(2) byproduct material.

Within 3 months of NRC approval of a revised closure plan and cost estimate, the licensee shall submit for NRC review and approval, a proposed revision to the financial surety arrangement if estimated costs in the newly approved site closure plan exceed the amount covered in the existing financial surety. The revised surety shall then be in effect within 3 months of written NRC approval.

Annual updates to the surety amount required by 10 CFR 40, Appendix A, Criterion 9, shall be provided to the NRC by October 1 of each year. If the NRC has not approved a proposed revision 30 days prior to the expiration date of the existing surety arrangement, the licensee shall extend the existing arrangement, prior to expiration, for one year. Along with each proposed revision or annual update of the surety, the licensee shall submit supporting documentation showing a breakdown of the costs and

the basis for the cost estimates with adjustments for inflation, maintenance of a minimum 15 percent contingency, changes in engineering plans, activities performed, and any other conditions affecting estimated costs for site closure.

The licensee shall provide an updated surety for NRC approval for any planned expansion or operational change which has not been included in the annual surety update. This surety update shall be provided to the NRC at least 30 days prior to the commencement of the planned expansion or operational change.

The licensee shall also provide the NRC with copies of surety-related correspondence submitted to the State of Nebraska, a copy of the State's surety review, and the final approved surety arrangement. The licensee must also ensure that the surety, where authorized to be held by the State, identifies the NRC-related portion of the surety and covers the above-ground decommissioning and decontamination, the cost of offsite disposal, soil and water sample analyses, and groundwater restoration associated with the site. The basis for the cost estimate is the NRC-approved site closure plan or the NRC-approved revisions to the plan. Reclamation/decommissioning plan, cost estimates, and annual updates should follow the outline in Appendix E to NUREG-1569 (NRC, 1997), entitled "Recommended Outline for Site-Specific *In Situ* Leach Facility Reclamation and Stabilization Cost Estimates."

Crow Butte Resources, Inc.'s currently approved surety instrument, an Irrevocable Standby Letter of Credit issued by Colorado National Bank, in favor of the State of Nebraska, shall be continuously maintained in the sum total amount of no less than $8,950,827 for the purpose of complying with 10 CFR 40, Appendix A, Criterion 9, until a replacement is authorized by both the State of Nebraska and the NRC.

17. Release of equipment, materials, or packages from the restricted area shall be in accordance with the NRC guidance document entitled, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," dated May 1987, or suitable alternative procedures approved by NRC prior to any such release.

18. The licensee shall submit a detailed decommissioning plan to NRC for review and approval at least twelve (12) months prior to planned final shutdown of mining operations.

Additional license conditions addressing environmental issues can be found in the EA, which accompanies this licensing action.

12.0 REFERENCES

Crow Butte Resources, Inc. (CBR), 1997a, "1998 Surety Estimate - Revision 3," transmitted by letter from Stephen P. Collings (CBR) to Joseph J. Holonich (NRC), dated November 10, 1997.

CBR, 1997b, "Standard Operating Procedures for Safety and Environmental Review Panel and Revised Section 5 Operations of the Renewal Application," transmitted by letter from Stephen P. Collings (CBR) to Joseph J. Holonich (NRC), dated October 31, 1997.

CBR, 1997c, "Request to amend Source Material License SUA-1534," transmitted by letter from Stephen P. Collings (CBR) to Joseph J. Holonich (NRC), dated July 28, 1997.

CBR, 1997d. "Response to Request for Additional Information - License Renewal," transmitted by letter from Steve Collings (CBR) to Joseph J. Holonich (NRC), dated June 25, 1997.

CBR, 1997e, "Response to Acceptance Review Comments for the Renewal of Source Material License No. SUA-1534," transmitted by letter from Steve Collings (CBR) to Joseph J. Holonich (NRC), dated April 1, 1997.

CBR, 1996, Amendment request transmitted by letter from Stephen P. Collings (CBR) to Joseph Holonich (NRC), dated April 22, 1996.

CBR, 1995, "Crow Butte Uranium Project, Dawes County, Nebraska. Application for Renewal of USNRC Radioactive Source Material License SUA-1534," dated December 1995 and submitted by letter from Stephen P. Collings (CBR) to Joseph J. Holonich (NRC), dated December 20, 1995.

U.S. Nuclear Regulatory Commission (NRC), 1997, "Draft Standard Review Plan for *In Situ* Leach Uranium Extraction License Applications," NUREG-1569, October 1997.

NRC,1996, "Ten-Year License Terms for Uranium Recovery Licensees," SECY-96-112, issued May 21, 1996.

NRC, 1995, "General Statement of Policy and Procedures for NRC Enforcement Actions (Enforcement Policy)," Office of Enforcement, NUREG-1600, July 1995.

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