CROW BUTTE RESOURCES, INC.

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January 3, 2005

Mr. Gary Janosko
Branch Chief
Fuel Cycle Licensing Branch
Division of Fuel Cycle Safety and Safeguards
c/o Document Control Desk
U.S. Nuclear Regulatory Commission
Washington D.C. 20555

Re: Docket No. 40-8943
License No. SUA-1534
Annual Report of Changes, Tests, or Experiments

Dear Mr. Janosko:

Crow Butte Resources, Inc. (CBR) is providing this annual report summarizing the changes, tests or experiments made under License Condition 9.4 of SUA-1534 during calendar year 2004. This report is made in accordance with the reporting requirements contained in License Condition 9.4 (E).

CBR's source material license was renewed on March 4, 1998. The renewed license contained Performance Based License Conditions (PBLC). In a PBLC, CBR is allowed to make changes or conduct tests and experiments under certain conditions. These changes, test and experiments must be reviewed and approved by the CBR Safety and Environmental Review Panel (SERP). During 2004, the CBR SERP approved six changes.

The following materials are attached to provide the required summary information and documentation required by License Condition 9.4 (E).

- SERP Evaluation Index, which summarizes each SERP Action and tracks any modifications to an approved action affected by subsequent SERP actions.

- A copy of the text of each approved SERP Evaluation. These evaluations describe the change or test approved and the safety and environmental evaluation performed by the SERP. Supporting documentation is maintained on site for NRC review.

NMSS01

- Highlighted versions of page changes made to the License Renewal Application (LRA) because of the SERP actions or NRC license amendment in 2004. These highlighted page changes use a strikethrough to denote deleted text and an underline to indicate new text.

- Page replacement versions of page changes for insertion in the updated NRC copy of the LRA. These pages have a revision date in the footer.

If you have any questions or require further information, please do not hesitate to contact me at (308) 665-2215.

Sincerely,
CROW BUTTE RESOURCES, INC.

Michael L. Griffin
Manager of Health, Safety, and Environmental Affairs

Enclosures: As Stated

cc: U.S. Nuclear Regulatory Commission
Mr. John Lusher - ADDRESSEE ONLY
Fuel Cycle Licensing Branch
Mail Stop T-8A33
Washington, DC 20555

CROW BUTTE RESOURCES, INC.

2004 SERP Evaluation Index

Safety and Environmental Review Panel

2004 SERP Index

SERP Evaluation Number	Date	Action Taken	Modifications to Previous SERP Actions
SERP 04-01	23 Feb 2004	Approval of License Renewal Application Changes	None
SERP 04-02	24 Mar 2004	Wellhouse 42 Review and Approval	None
SERP 04-03	12 Apr 2004	Approval of Initial Startup of New Yellowcake Dryer	None
SERP 04-04	30 Jun 2004	Wellhouse 38 Review and Approval	None
SERP 04-05	28 Sep 2004	Wellhouse 43 Review and Approval	None
SERP 04-06	3 Dec 2004	Wellhouse 39 Review and Approval	None

CROW BUTTE RESOURCES, INC.

SERP 04-01 Evaluation

CROW BUTTE RESOURCES, INC.

SAFETY AND ENVIRONMENTAL REVIEW PANEL

Evaluation Report – SERP 04-01

Proposed Revisions to the Approved License Renewal Application

February 23, 2004

The Crow Butte Resources, Inc. (CBR) Safety and Environmental Review Panel (SERP) met in accordance with USNRC Source Materials License SUA-1534 to review proposed changes to the License Renewal Application. These changes were recommended to reflect recent changes to the CBR operating procedures, the NRC License, and an organizational change that affects the radiation safety department.

The SERP appointed for this evaluation consisted of the following members:

Name	Title	Area of Expertise
Jim Stokey	Mine Manager	Management
Mike Griffin	Manager of Health, Safety and Environmental Affairs	Regulatory Affairs
Rhonda Grantham	Corporate Radiation Safety Officer	Radiation Safety
John Cash	Operations Superintendent	Operations

Dr. Stokey is the SERP Chairman. Mr. Griffin was appointed SERP Secretary for this evaluation.

PURPOSE OF SERP EVALUATION

The purpose of the SERP evaluation was to review the following proposed changes to the License Renewal Application:

1. During the course of 2003, CBR developed an "Environmental Management System" (EMS) Program. This program is designed to provide a comprehensive program for protection of the environment and worker health and safety, including radiation safety. The program is organized into eight volumes in the following topical areas:

   Volume 1 – Standards
   Volume 2 – Management Procedures
   Volume 3 – Operating Manual (SOPs)
   Volume 4 – Health Physics Manual
   Volume 5 – Industrial Safety Manual
   Volume 6 – Environmental Manual
   Volume 7 – Training Manual
   Volume 8 – Emergency Manual

   At the time of this SERP evaluation, Volumes III through VIII are complete and in use at CBR. Volumes I and II involve program standards and management procedures and are currently under development. The EMS Program Volumes replace the Standard Operating Procedures (SOPs) formerly used by CBR to meet NRC licensing commitments and referenced in many portions of the License Renewal Application (LRA). In addition, the new EMS Program contains much more detailed programmatic and procedural requirements that are described in the proposed LRA changes. In order to revise the LRA to reflect the new EMS Program, a significant number of changes are required.

2. An organizational change has been made that indirectly affects the reporting responsibilities of the radiation safety staff. Specifically, the reporting for the Mine Manager has been changed as shown in the revised Figure 5.1-1 from the approved application. The Mine Manager now reports directly to the Senior Vice President – Operations. Since the RSO reports to the Manager of Health, Safety, and Environmental Affairs who in turn reports to the Mine Manager, a change in the reporting for the Mine Manager will indirectly affect the radiation safety staff reporting.

3. In October 2003, Amendment 16 to SUA-1534 removed the requirement to monitor sodium and sulfate in monitor wells. In January 2004, the Nebraska Department of Environmental Quality (NDEQ) approved a similar change to the Underground Injection Control (UIC) permit and monitoring for these two parameters was discontinued. The groundwater monitoring section of the LRA requires revisions to reflect this regulatory change.

AUTHORITY OF SERP

License Condition 9.4 allows CBR to make changes in the facility or procedures or conduct tests or experiments that are not presented in the approved application if such changes do not:

i. Result in any appreciable increase in the frequency of occurrence of an accident previously evaluated in the license application (as updated);
ii. Result in any appreciable increase in the likelihood of occurrence of a malfunction of a structure, system, or component (SSC) important to safety previously evaluated in the license application (as updated);
iii. Result in any appreciable increase in the consequences of an accident previously evaluated in the license application (as updated);
iv. Result in any appreciable increase in the consequences of a malfunction of an SSC previously evaluated in the license application (as updated);
v. Create a possibility for an accident of a different type that any previously evaluated in the license application (as updated);
vi. Create a possibility for a malfunction of an SSC with a different result than previously evaluated in the license application (as updated);
vii. Result in a departure from the method of evaluation described in the license application (as updated) used in establishing the final safety evaluation report (FSER) or the environmental assessment (EA) or the technical evaluation reports (TERs) or other analysis and evaluations for license amendments.
viii. For the purposes of SERP evaluations, SSC means any SSC which has been referenced in a staff SER, TER, EA, or environmental impact statement (EIS) and supplements and amendments.

SERP EVALUATION

The SERP evaluation was conducted in accordance with CBR Standard Operating Procedure (SOP) C-2, *Safety and Environmental Review Panel.* The SERP reviewed the proposed change and evaluated this information as compared with the requirements of the licensing basis, including the following documents:

- Title 10, Code of Federal Regulations;
- Source Materials License SUA-1534, Amendment No. 16 dated October 20, 2003;
- *Application for Renewal of USNRC Radioactive Source Materials License SUA-1534*, Crow Butte Resources, Inc. December 1995;
- *Environmental Assessment for Renewal of Source Materials License No. SUA-1534*, USNRC February 1998;
- *Safety Evaluation Report for Renewal of Source Materials License No. SUA-1534*, USNRC February 1998;

- Technical Evaluation Reports issued in support of amendments to SUA-1534.

Title 10 Code of Federal Regulations

The proposed changes to the LRA will have no impact on CBR's ability to meet all applicable NRC regulations.

Source Materials License SUA-1534 Requirements

The SERP reviewed the requirements contained in Source Materials License SUA-1534, Amendment 16, dated October 20, 2003. The proposed changes will have no impact on CBR's ability to meet NRC License Conditions. Some of the proposed changes are intended to reflect recent amendments to the NRC License.

Environmental Assessment

The SERP reviewed the contents of the Environmental Assessment (EA) prepared by NRC in February 1998 to determine whether the proposed change caused substantive safety or environmental impacts. The proposed changes to the LRA do not conflict with the EA.

Financial Surety

The proposed changes to the LRA will have no effect on the level of financial surety maintained by CBR.

Safety Evaluation Report

The Safety Evaluation Report (SER) prepared by NRC in 1998 principally provides the basis for worker safety at Crow Butte. The proposed changes applied to the following sections of the SER:

Section 3.1, Organization, discusses the relationships of the organizational components responsible for operations, radiation safety, and environmental protection at the Crow Butte site. The proposed change does not alter the organizational position of the RSO, in accordance with organizational changes previously approved by the CBR SERP. Therefore, there is no change to the intent of Section 3.1 of the SER.

Section 3.4, Administrative and Operation Procedures, discusses the requirement that SOPs be established, reviewed, and approved by the RSO. The new EMS Program replaces the SOPs and fulfills an expanded function from that described in Section 3.4 of the SER.

Section 4.0, Radiation Safety Controls and Monitoring, discusses the requirements for the radiation safety program elements. In many places, reference to specific SOPs would be replaced by reference to the corresponding Volumes in the EMS Program. Therefore, the recommended changes simply update the LRA in describing how CBR will implement the radiation safety program.

Based on this review, the proposed changes to the LRA will have no impact on CBR's ability to continue to meet the commitments cited in the SER.

Technical Evaluation Reports

The SERP reviewed the Technical Evaluation Reports (TERs) prepared by NRC staff to support amendments made to SUA-1534 since renewal in 1998. None of the TERs prepared since license renewal directly address the issues related to the proposed revisions to the LRA.

Degradation of Essential Safety or Environmental Commitment

SUA-1534 allows CBR to make changes as long as they do not degrade the essential safety or environmental commitments made in the application. The SERP determined that safety commitments made in the LRA and discussed in the EA and the SER are not affected by the proposed changes to the LRA and will not degrade the safety and environmental commitments.

Conclusion

It was the conclusion of the SERP that the proposed changes are allowed by License SUA-1534 and should be approved. The revised pages of the license application required in accordance with License Condition 9.4 were reviewed and approved and are attached to this evaluation.

Approved this 23th day of February 2003:

Jim Stokey, Mine Manager
SERP Chairman

Mike Griffin, Manager of Health, Safety, and Environmental Affairs
SERP Secretary

Rhonda Grantham

Rhonda Grantham, Radiation Safety Officer

John Cash, Operations Superintendent

CROW BUTTE RESOURCES, INC.

SERP 04-02 Evaluation

Crow Butte Resources, Inc.

Safety and Environmental Review Panel

Evaluation Report – SERP 04-02

Wellhouse 42 Approval to Operate

March 24, 2004

The Crow Butte Resources, Inc. (CBR) Safety and Environmental Review Panel (SERP) met to review and approve operation of Wellhouse 42 in Mine Unit 9 at the Crow Butte Uranium Project.

The SERP appointed for this evaluation consisted of the following members:

Name	Title	Area of Expertise
Jim Stokey	Mine Manager	Management
Brian Pile	Project Engineer/ Wellfield Construction Superintendent	Operations
John Cash	Operations Superintendent	Operations
Mike Brost	Chief Geologist	Operations
Mike Griffin	Manager of Health, Safety, and Environmental Affairs	Environmental
Rhonda Grantham	Radiation Safety Officer	Radiation Safety

Dr. Stokey is the SERP Chairman. Mr. Griffin was appointed SERP Secretary for this evaluation.

Purpose of SERP Evaluation

The purpose of this evaluation by the CBR SERP was to review and approve Wellhouse 42 for operation.

License Condition 9.4 allows CBR to make changes in the facility or procedures or conduct tests or experiments that are not presented in the approved application if such changes do not:

i. Result in any appreciable increase in the frequency of occurrence of an accident previously evaluated in the license application (as updated);
ii. Result in any appreciable increase in the likelihood of occurrence of a malfunction of a structure, system, or component (SSC) important to safety previously evaluated in the license application (as updated);
iii. Result in any appreciable increase in the consequences of an accident previously evaluated in the license application (as updated);
iv. Result in any appreciable increase in the consequences of a malfunction of an SSC previously evaluated in the license application (as updated);
v. Create a possibility for an accident of a different type that any previously evaluated in the license application (as updated);
vi. Create a possibility for a malfunction of an SSC with a different result than previously evaluated in the license application (as updated);
vii. Result in a departure from the method of evaluation described in the license application (as updated) used in establishing the final safety evaluation report (FSER) or the environmental assessment (EA) or the technical evaluation reports (TERs) or other analysis and evaluations for license amendments.
viii. For the purposes of SERP evaluations, SSC means any SSC which has been referenced in a staff SER, TER, EA, or environmental impact statement (EIS) and supplements and amendments.

The SERP evaluation was conducted in accordance with CBR Standard Operating Procedure (SOP) C-2, *Safety and Environmental Review Panel.* The SERP reviewed the Wellhouse startup checklists and supporting documentation and evaluated this information as compared with the requirements of the licensing basis, including the following documents:

- Title 10, Code of Federal Regulations;
- Source Materials License SUA-1534, Amendment No. 16 dated October 20, 2003;
- *Application for Renewal of USNRC Radioactive Source Materials License SUA-1534*, Crow Butte Resources, Inc. December 1995;
- *Environmental Assessment for Renewal of Source Materials License No. SUA-1534*, USNRC February 1998;
- *Safety Evaluation Report for Renewal of Source Materials License No. SUA-1534*, USNRC February 1998;
- Technical Evaluation Reports issued in support of amendments to SUA-1534.

Title 10 Code of Federal Regulations

The proposed change will have no impact on CBR's ability to meet all applicable NRC regulations.

Source Materials License SUA-1534 Requirements

Amendment 16 to SUA-1534 dated October 20, 2003 was reviewed for specific requirements related to approval and operation of a wellhouse.

Mine Unit 9 was previously approved by the CBR SERP (see SERP 03-05 dated October 23, 2003). Therefore, no review of monitor well location, installation or baseline sampling and Upper Control Limit determination is required for approval of Wellhouse 42.

License Condition 10.2: This License Condition requires that CBR construct all wells in accordance with the methods contained in the Section 3.1.2 of the approved License Renewal Application (LRA). License Condition 10.2 also requires that CBR perform mechanical integrity tests (MIT) for all injection and production wells.

The well construction methods in use for Wellhouse 42 are the same as those described in the LRA. All MIT data sheets were contained in the Notice of Intent to Operate Wellhouse 42 that was submitted to the NDEQ. These MIT data sheets were reviewed by the SERP. The records indicate that the MITs performed in Wellhouse 42 met the requirements.

License Condition 9.3: This License Condition requires that CBR conduct operations in accordance with the representations contained in the LRA. Section 3.1.3 of the LRA discusses construction materials, instrumentation, and monitoring requirements. Section 3.3 also discusses instrumentation, including wellhouse injection and production instrumentation and wet building alarms for wellhouses. Section 7.2.3 of the LRA requires that leak tests be performed on all wellfield piping before placing the system into production operations.

The SERP reviewed the Wellhouse Start-up Checklist for Wellhouse 42. This checklist was developed by the Wellfield Construction staff to document completion of all required actions before initiating operations in a wellhouse. Some of these actions are required by regulatory and licensing requirements, while some were developed over the course of mining experience at Crow Butte. The Project Engineer/Wellfield Construction Superintendent reviewed these items and stated that all had been completed and the appropriate controls were in place.

A copy of the Wellhouse Start-Up Checklist is attached to this SERP Evaluation. Supporting documentation in the form of pressure tests and ground continuity checks are also attached.

Environmental Assessment

The SERP reviewed the contents of the Environmental Assessment (EA) prepared by NRC in February 1998 to determine whether the proposed change could cause substantive safety or environmental impacts.

Well construction and testing as described in the EA has been completed for the wells associated with Wellhouse 42.

Section 3.3.1 discusses leak testing of wellfield piping. The SERP reviewed the completion of pressure testing for piping systems associated with Wellhouse 42 and found that they meet the intent of the EA.

Financial Surety

The proposed change is covered in the NRC-approved financial surety maintained by CBR and approved by Amendment 16 to SUA-1534 in the amount of $14,909,670.

Safety Evaluation Report

The Safety Evaluation Report (SER) principally provides the basis for worker safety at Crow Butte and does not specifically address the issues related to approval of Wellhouse 42.

Technical Evaluation Reports

The SERP reviewed the Technical Evaluation Reports (TERs) prepared by NRC staff to support amendments made to SUA-1534 since renewal in 1998. None of the TERs prepared since license renewal directly address issues related to approval of a new Wellhouse for operation.

Degradation of Essential Safety or Environmental Commitment

SUA-1534 allows CBR to make changes as long as they do not degrade the essential safety or environmental commitments made in the application. The SERP determined that safety commitments made in the LRA and discussed in the EA have been met and that startup of Wellhouse 42 in Mine Unit 9 will not degrade the safety and environmental commitments.

Based upon this evaluation of the licensing basis, the CBR SERP hereby approves startup and operation of Wellhouse 42 in Mine Unit 9.

Approved this 24th day of March 2004.

Jim Stokey, Mine Manager
SERP Chairman

Mike Griffin, Manager of Health, Safety, and Environmental Affairs
SERP Secretary

Brian Pile, Project Engineer/Wellfield Construction Superintendent

John Cash, Operations Superintendent

Mike Brost, Chief Geologist

Rhonda Grantham, Radiation Safety Officer

CROW BUTTE RESOURCES, INC.

SERP 04-03 Evaluation

Crow Butte Resources, Inc.

Safety and Environmental Review Panel

Evaluation Report – SERP 04-03

Yellowcake Dryer Approval for Initial Operation

April 12, 2004

The Crow Butte Resources, Inc. (CBR) Safety and Environmental Review Panel (SERP) met to review and approve initial operation of the new yellowcake dryer at the Crow Butte Uranium Project.

The SERP appointed for this evaluation consisted of the following members:

Name	Title	Area of Expertise
Jim Stokey	Mine Manager	Management
Mike Griffin	Manager of Health, Safety, and Environmental Affairs	Environmental
Brian Pile	Project Engineer/ Wellfield Construction Superintendent	Operations
John Cash	Operations Superintendent	Operations
Rhonda Grantham	Radiation Safety Officer	Radiation Safety

Dr. Stokey is the SERP Chairman. Mr. Griffin was appointed SERP Secretary for this evaluation. Terry Anderson kept minutes of the meeting (attached).

Purpose of SERP Evaluation

The purpose of this evaluation by the CBR SERP was to review and approve initial operation of the new yellowcake dryer installed at the Central Process Plant. The dryer has been installed to replace a previous dryer that was removed from service in June 2003 due to maintenance problems associated with continued operation.

License Condition 9.4 allows CBR to make changes in the facility or procedures or conduct tests or experiments that are not presented in the approved application if such changes do not:

i. Result in any appreciable increase in the frequency of occurrence of an accident previously evaluated in the license application (as updated);
ii. Result in any appreciable increase in the likelihood of occurrence of a malfunction of a structure, system, or component (SSC) important to safety previously evaluated in the license application (as updated);
iii. Result in any appreciable increase in the consequences of an accident previously evaluated in the license application (as updated);
iv. Result in any appreciable increase in the consequences of a malfunction of an SSC previously evaluated in the license application (as updated);
v. Create a possibility for an accident of a different type that any previously evaluated in the license application (as updated);
vi. Create a possibility for a malfunction of an SSC with a different result than previously evaluated in the license application (as updated);
vii. Result in a departure from the method of evaluation described in the license application (as updated) used in establishing the final safety evaluation report (FSER) or the environmental assessment (EA) or the technical evaluation reports (TERs) or other analysis and evaluations for license amendments.
viii. For the purposes of SERP evaluations, SSC means any SSC which has been referenced in a staff SER, TER, EA, or environmental impact statement (EIS) and supplements and amendments.

The SERP evaluation was conducted in accordance with CBR Standard Operating Procedure (SOP) C-2, *Safety and Environmental Review Panel.* The SERP reviewed the status of several startup checklists and supporting documentation and draft operating procedures and evaluated this information as compared with the requirements of the licensing basis, including the following documents:

- Title 10, Code of Federal Regulations;
- Source Materials License SUA-1534, Amendment No. 16 dated October 20, 2003;
- *Application for Renewal of USNRC Radioactive Source Materials License SUA-1534*, Crow Butte Resources, Inc. December 1995;
- *Environmental Assessment for Renewal of Source Materials License No. SUA-1534*, USNRC February 1998;
- *Safety Evaluation Report for Renewal of Source Materials License No. SUA-1534*, USNRC February 1998;
- Technical Evaluation Reports issued in support of amendments to SUA-1534.

Dryer System Readiness Review

The SERP reviewed two readiness checklists developed by the Project Engineer and Operations Superintendent to track completion of action items before initial startup of the dryer.

1. The Operations Superintendent discussed an action item list of final dryer construction tasks that was segregated into critical items that must be completed before startup and items that could be completed following startup. The status of each item was reviewed by the SERP. Based on this review, three items were moved to the list of critical items that must be completed. They were 1) Provide a guard around the heat unit stack in the dryer room to prevent a potential burn hazard; 2) Repair the HEPA air conditioning unit; and 3) Improve the seal around the north rollup door. The critical items on this list (attached revision from John Cash dated April 12, 2004) must be completed before initial operation.
2. The Project Engineer reviewed an action item list he developed for ensuring that the system engineering, electrical, and control systems are functional and ready for operation (attached). Final testing and completion of a system P&ID remain to be completed.

Based on completion of the noted items, the SERP approved the readiness review.

Following the readiness review, the SERP reviewed the license basis issues for startup of a new dryer.

Title 10 Code of Federal Regulations

The proposed change will have no impact on CBR's ability to meet all applicable NRC regulations.

Source Materials License SUA-1534 Requirements

Amendment 16 to SUA-1534 dated October 20, 2003 was reviewed for specific requirements related to approval and operation of a new yellowcake dryer.

License Condition 10.8: This License Condition contains the emission control requirements for operation of a vacuum yellowcake dryer. The License Condition requires that if the vacuum system fails to meet specifications in the operating procedure, the dryer room shall be closed and posted as an airborne radioactivity area, the heat unit switched to cooldown, and packaging operations suspended. CBR must confirm that the system vacuum is maintained through periodic checks every four hours or by an alarm system that is checked before and after each drying cycle.

The draft operation procedure (draft revision to EMS Program Volume III, *Operating Manual*, Procedure P-19, *Yellowcake Dryer Operation and Maintenance*) developed by the Project Engineer was reviewed by the SERP to ensure that the requirements of License Condition 10.8 are included in the procedure. The required actions (or more stringent) were clearly included in the procedure.

The SERP reviewed the draft procedure in detail. The majority of the member comments were minor and editorial in nature. Some more significant comments included:

1. Providing an acceptable range for the oil system differential pressure;
2. Reordering the procedure to ensure that yellowcake is not added to a hot dryer, potentially producing large volumes of steam and stressing the dryer shell;
3. Defining proper temperature indications before packaging can begin;
4. Discussion of the amount of time involved in an automatic blowdown of the bag filters and whether the system vacuum would drop to an unacceptable level;
5. Moving drum inspection and drum weighing instructions to a more appropriate location in the procedure due to redesign of the drum handling and weighing systems;
6. Discussion of clarifying operator action on a loss of vacuum with the system in Hand or in Automatic; and
7. Change the receiving location for condensate pumped from the vacuum system condenser from yellowcake thickener to yellowcake thickener or other appropriate location for potentially contaminated solution since this water could be safely pumped to a sump or other tank intended to contain yellowcake. The License Renewal Application will need to be revised to address this change.

The revised procedure will be completed and approved for use before initial operation.

The SERP also reviewed the issue of chloride content in the slurry before drying. The Operations Superintendent stated that product controls would be in place to prevent yellowcake with high chloride content from being dried.

Environmental Assessment

The SERP reviewed the contents of the Environmental Assessment (EA) prepared by NRC in February 1998 to determine whether the proposed change could cause substantive safety or environmental impacts.

Section 3.7.3 discusses use of a vacuum dryer for effluent control. The new dryer meets the requirements in the EA.

Financial Surety

The proposed change is covered in the NRC-approved financial surety maintained by CBR and approved by Amendment 16 to SUA-1534 in the amount of $14,909,670. The surety includes costs associated with decommissioning two yellowcake dryers. The old dryer from CBR was removed and disposed in 2003, so the current surety amount is adequate.

Safety Evaluation Report

The Safety Evaluation Report (SER) principally provides the basis for worker safety at Crow Butte and does not specifically address the issues related to operation of a vacuum dryer.

Technical Evaluation Reports

The SERP reviewed the Technical Evaluation Reports (TERs) prepared by NRC staff to support amendments made to SUA-1534 since renewal in 1998. None of the TERs prepared since license renewal directly address issues related to operation of a vacuum dryer.

Degradation of Essential Safety or Environmental Commitment

SUA-1534 allows CBR to make changes as long as they do not degrade the essential safety or environmental commitments made in the application. The SERP determined that safety commitments made in the LRA and discussed in the EA have been met. The new dryer is functionally similar to the old dryer with the addition of operating and control features that will help ensure smooth operation. Therefore, the SERP determined that the startup of the new dryer would not degrade the safety and environmental commitments.

Based upon this evaluation of the licensing basis, the CBR SERP hereby approves the initial startup and operation of the new yellowcake dryer.

CROW BUTTE RESOURCES, INC.

SERP 04-03

Approved this 12th day of April 2004.

Jim Stokey, Mine Manager
SERP Chairman

Mike Griffin, Manager of Health, Safety, and Environmental Affairs
SERP Secretary

Brian Pile, Project Engineer/Wellfield Construction Superintendent

John Cash, Operations Superintendent

Rhonda Grantham, Radiation Safety Officer

CROW BUTTE RESOURCES, INC.

SERP 04-04 Evaluation

Crow Butte Resources, Inc.

Safety and Environmental Review Panel

Evaluation Report – SERP 04-04

Wellhouse 38 Approval to Operate

June 30, 2004

The Crow Butte Resources, Inc. (CBR) Safety and Environmental Review Panel (SERP) met to review and approve operation of Wellhouse 38 in Mine Unit 8 at the Crow Butte Uranium Project.

The SERP appointed for this evaluation consisted of the following members:

Name	Title	Area of Expertise
Jim Stokey	Mine Manager	Management
Brian Pile	Project Engineer/ Wellfield Construction Superintendent	Operations
John Cash	Operations Superintendent	Operations
Wade Beins	Project Geologist	Operations
Mike Griffin	Manager of Health, Safety, and Environmental Affairs	Radiation Safety

Dr. Stokey is the SERP Chairman. Mr. Griffin was appointed SERP Secretary for this evaluation.

Purpose of SERP Evaluation

The purpose of this evaluation by the CBR SERP was to review and approve Wellhouse 38 for operation.

License Condition 9.4 allows CBR to make changes in the facility or procedures or conduct tests or experiments that are not presented in the approved application if such changes do not:

i. Result in any appreciable increase in the frequency of occurrence of an accident previously evaluated in the license application (as updated);
ii. Result in any appreciable increase in the likelihood of occurrence of a malfunction of a structure, system, or component (SSC) important to safety previously evaluated in the license application (as updated);
iii. Result in any appreciable increase in the consequences of an accident previously evaluated in the license application (as updated);
iv. Result in any appreciable increase in the consequences of a malfunction of an SSC previously evaluated in the license application (as updated);
v. Create a possibility for an accident of a different type that any previously evaluated in the license application (as updated);
vi. Create a possibility for a malfunction of an SSC with a different result than previously evaluated in the license application (as updated);
vii. Result in a departure from the method of evaluation described in the license application (as updated) used in establishing the final safety evaluation report (FSER) or the environmental assessment (EA) or the technical evaluation reports (TERs) or other analysis and evaluations for license amendments.
viii. For the purposes of SERP evaluations, SSC means any SSC which has been referenced in a staff SER, TER, EA, or environmental impact statement (EIS) and supplements and amendments.

The SERP evaluation was conducted in accordance with CBR Standard Operating Procedure (SOP) C-2, *Safety and Environmental Review Panel.* The SERP reviewed the Wellhouse startup checklists and supporting documentation and evaluated this information as compared with the requirements of the licensing basis, including the following documents:

- Title 10, Code of Federal Regulations;
- Source Materials License SUA-1534, Amendment No. 17 dated April 19, 2004;
- *Application for Renewal of USNRC Radioactive Source Materials License SUA-1534,* Crow Butte Resources, Inc. December 1995;
- *Environmental Assessment for Renewal of Source Materials License No. SUA-1534,* USNRC February 1998;
- *Safety Evaluation Report for Renewal of Source Materials License No. SUA-1534,* USNRC February 1998;
- Technical Evaluation Reports issued in support of amendments to SUA-1534.

Title 10 Code of Federal Regulations

The proposed change will have no impact on CBR's ability to meet all applicable NRC regulations.

Source Materials License SUA-1534 Requirements

Amendment 17 to SUA-1534 dated April 19, 2004 was reviewed for specific requirements related to approval and operation of a wellhouse.

Mine Unit 8 was previously approved by the CBR SERP (see SERP 02-05 dated July 10, 2002). Therefore, no review of monitor well location, installation or baseline sampling and Upper Control Limit determination is required for approval of Wellhouse 38.

License Condition 10.2: This License Condition requires that CBR construct all wells in accordance with the methods contained in the Section 3.1.2 of the approved License Renewal Application (LRA). License Condition 10.2 also requires that CBR perform mechanical integrity tests (MIT) for all injection and production wells.

The well construction methods in use for Wellhouse 38 are the same as those described in the LRA. All MIT data sheets were contained in the Notice of Intent to Operate Wellhouse 38 that was submitted to the NDEQ. These MIT data sheets were provided by the Project Geologist and reviewed by the SERP. The records indicate that the MITs performed in Wellhouse 38 met the requirements.

License Condition 9.3: This License Condition requires that CBR conduct operations in accordance with the representations contained in the LRA. Section 3.1.3 of the LRA discusses construction materials, instrumentation, and monitoring requirements. Section 3.3 also discusses instrumentation, including wellhouse injection and production instrumentation and wet building alarms for wellhouses. Section 7.2.3 of the LRA requires that leak tests be performed on all wellfield piping before placing the system into production operations.

The SERP reviewed the Wellhouse Start-up Checklist for Wellhouse 38. This checklist was developed by the Wellfield Construction staff to document completion of all required actions before initiating operations in a wellhouse. Some of these actions are required by regulatory and licensing requirements, while some were developed over the course of mining experience at Crow Butte. The Project Engineer/Wellfield Construction Superintendent reviewed these items and stated that all had been completed and the appropriate controls were in place.

A copy of the Wellhouse Start-Up Checklist is attached to this SERP Evaluation. Supporting documentation in the form of pressure tests and ground continuity checks are also attached.

Environmental Assessment

The SERP reviewed the contents of the Environmental Assessment (EA) prepared by NRC in February 1998 to determine whether the proposed change could cause substantive safety or environmental impacts.

Well construction and testing as described in the EA has been completed for the wells associated with Wellhouse 38.

Section 3.3.1 discusses leak testing of wellfield piping. The SERP reviewed the completion of pressure testing for piping systems associated with Wellhouse 38 and found that they meet the intent of the EA.

Financial Surety

The proposed change is covered in the NRC-approved financial surety maintained by CBR and approved by Amendment 16 to SUA-1534 in the amount of $14,909,670.

Safety Evaluation Report

The Safety Evaluation Report (SER) principally provides the basis for worker safety at Crow Butte and does not specifically address the issues related to approval of Wellhouse 38.

Technical Evaluation Reports

The SERP reviewed the Technical Evaluation Reports (TERs) prepared by NRC staff to support amendments made to SUA-1534 since renewal in 1998. None of the TERs prepared since license renewal directly address issues related to approval of a new Wellhouse for operation.

Degradation of Essential Safety or Environmental Commitment

SUA-1534 allows CBR to make changes as long as they do not degrade the essential safety or environmental commitments made in the application. The SERP determined that safety commitments made in the LRA and discussed in the EA have been met and that startup of Wellhouse 38 in Mine Unit 8 will not degrade the safety and environmental commitments.

Based upon this evaluation of the licensing basis, the CBR SERP hereby approves startup and operation of Wellhouse 38 in Mine Unit 8.

CROW BUTTE RESOURCES, INC.

SERP 04-04

Approved this 30th day of June 2004.

Jim Stokey, Mine Manager
SERP Chairman

Mike Griffin, Manager of Health, Safety, and Environmental Affairs
SERP Secretary

Brian Pile, Project Engineer/Wellfield Construction Superintendent

John Cash, Operations Superintendent

Wade Beins, Project Geologist

CROW BUTTE RESOURCES, INC.

SERP 04-05 Evaluation

Crow Butte Resources, Inc.

Safety and Environmental Review Panel

Evaluation Report – SERP 04-05

Wellhouse 43 Approval to Operate

September 28, 2004

The Crow Butte Resources, Inc. (CBR) Safety and Environmental Review Panel (SERP) met to review and approve operation of Wellhouse 43 in Mine Unit 9 at the Crow Butte Uranium Project.

The SERP appointed for this evaluation consisted of the following members:

Name	Title	Area of Expertise
Jim Stokey	Mine Manager	Management
Mike Griffin	Manager of Health, Safety, and Environmental Affairs	Environmental
Brian Pile	Project Engineer/ Wellfield Construction Superintendent	Operations
John Cash	Operations Superintendent	Operations
Mike Brost	Chief Geologist	Operations
Rhonda Grantham	Radiation Safety Officer	Radiation Safety

Dr. Stokey is the SERP Chairman. Mr. Griffin was appointed SERP Secretary for this evaluation.

Purpose of SERP Evaluation

The purpose of this evaluation by the CBR SERP was to review and approve Wellhouse 43 for operation.

License Condition 9.4 allows CBR to make changes in the facility or procedures or conduct tests or experiments that are not presented in the approved application if such changes do not:

i. Result in any appreciable increase in the frequency of occurrence of an accident previously evaluated in the license application (as updated);
ii. Result in any appreciable increase in the likelihood of occurrence of a malfunction of a structure, system, or component (SSC) important to safety previously evaluated in the license application (as updated);
iii. Result in any appreciable increase in the consequences of an accident previously evaluated in the license application (as updated);
iv. Result in any appreciable increase in the consequences of a malfunction of an SSC previously evaluated in the license application (as updated);
v. Create a possibility for an accident of a different type that any previously evaluated in the license application (as updated);
vi. Create a possibility for a malfunction of an SSC with a different result than previously evaluated in the license application (as updated);
vii. Result in a departure from the method of evaluation described in the license application (as updated) used in establishing the final safety evaluation report (FSER) or the environmental assessment (EA) or the technical evaluation reports (TERs) or other analysis and evaluations for license amendments.
viii. For the purposes of SERP evaluations, SSC means any SSC which has been referenced in a staff SER, TER, EA, or environmental impact statement (EIS) and supplements and amendments.

The SERP evaluation was conducted in accordance with CBR Standard Operating Procedure (SOP) C-2, *Safety and Environmental Review Panel.* The SERP reviewed the Wellhouse startup checklists and supporting documentation and evaluated this information as compared with the requirements of the licensing basis, including the following documents:

- Title 10, Code of Federal Regulations;
- Source Materials License SUA-1534, Amendment No. 17 dated April 19, 2004;
- *Application for Renewal of USNRC Radioactive Source Materials License SUA-1534*, Crow Butte Resources, Inc. December 1995;
- *Environmental Assessment for Renewal of Source Materials License No. SUA-1534*, USNRC February 1998;
- *Safety Evaluation Report for Renewal of Source Materials License No. SUA-1534*, USNRC February 1998;
- Technical Evaluation Reports issued in support of amendments to SUA-1534.

Title 10 Code of Federal Regulations

The proposed change will have no impact on CBR's ability to meet all applicable NRC regulations.

Source Materials License SUA-1534 Requirements

Amendment 17 to SUA-1534 dated April 19, 2004 was reviewed for specific requirements related to approval and operation of a wellhouse.

Mine Unit 9 was previously approved by the CBR SERP (see SERP 03-05 dated October 22, 2003). Therefore, no review of monitor well location, installation or baseline sampling and Upper Control Limit determination is required for approval of Wellhouse 38.

License Condition 10.2: This License Condition requires that CBR construct all wells in accordance with the methods contained in the Section 3.1.2 of the approved License Renewal Application (LRA). License Condition 10.2 also requires that CBR perform mechanical integrity tests (MIT) for all injection and production wells.

The well construction methods in use for Wellhouse 43 are the same as those described in the LRA. All MIT data sheets were contained in the Notice of Intent to Operate Wellhouse 43 that was submitted to the NDEQ. These MIT data sheets were provided by the Chief Geologist and reviewed by the SERP. The records indicate that the MITs performed in Wellhouse 43 met the requirements.

License Condition 9.3: This License Condition requires that CBR conduct operations in accordance with the representations contained in the LRA. Section 3.1.3 of the LRA discusses construction materials, instrumentation, and monitoring requirements. Section 3.3 also discusses instrumentation, including wellhouse injection and production instrumentation and wet building alarms for wellhouses. Section 7.2.3 of the LRA requires that leak tests be performed on all wellfield piping before placing the system into production operations.

The SERP reviewed the Wellhouse Start-up Checklist for Wellhouse 43. This checklist was developed by the Wellfield Construction staff to document completion of all required actions before initiating operations in a wellhouse. Some of these actions are required by regulatory and licensing requirements, while some were developed over the course of mining experience at Crow Butte. The Project Engineer/Wellfield Construction Superintendent reviewed these items and stated that all had been completed and the appropriate controls were in place.

A copy of the Wellhouse Start-Up Checklist is attached to this SERP Evaluation. Supporting documentation in the form of pressure tests and ground continuity checks are also attached.

Environmental Assessment

The SERP reviewed the contents of the Environmental Assessment (EA) prepared by NRC in February 1998 to determine whether the proposed change could cause substantive safety or environmental impacts.

Well construction and testing as described in the EA has been completed for the wells associated with Wellhouse 43.

Section 3.3.1 discusses leak testing of wellfield piping. The SERP reviewed the completion of pressure testing for piping systems associated with Wellhouse 43 and found that they meet the intent of the EA.

Financial Surety

The proposed change is covered in the NRC-approved financial surety maintained by CBR and approved by Amendment 16 to SUA-1534 in the amount of $14,909,670.

Safety Evaluation Report

The Safety Evaluation Report (SER) principally provides the basis for worker safety at Crow Butte and does not specifically address the issues related to approval of Wellhouse 43.

Technical Evaluation Reports

The SERP reviewed the Technical Evaluation Reports (TERs) prepared by NRC staff to support amendments made to SUA-1534 since renewal in 1998. None of the TERs prepared since license renewal directly address issues related to approval of a new Wellhouse for operation.

Degradation of Essential Safety or Environmental Commitment

SUA-1534 allows CBR to make changes as long as they do not degrade the essential safety or environmental commitments made in the application. The SERP determined that safety commitments made in the LRA and discussed in the EA have been met and that startup of Wellhouse 43 in Mine Unit 9 will not degrade the safety and environmental commitments.

CROW BUTTE RESOURCES, INC.

SERP 04-05

Based upon this evaluation of the licensing basis, the CBR SERP hereby approves startup and operation of Wellhouse 43 in Mine Unit 9.

Approved this 28th day of September 2004.

Jim Stokey, Mine Manager
SERP Chairman

Mike Griffin, Manager of Health, Safety, and Environmental Affairs
SERP Secretary

Rhonda Grantham, Radiation Safety Officer

Brian Pile, Project Engineer/Wellfield Construction Superintendent

John Cash, Operations Superintendent

Mike Brost, Chief Geologist

STATE OF NEBRASKA

Mike Johanns
Governor

DEPARTMENT OF ENVIRONMENTAL QUALITY
Michael J. Linder
Director
Suite 400, The Atrium
1200 'N' Street
P.O. Box 98922
Lincoln, Nebraska 68509-8922
Phone (402) 471-2186
FAX (402) 471-2909

JUL 20 2004

RECEIVED
JUL 24 2004

Mr. Stephen Collings, President
Crow Butte Resources, Inc.
274 Union Blvd., Ste. 310
Lakewood, Colorado 80228

Dear Mr. Collings:

On June 8, 2004, the Nebraska Department of Environmental Quality received a submittal of information from Crow Butte Resources, Inc. The submittal serves as Notice of Intent to Operate and contains Well Completion Reports and Casing Integrity Test Reports for recently installed wells (Wellhouse 43) in the construction of Mine Unit 9.

The Department has reviewed the information submitted and determined that it is adequate and complete. Upper Control Limits and Restoration Values established for Mine Unit 9 have already been submitted and approved. Approval of the additional portion of Mine Unit 9 will not alter those values. The Department hereby approves the Notice of Intent to Operate for the additional portion of Mine Unit 9.

If you have any questions or comments concerning this letter or the review of the Notice of Intent to Operate, please contact David Miesbach of my staff at (402) 471-4982. Thank you.

Sincerely,

Michael J. Linder
Director

ML/dlm
word/files/dave/cbr/letter/notintwb.doc

An Equal Opportunity/Affirmative Action Employer

CROW BUTTE RESOURCES, INC.

SERP 04-06 Evaluation

Crow Butte Resources, Inc.

Safety and Environmental Review Panel

Evaluation Report – SERP 04-06

Wellhouse 39 Approval to Operate

December 3, 2004

The Crow Butte Resources, Inc. (CBR) Safety and Environmental Review Panel (SERP) met to review and approve operation of Wellhouse 39 in Mine Unit 8 at the Crow Butte Uranium Project.

The SERP appointed for this evaluation consisted of the following members:

Name	Title	Area of Expertise
Jim Stokey	Mine Manager	Management
Mike Griffin	Manager of Health, Safety, and Environmental Affairs	Radiation Safety/ Environmental
Brian Pile	Project Engineer/ Wellfield Construction Superintendent	Operations
John Cash	Operations Superintendent	Operations
Mike Brost	Chief Geologist	Operations

Dr. Stokey is the SERP Chairman. Mr. Griffin was appointed SERP Secretary for this evaluation.

Purpose of SERP Evaluation

The purpose of this evaluation by the CBR SERP was to review and approve Wellhouse 39 for operation.

License Condition 9.4 allows CBR to make changes in the facility or procedures or conduct tests or experiments that are not presented in the approved application if such changes do not:

i. Result in any appreciable increase in the frequency of occurrence of an accident previously evaluated in the license application (as updated);
ii. Result in any appreciable increase in the likelihood of occurrence of a malfunction of a structure, system, or component (SSC) important to safety previously evaluated in the license application (as updated);
iii. Result in any appreciable increase in the consequences of an accident previously evaluated in the license application (as updated);
iv. Result in any appreciable increase in the consequences of a malfunction of an SSC previously evaluated in the license application (as updated);
v. Create a possibility for an accident of a different type that any previously evaluated in the license application (as updated);
vi. Create a possibility for a malfunction of an SSC with a different result than previously evaluated in the license application (as updated);
vii. Result in a departure from the method of evaluation described in the license application (as updated) used in establishing the final safety evaluation report (FSER) or the environmental assessment (EA) or the technical evaluation reports (TERs) or other analysis and evaluations for license amendments.
viii. For the purposes of SERP evaluations, SSC means any SSC which has been referenced in a staff SER, TER, EA, or environmental impact statement (EIS) and supplements and amendments.

The SERP evaluation was conducted in accordance with CBR Standard Operating Procedure (SOP) C-2, *Safety and Environmental Review Panel.* The SERP reviewed the Wellhouse startup checklists and supporting documentation and evaluated this information as compared with the requirements of the licensing basis, including the following documents:

- Title 10, Code of Federal Regulations;
- Source Materials License SUA-1534, Amendment No. 18 dated November 16, 2004;
- *Application for Renewal of USNRC Radioactive Source Materials License SUA-1534*, Crow Butte Resources, Inc. December 1995;
- *Environmental Assessment for Renewal of Source Materials License No. SUA-1534*, USNRC February 1998;
- *Safety Evaluation Report for Renewal of Source Materials License No. SUA-1534*, USNRC February 1998;
- Technical Evaluation Reports issued in support of amendments to SUA-1534.

Title 10 Code of Federal Regulations

The proposed change will have no impact on CBR's ability to meet all applicable NRC regulations.

Source Materials License SUA-1534 Requirements

Amendment 18 to SUA-1534 dated November 16, 2004 was reviewed for specific requirements related to approval and operation of a wellhouse.

Mine Unit 8 was previously approved by the CBR SERP (see SERP 02-05 dated July 10, 2002). Therefore, no review of monitor well location, installation or baseline sampling and Upper Control Limit determination is required for approval of Wellhouse 39.

License Condition 10.2: This License Condition requires that CBR construct all wells in accordance with the methods contained in the Section 3.1.2 of the approved License Renewal Application (LRA). License Condition 10.2 also requires that CBR perform mechanical integrity tests (MIT) for all injection and production wells.

The well construction methods in use for Wellhouse 39 are the same as those described in the LRA. All MIT data sheets were contained in the Notice of Intent to Operate Wellhouse 39 that was submitted to the NDEQ. These MIT data sheets were provided by the Chief Geologist and reviewed by the SERP. The records indicate that the MITs performed in Wellhouse 39 met the requirements.

License Condition 9.3: This License Condition requires that CBR conduct operations in accordance with the representations contained in the LRA. Section 3.1.3 of the LRA discusses construction materials, instrumentation, and monitoring requirements. Section 3.3 also discusses instrumentation, including wellhouse injection and production instrumentation and wet building alarms for wellhouses. Section 7.2.3 of the LRA requires that leak tests be performed on all wellfield piping before placing the system into production operations.

The SERP reviewed the Wellhouse Start-up Checklist for Wellhouse 39. This checklist was developed by the Wellfield Construction staff to document completion of all required actions before initiating operations in a wellhouse. Some of these actions are required by regulatory and licensing requirements, while some were developed over the course of mining experience at Crow Butte. The Project Engineer/Wellfield Construction Superintendent reviewed these items and stated that all had been completed and the appropriate controls were in place.

A copy of the Wellhouse Start-Up Checklist is attached to this SERP Evaluation. Supporting documentation in the form of pressure tests and ground continuity checks are also attached.

Environmental Assessment

The SERP reviewed the contents of the Environmental Assessment (EA) prepared by NRC in February 1998 to determine whether the proposed change could cause substantive safety or environmental impacts.

Well construction and testing as described in the EA has been completed for the wells associated with Wellhouse 39.

Section 3.3.1 discusses leak testing of wellfield piping. The SERP reviewed the completion of pressure testing for piping systems associated with Wellhouse 39 and found that they meet the intent of the EA.

Financial Surety

The proposed change is covered in the NRC-approved financial surety maintained by CBR and approved by Amendment 18 to SUA-1534 in the amount of $16,033,706.

Safety Evaluation Report

The Safety Evaluation Report (SER) principally provides the basis for worker safety at Crow Butte and does not specifically address the issues related to approval of Wellhouse 39.

Technical Evaluation Reports

The SERP reviewed the Technical Evaluation Reports (TERs) prepared by NRC staff to support amendments made to SUA-1534 since renewal in 1998. None of the TERs prepared since license renewal directly address issues related to approval of a new Wellhouse for operation.

Degradation of Essential Safety or Environmental Commitment

SUA-1534 allows CBR to make changes as long as they do not degrade the essential safety or environmental commitments made in the application. The SERP determined that safety commitments made in the LRA and discussed in the EA have been met and that startup of Wellhouse 39 in Mine Unit 8 will not degrade the safety and environmental commitments.

Based upon this evaluation of the licensing basis, the CBR SERP hereby approves startup and operation of Wellhouse 39 in Mine Unit 8.

CROW BUTTE RESOURCES, INC.

SERP 04-06

Approved this 3rd day of December 2004.

Jim Stokey, Mine Manager
SERP Chairman

Mike Griffin, Manager of Health, Safety, and Environmental Affairs
SERP Secretary

Brian Pile, Project Engineer/Wellfield Construction Superintendent

John Cash, Operations Superintendent

Mike Brost, Chief Geologist

CROW BUTTE RESOURCES, INC.

License Renewal Application

Affected Pages (highlighted version)

2004 SERP Actions

5. OPERATIONS

Crow Butte Resources, Inc. (CBR) operates a commercial scale in-situ leach uranium mine (the Crow Butte Uranium Project) near Crawford, Nebraska. CBR maintains a headquarters in Denver, Colorado where site-licensing actions originate. All CBR operations, including the Crow Butte Uranium Project operations, are conducted in conformance with applicable laws, regulations, and requirements of the various regulatory agencies. The responsibilities described below have been designed to both ensure compliance and further implement CBRs policy for providing a safe working environment with cost effective incorporation of the philosophy of maintaining radiation exposures as low as is reasonably achievable (ALARA).

5.1. CORPORATE ORGANIZATION/ADMINISTRATIVE PROCEDURES

~~The CBR organizational chart as it pertains to the responsibility for radiation safety and environmental protection at the Crow Butte Uranium Project facility is given as Figure 5.1-1. The personnel identified are responsible for the development, review, approval, implementation, and adherence to operating procedures, radiation safety programs, environmental and groundwater monitoring programs as well as routine and non-routine maintenance activities. Specific responsibilities of the organization are provided below.~~
CBR will maintain a performance-based approach to the management of the environment and employee health and safety, including radiation safety. The Environmental Management System (EMS) Program encompasses licensing, compliance, environmental monitoring, industrial hygiene, and health physics programs under one umbrella, and it includes involvement for all employees from the individual worker to senior management. This EMS program will allow CBR to operate efficiently and maintain an effective environment, health and safety program.

Figure 5.1-1 is a partial organization chart for CBR with respect to the operation of the Crow Butte Uranium Project and associated operations and represents the management levels that play a key part in the EMS Program. The personnel identified are responsible for the development, review, approval, implementation, and adherence to operating procedures, radiation safety programs, environmental and groundwater monitoring programs as well as routine and non-routine maintenance activities. These individuals may also serve a functional part of the Safety and Environmental Review Panel (SERP) described under Section 5.3.3.

Specific responsibilities of the organization are provided below.

5.1.1. BOARD OF DIRECTORS

The Board of Directors has the ultimate responsibility and authority for radiation safety and environmental compliance for CBR. The Board of Directors sets corporate policy and provides procedural guidance in these areas. The Board of Directors provides operational direction to the President of CBR.

5.1.2. PRESIDENT

The President is responsible for interpreting and acting upon the Board of Directors policy and procedural decisions. The President directly supervises the Senior Vice President of Operations. The President is empowered by the Board of Directors to have the responsibility and authority for the radiation safety and environmental compliance programs. The President is responsible for ensuring that the operations staff is complying with all applicable regulations and permit/license conditions through direct supervision of the Senior Vice President of Operations.

~~5.1.1.~~5.1.3. SENIOR VICE PRESIDENT - OPERATIONS

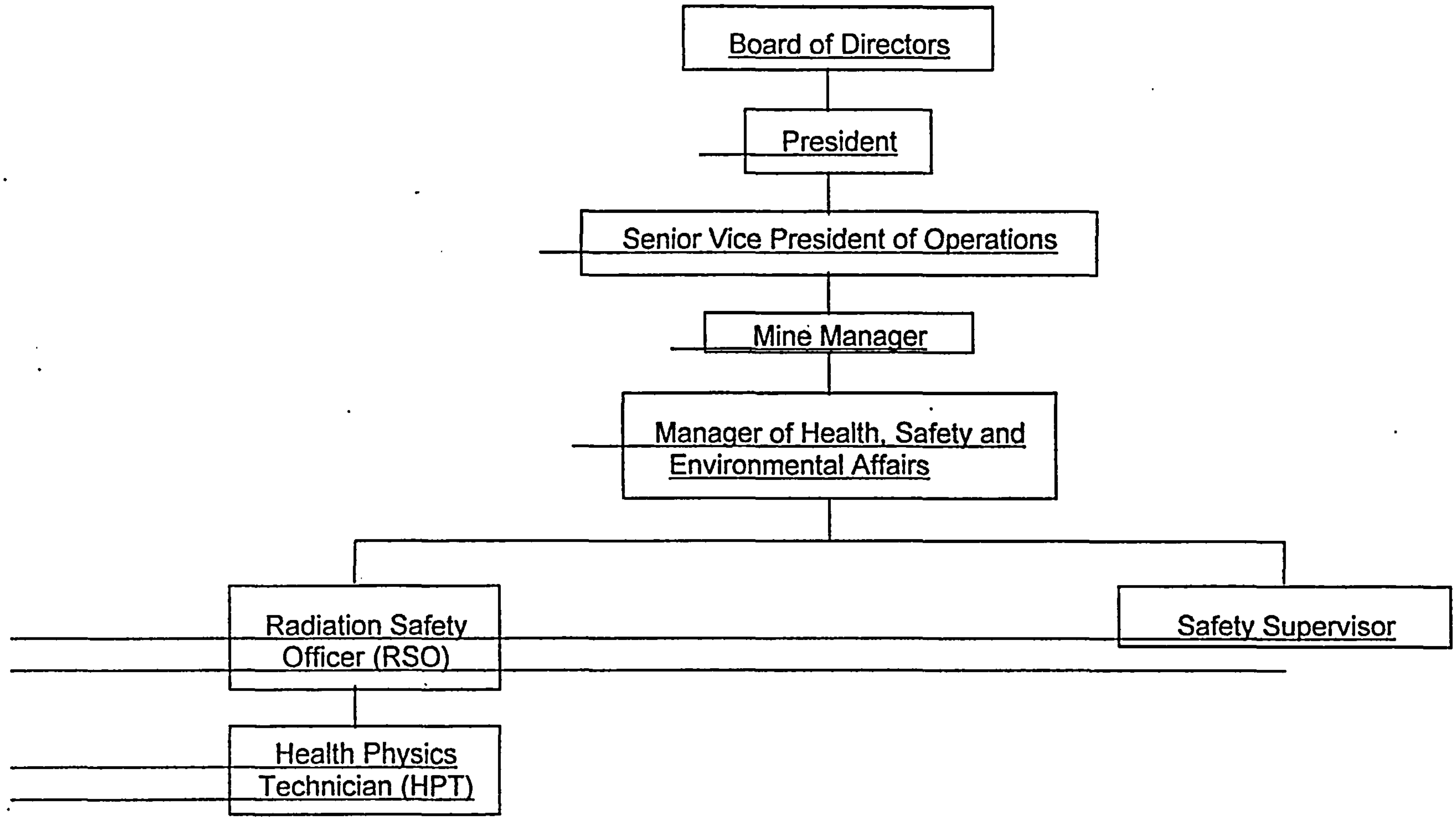
~~The overall responsibility for the radiation, environmental, and safety activities of the Crow Butte Facility rests with the Senior Vice President - Operations of CBR. The Senior Vice President - Operations is also responsible for license development and license modifications. The Vice President, Engineering and Development will, in the absence or disability of the Senior Vice President - Operations, perform the duties of the Senior Vice President - Operations.~~

The overall responsibility for the radiation, environmental, and safety activities of the Crow Butte Facility rests with the Senior Vice President of Operations. The Senior Vice President of Operations reports to the President and is directly responsible for ensuring that CBR personnel comply with industrial safety, radiation safety, and environmental protection programs as established in the EMS Program. The Senior Vice President of Operations is also responsible for company compliance with all regulatory license conditions/stipulations, regulations and reporting requirements. The Senior Vice President of Operations has the responsibility and authority to terminate immediately any activity that is determined to be a threat to employees or public health, the environment, or potentially a violation of state or federal regulations. The Senior Vice President of Operations is also responsible for license development and license modifications.

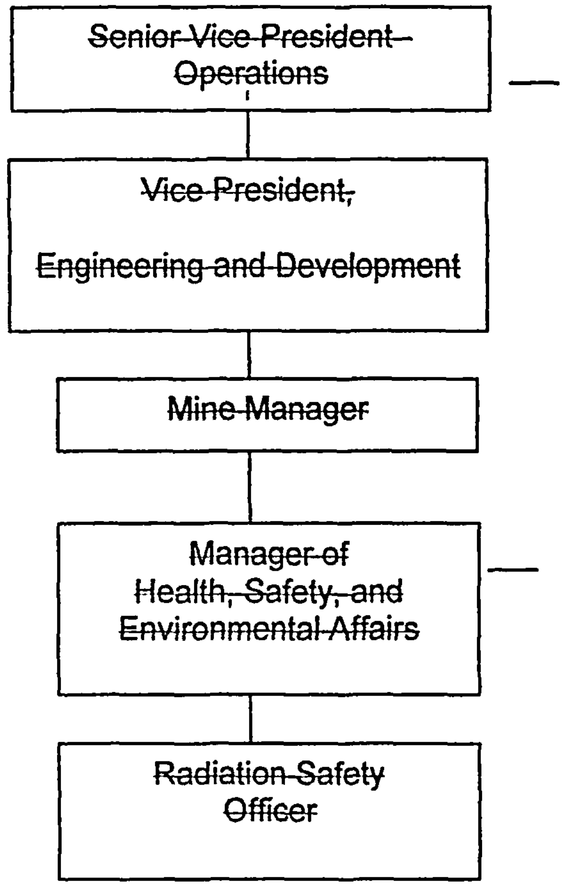
~~5.1.2. VICE PRESIDENT, ENGINEERING AND DEVELOPMENT~~

~~The Vice President, Engineering and Development is responsible for all Crow Butte commercial production facilities, reporting directly to the Senior Vice President Operations.~~

Figure 5.1-1: Crow Butte Resources Organizational Chart



~~**Figure 5.1-1: Crow Butte Resources Organizational Chart**~~



~~5.1.1.~~5.1.4. MINE MANAGER

~~The Mine Manager is responsible for all uranium production activity at the project site. The Mine Manager is also responsible for implementing any safety and/or monitoring programs associated with operations, including yellowcake handling procedures. The Mine Manager is authorized to immediately implement any action to correct or prevent radiation safety hazards. The Mine Manager reports directly to the Vice President, Engineering and Development.~~

The Mine Manager is responsible for all uranium production activity at the project site. The Mine Manager is also responsible for implementing any industrial and radiation safety and environmental protection programs associated with operations. The Mine Manager is authorized to immediately implement any action to correct or prevent hazards. The Mine Manager has the responsibility and the authority to suspend, postpone or modify, immediately if necessary, any activity that is determined to be a threat to employees, public health, the environment, or potentially a violation of state or federal regulations. The Mine Manager cannot unilaterally override a decision for suspension, postponement or modification if that decision is made by the Senior Vice President of Operations and/or the Manager of Health, Safety and Environmental Affairs. The Mine Manager reports directly to the Senior Vice President of Operations.

~~5.1.2.~~5.1.5. MANAGER OF HEALTH, SAFETY, AND ENVIRONMENTAL AFFAIRS

~~The Manager of Health, Safety, and Environmental Affairs is responsible for ensuring that CBR complies with all applicable regulatory requirements including those involving environmental protection and radiation safety. The Manager of Health, Safety, and Environmental Affairs reports directly to the Mine Manager and supervises the RSO to ensure that the radiation safety and environmental monitoring and protection programs are conducted in a manner consistent with regulatory requirements. The Manager of Health, Safety, and Environmental Affairs has no production related responsibilities. The Manager of Health, Safety, and Environmental Affairs also has the responsibility to advise the Senior Vice President – Operations on matters involving radiation safety and to implement changes and/or corrective actions involving radiation safety authorized by the Senior Vice President – Operations.~~

The Manager of Health, Safety, and Environmental Affairs is responsible for all radiation protection, health and safety, and environmental programs as stated in the EMS Program and for ensuring that CBR complies with all applicable regulatory requirements. The Manager of Health, Safety, and

Environmental Affairs reports directly to the Mine Manager and supervises the RSO to ensure that the radiation safety and environmental monitoring and protection programs are conducted in a manner consistent with regulatory requirements. This position assists in the development and review of radiological and environmental sampling and analysis procedures and is responsible for routine auditing of the programs. The Manager of Health, Safety, and Environmental Affairs has no production-related responsibilities. The Manager of Health, Safety, and Environmental Affairs also has the responsibility to advise the Senior Vice President of Operations on matters involving radiation safety and to implement changes and/or corrective actions involving radiation safety authorized by the Senior Vice President of Operations.

~~5.1.5.~~5.1.6. RADIATION SAFETY OFFICER

The RSO is responsible for the development, administration, and enforcement of all radiation safety programs. The RSO 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 RSO is responsible for the implementation of all on-site environmental programs, including emergency procedures. The RSO inspects facilities to verify compliance with all applicable requirements in the areas of radiological health and safety. The RSO works closely with all supervisory personnel to insure that established programs are maintained. The RSO is also responsible for the collection and interpretation of employee exposure related monitoring, including data from radiological safety. The RSO makes recommendations to improve any and all radiological safety related controls. The RSO has no production-related responsibilities. The RSO will report to the Manager of Health, Safety, and Environmental Affairs

~~5.1.6.~~5.1.7. HEALTH PHYSICS TECHNICIAN

The Health Physics Technician (HPT) assists the RSO with the implementation of the radiological and industrial safety programs. The HPT is responsible for the orderly collection and interpretation of all monitoring data, to include data from radiological safety and environmental programs. The HPT reports directly to the RSO.

5.1.8. SAFETY SUPERVISOR

The Safety Supervisor is responsible for the non-radiation related health and safety programs. The Safety Supervisor is authorized to conduct inspections and to immediately order any change necessary to preclude or eliminate safety hazards and/or maintain regulatory compliance. Responsibilities include the development and implementation of health and safety programs in compliance with Mine Safety and Health Administration (MSHA) regulations. Responsibilities of the Safety Supervisor include development of industrial safety and health programs and procedures, coordination with the RSO where industrial and radiological safety concerns are interrelated, safety and health training of new and existing employees, and the maintenance of appropriate records to document compliance with regulations. The Safety Supervisor may also be a qualified HPT and may function in that capacity when needed. The Safety Supervisor reports directly to the Manager of Health, Safety and Environmental Affairs.

5.2. ALARA POLICY

The purpose of the ALARA (As Low As Reasonably Achievable) Policy is to keep exposures to all radioactive materials and other hazardous material as low as possible and to as few personnel as possible, taking into account the state of technology and the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to the utilization of atomic energy in the public interest.

In order for an ALARA Policy to correctly function, all individuals including management, supervisors, health physics staff, and workers, must take part in and share responsibility for keeping all exposures as low as reasonably achievable. This policy addresses this need and describes the responsibilities of each level in the organization.

5.2.1. MANAGEMENT RESPONSIBILITIES

Consistent with Regulatory Guide 8.31 *Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Recovery Facilities Will Be As Low As Reasonably Achievable* (Revision 1, May 2002), the licensee management is responsible for the development, implementation, and enforcement of applicable rules, policies, and procedures as directed by regulatory agencies and company policies. These shall include the following:

1 The development of a strong commitment to and continuing support of the implementation and operations of the ALARA program;
2 An Annual Audit Program which reviews radiation monitoring results, procedural, and operational methods;
3 A continuing evaluation of the Health Physics Program including adequate staffing and support; and

4 Proper training and discussions that address the ALARA program and its function to all facility employees and, when appropriate, to contractors and visitors.

5.2.2. RADIATION SAFETY OFFICER RESPONSIBILITY

The RSO shall be charged with ensuring the technical adequacy of the radiation protection program, implementation of proper radiation protection measures, and the overall surveillance and maintenance of the ALARA program. The RSO shall be assigned the following:

1. The responsibility for the development and administration of the ALARA program;
2. Sufficient authority to enforce regulations and administrative policies that affect any radiological aspect of the EMS Program;
3. Assist with the review and approval of new equipment, process changes or operating procedures to ensure that the plans do not adversely affect the radiological aspects of the EMS Program;
4. Maintain equipment and surveillance programs to assure continued implementation of the ALARA program;
5. Assist with conducting an Annual ALARA Audit as discussed in Section 5.4.4 to determine the effectiveness of the program and make any appropriate recommendations or changes as may be dictated by the ALARA philosophy;
6. Review annually all existing operating procedures involving or potentially involving any handling, processing, or storing of radioactive materials to ensure the procedures are ALARA and do not violate any newly established or instituted radiation protection practices; and
7. Conduct or designate daily inspections of pertinent facility areas to observe that general radiation control practices, hygiene, and housekeeping practices are in line with the ALARA principle.

5.2.3. SUPERVISOR RESPONSIBILITY

Supervisors shall be the front line for implementing the ALARA program. Each supervisor shall be trained and instructed in the general radiation safety practices and procedures. Their responsibilities include:

1. Adequate training to implement the general philosophy behind the ALARA program;
2. Provide direction and guidance to subordinates in ways to adhere to the ALARA program;

3. Enforcement of rules and policies as directed by the EMS Program, which implement the requirements of regulatory agencies and company management; and
4. Seeking additional help from management and the RSO should radiological problems be deemed by the supervisor to be outside their sphere of training.

5.2.4. WORKER RESPONSIBILITY

Because success of both the radiation protection and ALARA programs are contingent upon the cooperation and adherence to those policies by the workers themselves, the facility employees must be responsible for certain aspects of the program in order for the program to accomplish its goal of keeping exposures as low as possible. Worker responsibilities include:

1. Adherence to all rules, notices, and operating procedures as established by management and the RSO through the EMS Program;
2. Making valid suggestions which might improve the radiation protection and ALARA programs;
3. Reporting promptly, to immediate supervisor, any malfunction of equipment or violation of procedures which could result in an increased radiological hazard;
4. Proper use of protective equipment;
5. Proper performance of required contamination surveys.

5.3. MANAGEMENT CONTROL PROGRAM

5.3.1. ENVIRONMENTAL MANAGEMENT SYSTEM

CBR's Environmental Management System (EMS) Program formalizes the Company's approach to environmental, health, and safety management to ensure consistency across its operations. The EMS Program is a key element in assuring that all employees demonstrate "due diligence" in addressing environmental, health, and safety issues and describes how the operations of the facility will comply with the requirements of the CBR Environmental, Health, and Safety Policy (EH&S) Policy and regulatory requirements.

The CBR EMS Program:

1. Assures that sound management practices and processes are in place to ensure that strong environmental, health, and safety performance is sustainable.
2. Clearly sets out and formalizes the expectations of management.

3. Provides a systematic approach to the identification of issues and ensures that a system of risk identification and management is in place.
4. Provides a framework for personal, site and corporate responsibility and leadership.
5. Provides a systematic approach for the attainment of CBR's objectives.
6. Ensures continued improvement of programs and performance.

The EMS Program has the following characteristics:

1. The system is compatible with the ISO 14001 Environment Management System.
2. The system is straightforward in design and is intended as an effective management tool for all types of activities and operations, and is capable of implementation at all levels of the organization.
3. The system is supported by standards that clearly spell out CBR's expectations, while leaving the means by which these are attained as a responsibility of line management.
4. The system is readily auditable.
5. The system is designed to provide a practical tool to assist the operations in identifying and achieving their objectives while satisfying CBR's governance requirements.

The EMS Program uses a series of standards that align with specific management processes and sets out the minimum expectations for performance. The standards consist of management processes that consist of assessment, planning, implementation (including training, corrective actions, safe work programs, and emergency response), checking (including auditing, incident investigation, compliance management, and reporting), and management review.

5.3.1.1. OPERATING PROCEDURES

CBR has developed procedures consistent with the corporate policies and standards and regulatory requirements to implement these management controls. The EMS Program consists of the following standards and operating procedures contained in eight volumes:

Volume 1 – Standards
Volume 2 – Management Procedures
Volume 3 – Operating Manual (SOPs)
Volume 4 – Health Physics Manual
Volume 5 – Industrial Safety Manual
Volume 6 – Environmental Manual
Volume 7 – Training Manual
Volume 8 – Emergency Manual

Written operating procedures have been developed for all process activities including those activities involving radioactive materials for the Crow Butte Uranium Project. Where radioactive material handling is involved, pertinent radiation safety practices are incorporated into the operating procedure. Additionally, written operating procedures have been developed for non-process activities including environmental monitoring, health physics procedures, emergency procedures, and general safety.

The procedures enumerate pertinent radiation safety procedures to be followed. A copy of the written procedure will be kept in the area where it is used. All procedures involving radiation safety will be reviewed and approved in writing by the RSO or another individual with similar qualifications prior to being implemented. The RSO will also perform a documented review of the operating procedures annually.

5.3.1.2. RADIATION WORK PERMITS

In the case that employees are required to conduct activities of a nonroutine nature where there is the potential for significant exposure to radioactive materials and for which no operating procedure exists, a Radiation Work Permit (RWP) will be required. The RWP will describe the scope of the work, precautions necessary to maintain radiation exposures to ALARA, and any supplemental radiological monitoring and sampling to be conducted during the work. The RWP shall be reviewed and approved in writing by the RSO (or qualified designee in the absence of the RSO) prior to initiation of the work.

The RSO may also issue Standing Radiation Work Permits (SRWPs) for periodic tasks that require similar radiological protection measures (e.g., maintenance work on a specified plant system). The SRWP will describe the scope of the work, precautions necessary to maintain radiation exposures to ALARA, and any supplemental radiological monitoring and sampling to be conducted during the work. The SRWP shall be reviewed and approved in writing by the RSO (or qualified designee in the absence of the RSO) prior to initiation of the work.

5.3.2. PERFORMANCE BASED LICENSE CONDITION

This license application is the basis of the Performance Based License (PBL) originally issued in 1998. Under that license CBR may, without prior NRC approval or the need to obtain a License Amendment:

1. Make changes to the facility or process, as presented in the license application (as updated).

2. Make changes in the procedures presented in the license application (as updated).
3. Conduct tests or experiments not presented in the license application (as updated).

A License Amendment and/or NRC approval will be necessary prior to implementing a proposed change, test or experiment if the change, test or experiment would:

1. Result in any appreciable increase in the frequency of occurrence of an accident previously evaluated in the license application (as updated);
2. Result in any appreciable increase in the likelihood of occurrence of a malfunction of a structure, system, or component (SSC) important to safety previously evaluated in the license application (as updated);
3. Result in any appreciable increase in the consequences of an accident previously evaluated in the license application (as updated);
4. Result in any appreciable increase in the consequences of a malfunction of an SSC previously evaluated in the license application (as updated);
5. Create a possibility for an accident of a different type than any previously evaluated in the license application (as updated);
6. Create a possibility for a malfunction of an SSC with a different result than previously evaluated in the license application (as updated);
7. Result in a departure from the method of evaluation described in the license application (as updated) used in establishing the final safety evaluation report (FSER) or the environmental assessment (EA) or technical evaluation reports (TERs) or other analysis and evaluations for license amendments.
8. For purposes of this paragraph as applied to this license, SSC means any SSC that has been referenced in a staff SER, TER, EA, or environmental impact statement (EIS) and supplements and amendments thereof.

Additionally CBR must obtain a license amendment unless the change, test, or experiment is consistent with the NRC conclusions, or the basis of, or analysis leading to, the conclusions of actions, designs, or design configurations analyzed and selected in the site or facility SER, TERs, and EIS or EA. This would include all supplements and amendments, and TERs, EAs, and EISs issued with amendments to this license.

~~5.1.7. RADIATION SAFETY AUDITS~~

~~CBR will conduct audits of the radiation safety program. These audits may be conducted by the Manager of Health, Safety, and Environmental Affairs. Additionally, CBR may utilize an outside radiation protection auditing service to provide assurance that all radiation health protection procedures and license condition requirements are being conducted properly at the Crow~~

~~Butte Uranium Project facility. Any outside service used for this purpose is qualified in radiation safety procedures as well as environmental aspects of solution mining operations. Whether conducted internally or through the use of an audit service, the auditor will meet the minimum qualifications for education and experience as for the RSO as described in Section 5.4.~~

~~5.2. MANAGEMENT CONTROL PROGRAM~~

~~5.2.1. OPERATING PROCEDURES~~

~~Written Standard Operating Procedures (SOPs) have been developed for all process activities, including those activities involving radioactive materials, for the Crow Butte Uranium Project facility. Where radioactive material handling is involved, pertinent radiation safety practices are incorporated into the SOP. Additionally, written SOPs have been developed for non-process activities including environmental monitoring, health physics procedures, emergency procedures, and general safety. Written SOPs have been developed, reviewed, and approved by the appropriate supervisors including the RSO. All written SOPs are reviewed for radiological protection aspects and approved by the RSO prior to implementation. Additionally, the RSO reviews all SOPs on an annual basis. Applicable current SOPs are referenced throughout this document. SOPs are revised as necessary to meet changing operational and regulatory requirements. Any revisions made to the SOPs are reviewed and approved by the RSO and appropriate supervisor prior to implementation. Written SOPs are kept in the areas of the plant facility where they are used for easy access by employees.~~

~~For the performance of non-routine work or maintenance activities where the potential for radiation exposure exists and for which written operating procedures have not been prepared, a Radiation Work Permit (RWP) is required. The RWP specifies the necessary radiological safety precautions, equipment, or specialized clothing, and radiological surveys required for performing the job. The RSO or designee by way of specialized training issues RWPs.~~

~~5.2.2.~~5.3.3. SAFETY AND ENVIRONMENTAL REVIEW PANEL (SERP)

~~The SERP consists of a minimum of three individuals. One member of the SERP has expertise in management, one member has expertise in operations and/or construction, and one member has expertise in radiation safety and environmental matters with responsibility of assuring changes conform to radiation safety and environmental requirements. Other members of the SERP may be included as appropriate to address specific technical issues.~~

~~The SERP is responsible for monitoring any proposed change in the facility or process, making changes in procedures, and conducting tests or experiments not contained in the current NRC license. As such, they are responsible for insuring that any such change results in no degradation in the essential safety or environmental commitments of CBR. The SERP conducts its activities in accordance with the instructions currently contained in SOP C-2, "Safety and Environmental Review Panel".~~

A Safety and Environmental Review Panel (SERP) will make the determination of compliance concerning the conditions discussed in Section 5.3.2. The SERP will consist of a minimum of three individuals. One member of the SERP will have expertise in management and will be responsible for managerial and financial approval for changes; one member will have expertise in operations and/or construction and will have expertise in implementation of any changes; and one member will be the Radiation Safety Officer (RSO), or equivalent. Other members of the SERP may be utilized as appropriate, to address technical aspects of the change, experiment or test, in several areas, such as health physics, groundwater hydrology, surface water hydrology, specific earth sciences, and others. Temporary members, or permanent members other than the three identified above, may be consultants.

The SERP is responsible for monitoring any proposed change in the facility or process, making changes in procedures, and conducting tests or experiments not contained in the current NRC license. As such, they are responsible for insuring that any such change results in no degradation in the essential safety or environmental commitments of CBR.

5.3.3.1. SAFETY AND ENVIRONMENTAL REVIEW PANEL REVIEW PROCEDURES

The CBR SERP will implement the following review procedures for the evaluation of all appropriate changes to the facility operations. The SERP may delegate any portion of these responsibilities to a committee of two or more members of the SERP. Any committees so constituted will report their findings to the full SERP for a determination of compliance with Section 5.3.2 of this chapter. In their documented review of whether a potential change, test, or experiment (hereinafter called the change) is allowed under the PBL (or Performance Based License Condition (PBLC)) without a license amendment, the SERP shall consider the following:

- Current NRC License Requirements

The SERP will conduct a review of the most current NRC license conditions to assess which, if any, conditions will have an impact on or be impacted by the potential SERP action. If the SERP action will conflict with a specific license requirement, then a license amendment is necessary before initiating the change. This review includes information included in the approved license application.

- Ability to Meet NRC Regulations

The SERP will determine if the change, test, or experiment conflicts with applicable NRC regulations (example: 10 CFR Parts 20 and 40 requirements). If the SERP action conflicts with NRC regulations, a license amendment is necessary.

- Licensing Basis

The SERP will review whether the change, test, or experiment is consistent with NRC's conclusions regarding actions analyzed and selected in the licensing basis. Documents that the SERP must review in conducting this evaluation include the SER and EA prepared in support of the license renewal application (February 1998) and any SERs, TERs, EAs, or EISs prepared to support amendments to the license. The RSO will maintain a current copy of all pertinent documents for review by the SERP during these evaluations.

- Financial Surety

The SERP will review the proposed action to determine if any adjustment to financial surety arrangement or approved amount is required. If the proposed action will require an increase to the existing surety amount, the financial surety instrument must be increased accordingly before the change can be approved. The surety estimate must be updated either through a license amendment or through the course of the annual surety update to the NRC. The NRC incorporates the annual surety update by license amendment.

- Essential Safety and Environmental Commitments

The SERP will assure that there is no degradation in the essential safety or environmental commitment in the license application, or as provided by the approved reclamation plan.

5.3.3.2. DOCUMENTATION OF SERP REVIEW PROCESS

After the SERP conducts the review process for a proposed action, it will document its findings, recommendations, and conclusions in a written report format. All members of the SERP shall sign concurrence on the final report. If the report concludes that the action meets the appropriate PBL or PBLC requirements and does not require a license amendment, the proposed action may then be implemented. If the report concludes that a license amendment is necessary before implementing the action, the report will document the reasons why, and what course CBR plans to pursue. The SERP report shall include the following:

- A description of the proposed change, test, or experiment (proposed action);
- A listing of all SERP members conducting the review and their qualifications (if a consultant or other member not previously qualified);
- The evaluation of the proposed action including all aspects of the SERP review procedures listed above;
- Conclusions and recommendations;
- Signatory approvals of the SERP members; and
- Any attachments such as all applicable technical, environmental, or safety evaluations, reports, or other relevant information including consultant reports.

All SERP reports and associated records of any changes made pursuant to the PBL or PBLC shall be maintained through termination of the NRC license.

On an annual basis, CBR will submit a report to the NRC that describes all changes, tests, or experiments made pursuant to the PBL or PBLC. The report will include a summary of the SERP evaluation of each change. In addition, CBR will annually submit any pages of the license renewal application to reflect changes to the License Renewal Application or supplementary information. Each replacement page shall include both a change indicator for the area of change, (e.g., bold marking vertically in the margin adjacent to the portion actually change), and a page change identification, (date of change or change number, or both).

~~5.3.~~5.4. MANAGEMENT AUDIT AND INSPECTION PROGRAM

The following internal inspections, audits, and reports are performed for the Crow Butte Uranium Project operations:

5.4.1. DAILY INSPECTIONS

~~DAILY~~

The RSO, HPT or a qualified designated operator conducts a daily walkthrough inspection of the plant. The inspection entails a visual examination of compliance or other problems that are reviewed with the ~~Plant Manager~~Operations Superintendent. Results of the Daily Inspections are documented.

5.4.2. WEEKLY RSO INSPECTIONS

~~The RSO and the Plant Manager or their qualified designees conduct a weekly inspection of the plant to observe general radiation safety practices and to review required changes in equipment and procedures. The results of these weekly inspections are documented.~~

On a weekly basis, the RSO and Operations Superintendent (or designees in their absence) will conduct an inspection of all facility areas to observe general radiation control practices and review required changes in procedures and equipment.

5.4.3. MONTHLY RSO REPOORT

The RSO provides a written summary of the month's radiological activities at the Crow Butte Uranium Project facilities. The report includes a review of all monitoring and exposure data for the month, a summary of the daily and weekly inspections, a summary of worker protection activities, a summary of all pertinent radiation survey records, a discussion of any trends in the ALARA program, and a review of adequacy of the implementation of the USNRC license conditions. Recommendations are made for any corrective actions or improvements in the process or safety programs.

~~Quarterly~~

~~Quarterly inspections are performed of the evaporation ponds in accordance with the guidance contained in USNRC Regulatory Guide 3.11.1, "Operational Inspection and Surveillance of Embankment Retention Systems for Uranium Mill Tailings".~~

~~Annually~~

~~On an annual basis, an audit of the radiation protection and ALARA program is conducted in accordance with USNRC Regulatory Guide 8.31, "Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Recovery Facilities Will Be As Low As Reasonably Achievable", Revision 1. A~~

~~written report of the results is submitted to corporate management. The auditor may be the Manager of Health, Safety, and Environmental Affairs or an outside radiation safety auditor as identified in Figure 5.1-1 and discussed in Section 5.1-8. The RSO may accompany the auditor, but may not participate in the conclusions.~~

~~The annual ALARA audit report summarizes the following data:~~

1. ~~Employee exposure records~~
2. ~~Bioassay results~~
3. ~~Inspection log entries and summary reports of daily mine and process inspections~~
4. ~~Documented training program activities~~
5. ~~Applicable safety meeting reports~~
6. ~~Radiological survey and sampling data~~
7. ~~Reports on any overexposure of workers~~
8. ~~Operating procedures that were reviewed during this time period~~

~~The ALARA audit report specifically discusses the following:~~

1. ~~Trends in personnel exposures~~
2. ~~Proper use, maintenance and inspection of equipment used for exposure control~~
3. ~~Recommendations on ways to further reduce personnel exposures from uranium and its daughters.~~

~~The ALARA audit report is submitted to and reviewed by the Senior Vice President—Operations and the RSO. Implementation of the recommendations to further reduce employee exposures, or improvements to the ALARA program, is discussed with the ALARA auditor. The audit report is maintained on file for review by the NRC.~~

~~An audit of the Quality Assurance/Quality Control (QA/QC) program is also conducted on an annual basis. The audit is performed by an individual qualified in analytical and monitoring techniques who does not have direct responsibilities in the areas being audited. The results of the QA/QC audit are documented and reported to the Senior Vice President—Operations and the~~

~~RSO. The RSO has the primary responsibility for the implementation of the QA/QC programs at the Crow Butte Uranium Project facilities.~~

5.4.4. ANNUAL ALARA AUDITS

CBR will conduct annual audits of the radiation safety and ALARA programs. The Manager of Health, Safety, and Environmental Affairs may conduct these audits. Alternatively, CBR may use qualified personnel from other uranium recovery facilities or an outside radiation protection auditing service to conduct these audits. The purpose of the audits is to provide assurance that all radiation health protection procedures and license condition requirements are being conducted properly at the Crow Butte Uranium Project facility. Any outside personnel used for this purpose will be qualified in radiation safety procedures as well as environmental aspects of solution mining operations. Whether conducted internally or through the use of an audit service, the auditor will meet the minimum qualifications for education and experience as for the RSO as described in Section 5.5.

The audit of the radiation protection and ALARA program is conducted in accordance with the recommendations contained in Regulatory Guide 8.31, *Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Recovery Facilities Will Be As Low As Reasonably Achievable* (Revision 1, May 2002). A written report of the results is submitted to corporate management. The RSO may accompany the auditor but may not participate in the conclusions.

The annual ALARA audit report summarizes the following data:

1. Employee exposure records
2. Bioassay results
3. Inspection log entries and summary reports of mine and process inspections
4. Documented training program activities
5. Applicable safety meeting reports
6. Radiological survey and sampling data
7. Reports on any overexposure of workers
8. Operating procedures that were reviewed during this time period

The ALARA audit report specifically discusses the following:

1. Trends in personnel exposures

2. Proper use, maintenance and inspection of equipment used for exposure control

3. Recommendations on ways to further reduce personnel exposures from uranium and its daughters.

The ALARA audit report is submitted to and reviewed by the Senior Vice President of Operations and Mine Manager. Implementations of the recommendations to further reduce employee exposures, or improvements to the ALARA program, are discussed with the ALARA auditor.

An audit of the Quality Assurance/Quality Control (QA/QC) program is also conducted on an annual basis. An individual qualified in analytical and monitoring techniques who does not have direct responsibilities in the areas being audited performs the audit. The results of the QA/QC audit are documented with the ALARA Audit. The RSO has the primary responsibility for the implementation of the radiological QA/QC programs at the Crow Butte Uranium Project facilities.

~~5.4.~~5.5. HEALTH PHYSICS QUALIFICATIONS

CBR project staff is highly experienced in the management of uranium development, mining, and operations. The following minimum personnel specifications and qualifications are strictly adhered to.

5.5.1. RADIATION SAFETY OFFICER QUALIFICATIONS

The minimum qualifications for the Radiation Safety Officer (RSO) are as follows:

- Education - A Bachelor's Degree in the physical sciences, industrial hygiene, environmental technology or engineering from an accredited college or university or an equivalent combination of training and relevant experience in uranium mill/solution mining radiation protection.

- Health Physics Experience - A minimum of 1 year of work experience relevant to uranium mill/solution mining operations in applied health physics, radiation protection, industrial hygiene or similar work.

- Specialized Training - A formalized, specialized course(s) in health physics specifically applicable to uranium milling/solution mining operations, of at least 4 weeks duration. The RSO attends refresher training on uranium mill health physics every two years.

- Specialized Knowledge - The RSO, through classroom training and on-the-job experience, possesses a thorough knowledge of the proper application and use of all health physics equipment used in the operation, the procedures used for radiological sampling and monitoring, methods used to calculate personnel exposures to uranium and its daughters, and a thorough understanding of the solution mining process and equipment used and how hazards are generated and controlled during the process.

5.5.2. HEALTH PHYSICS TECHNICIAN QUALIFICATIONS

The Health Physics Technician (HPT) will have one of the following combinations of education, training, and experience:

1. Education - An associate degree or 2 years or more of study in the physical sciences, engineering, or a health-related field.

   Training - At least a total of 4 weeks of generalized training in radiation health protection applicable to uranium mills/solution mining operations.

   Experience - One year of work experience using sampling and analytical laboratory procedures that involve health physics, industrial hygiene, or industrial safety measures to be applied in a uranium mill/solution mining operation.

2. Education - A high school diploma.

   Training - A total of at least 3 months of specialized training in radiation protection relevant to uranium mills of which up to 1 month may be on-the-job training.

   Experience - Two years of relevant work experience in applied radiation protection.

~~5.5.~~5.6. 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. This training program is administered in keeping with standard radiological protection guidelines. The technical content of the training program is under the direction of the RSO. The RSO or a qualified designee conducts training.~~

All site employees and contractor personnel at the Crow Butte Uranium Project are administered a training program based upon the EHS Management System covering radiation safety, radioactive material handling, and radiological emergency procedures. This training program is administered in keeping with standard radiological protection guidelines and the guidance provided in USNRC Regulatory Guide 8.29, *Instructions Concerning Risks From Occupational Radiation Exposure* (Revision 1, February 1996); Regulatory Guide 8.31, *Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Recovery Facilities Will Be As Low As Reasonably Achievable* (Revision 1, May 2002); and Regulatory Guide 8.13, *Instruction Concerning Prenatal Radiation Exposure* (Revision 3, June 1999). The technical content of the training program is under the direction of the RSO. The RSO or a qualified designee conducts all radiation safety training.

~~5.5.1.~~5.6.1. TRAINING PROGRAM CONTENT

5.6.1.1. VISITORS

Visitors to the Crow Butte Uranium Project who have not received training are escorted by on site personnel properly trained and knowledgeable about the hazards of the facility. At a minimum, visitors are instructed specifically on what they should do to avoid possible hazards in the area of the facility that they are visiting.

5.6.1.2. CONTRACTORS

Any contractors having work assignments at the facility are given appropriate radiological safety training~~ and safety instruction~~. Contract workers who will be performing work on heavily contaminated equipment receive the same training normally required of ~~permanent~~ Crow Butte workers as discussed in Section 5.6.1.3.

5.6.1.3. ~~PERMANENT EMPLOYEES~~

CROW BUTTE RESOURCES EMPLOYEES

The CBR EMS Program Volume VII, *Training Manual*, incorporates the following topics recommended in USNRC Regulatory Guide 8.31, *Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Recovery Facilities Will Be As Low As Reasonably Achievable* (Revision 1, May 2002):
~~The CBR Radiation Safety Training Program incorporates the following topics discussed in USNRC Regulatory Guide 8.31, "Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Recovery Facilities Will Be As Low As Reasonably Achievable", Revision 1:~~

Fundamentals of health protection

- The radiological and toxic hazards of exposure to uranium and its daughters.
- How uranium and its daughters enter the body (inhalation, ingestion, and skin penetration.
- Why exposures to uranium and its daughters should be kept as low as reasonably achievable (ALARA).

Personal Hygiene at Uranium Mines

- Wearing protective clothing
- Using respirators when appropriate.
- Eating, drinking and smoking only in designated areas.
- Using proper methods for decontamination.

Facility-provided protection

- Cleanliness of working space.
- Safety designed features for process equipment.
- Ventilation systems and effluent controls.
- Standard operating procedures.
- Security and access control to designated areas.

Health protection measurements

- Measurements of airborne radioactive material.
- Bioassay to detect uranium (urinalysis and in vivo counting).
- Surveys to detect contamination of personnel and equipment.
- Personnel dosimetry.

Radiation protection regulations

- Regulatory authority of NRC, MSHA and state.
- Employee rights in 10 CFR Part 19.
- Radiation protection requirements in 10 CFR Part 20.

Emergency procedures

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 documented. Every two months, all workers attend a general safety meeting.

~~5.5.2.~~5.6.2. TESTING REQUIREMENTS

A written test with questions directly relevant to the principals of radiation safety and health protection in the facility covered in the training course is given to each worker. The instructor reviews the test results with each worker and discusses incorrect answers to the questions with the worker until worker understanding is achieved. Workers who fail the exam are retested and test results remain on file.

~~5.5.3.~~5.6.3. ON-THE-JOB TRAINING

5.6.3.1. ~~HPT~~HEALTH PHYSICS TECHNICIAN

On-the-job training is provided to HPTs in radiation exposure monitoring and exposure determination programs, instrument calibration, plant inspections, posting requirements, respirator programs and health physics procedures contained in EMS Program Volume IV, *Health Physics Manual.*~~On-the-job training is provided to HPTs in radiation exposure monitoring and exposure determination programs, instrument calibration, plant inspections, posting requirements, respirator programs, and Health Physics Standard Operating Procedures (SOPs).~~

~~5.5.4.~~5.6.4. REFRESHER TRAINING

~~Following initial radiation safety training, all permanent employees receive on-going radiation safety training as part of the routine bimonthly safety meetings. This on-going training is used to discuss problems and questions that have arisen, any relevant information or regulations that have changed, exposure trends and other pertinent topics.~~

Following initial radiation safety training, all permanent employees and long-term contractors receive on-going radiation safety training as part of the annual refresher training and, if determined necessary by the RSO, during monthly safety meetings. This on-going training is used to discuss problems and questions that have arisen, any relevant information or regulations that have changed, exposure trends and other pertinent topics.

~~5.5.5.~~5.6.5. TRAINING RECORDS

~~Records of training are kept for a period of five years for all process employees.~~
Records of training are kept for a period of five years for all employees trained as radiation workers (i.e., occupationally exposed employees).

~~5.6.~~5.7. SECURITY

~~The entrance to the Crow Butte Uranium Project site is a gravel road to the west of the facility. The entrance to the site is posted indicating that permission is required prior to entry. The gate on the access route can be locked. The plant site is within the fenced permit area and properly posted in accordance with 10 CFR § 20.1902 (e). The evaporation ponds are also fenced and posted. All visitors entering the restricted areas on the Crow Butte Uranium Project site are required to register at the main office and are not permitted inside the plant or wellfield areas without proper authorization. Inexperienced visitors are escorted unless they are frequent visitors who have been instructed regarding areas to be avoided.~~

~~The plant will normally operate 24 hours per day and 7 days per week, so CBR employees will normally be on-site except for occasional shutdowns. All plant personnel are instructed to immediately report any unauthorized persons to their supervisors. The supervisor will contact the reported unauthorized person and make sure that they have been authorized for entry. If the person is unauthorized, and has no business on the property, they will be escorted to the main entrance for departure.~~

CBR security measures for the current operation are specified in the Security Plan and Security Threat chapter in Volume VIII, *Emergency Manual.* Crow Butte Resources, Inc. (CBR) is committed to:

- Providing employees with a safe, healthful, and secure working environment;
- Maintaining control and security of NRC licensed material;
- Ensuring the safe and secure handling and transporting of hazardous materials; and
- Managing records and documents that may contain sensitive and confidential information.

The NRC requires licensees to maintain control over licensed material (i.e., natural uranium ("source material") and byproduct material defined in 10 CFR §40.4). 10 CFR 20, Subpart I, *Storage and Control of Licensed Material,* requires the following:

§20.1801 Security of Stored Material

The licensee shall secure from unauthorized removal or access licensed materials that are stored in controlled or unrestricted areas.

§20.1802 Control of Material not in Storage

The licensee shall control and maintain constant surveillance of licensed material that is in a controlled or unrestricted area and that is not in storage.

Stored material at the Crow Butte Uranium Project would include uranium packaged for shipment from the facility or byproduct materials awaiting disposal. Examples of material not in storage would include yellowcake slurry or loaded ion exchange resin removed from the restricted area for transfer to other areas.

5.7.1. PERMIT AREA AND PLANT FACILITY SECURITY

5.7.1.1. CENTRAL PROCESSING FACILITY AREA

All Central Processing facility areas where source or byproduct material is handled are fenced. The main access road is equipped with a locking gate. Strategically placed surveillance cameras monitor the access road and areas around the Central Processing facility. A 24-hour per day 7-day per week staff is on duty in the Central Processing facility.

Central Plant operators perform an inspection to ensure the proper storage and security of licensed material at the beginning of each shift. The inspection determines whether all licensed material is properly stored in a restricted area or, if in controlled or unrestricted areas, is properly secured. In particular, operators ensure that loaded ion exchange resin, slurry, drummed yellowcake, and byproduct material is properly secured. If licensed material is found outside a restricted area, the operator will ensure that it is secured, locked, moved to a restricted area, or kept under constant surveillance by direct observation by site personnel or surveillance cameras. The results of this inspection will be properly documented.

5.7.1.2. OFFICE BUILDING

There is a reception area located at the main entrance into the office building. All other entrances are locked during off-shift hours. There are a limited number of traceable keys to the office and they are given out to select employees. The main door and the door to the Central Plant facility entrance are also equipped with an access keypad.

Visitors entering the office are greeted by the receptionist and announced to the receiving person. All visitors are required to sign the access log and indicate the purpose of their visit and the employee to be visited. The person being visited is responsible to supervise the visitors at all times when they are on site. Visitors are only allowed at the facility during regular working hours unless prior approval is obtained from the Mine Manager or the Manager of Health, Safety, and Environmental Affairs.

5.7.2. TRANSPORTATION SECURITY

CBR routinely receives, stores, uses, and ships hazardous materials as defined by the U.S. Department of Transportation (DOT). In addition to the packaging and shipping requirements contained in the DOT Hazardous Materials Regulations (HMR), 49 CFR 172, Subpart I, *Security Plans*, requires that persons that offer for transportation or transport certain hazardous materials develop a Security Plan. Shipments may qualify for this DOT requirement under the following categories:

§172.800(b)(4) A shipment of a quantity of hazardous materials in a bulk package having a capacity equal to or greater than 13,248 L (3,500 gallons) for liquids or gases or more than 13.24 cubic meters (468 cubic feet) for solids;

§172.800(b)(5) A shipment in other than a bulk packaging of 2,268 kg (5,000 pounds) gross weight or more of one class of hazardous material for which placarding of a vehicle, rail car, or freight container is required for that class under the provisions of subpart F of this part;

§172.800(b)(7) A quantity of hazardous material that requires placarding under the provisions of subpart F of this part.

DOT requires that Security Plans assess the possible transportation security risks and evaluate appropriate measures to address those risks. All hazardous materials shippers and transporters subject to these standards must take measures to provide personnel security by screening applicable job applicants, prevent unauthorized access to the hazardous materials or vehicles being prepared for shipment, and provide for en route security. Companies must also train appropriate personnel in the elements of the Security Plan.

Transport of licensed/hazardous material by CBR employees will generally be restricted to transferring contaminated equipment between company facilities. This transport generally occurs over short distances through remote areas. Therefore, the potential for a security threat during transport by CBR vehicle is minimal. The goal of the driver, cargo, and equipment security measures is to ensure the safety of the driver and the security and integrity of the cargo from the point of origin to the final destination by:

- Clearly communicating general point-to-point security procedures and guidelines to all drivers and non-driving personnel;
- Providing the means and methods of protecting the drivers, vehicles, and customer's cargo while on the road; and
- Establishing consistent security guidelines and procedures that shall be observed by all personnel.

For the security of all tractors and trailers, the following will be adhered to:

- If material is stored in the vehicle, access must be secured at all openings with locks and/or tamper indicators;
- Off site tractors will always be secured when left unattended with windows closed, doors locked, the engine shut off, and no keys or spare keys in or on the vehicle;
- The unit is to be kept visible by an employee at all times when left unattended outside a restricted area.

The security guidelines and procedures apply to all transport assignments. All drivers and non-driving personnel are expected to be knowledgeable of, and adhere to, these guidelines and procedures when performing any load-related activity.

~~5.7.~~5.8. RADIATION SAFETY CONTROLS AND MONITORING

CBR has a strong corporate commitment to and support for the implementation of the radiological control program at the Crow Butte Uranium Project facility. This corporate commitment to maintaining personnel exposures as low as reasonably achievable (ALARA) has been incorporated into the radiation safety controls and monitoring programs described in the following sections. This license renewal application contains the results through 1995 of the radiological control program since 1990. Each area in this Section describes the historical program and the results of monitoring since 1990. Where the monitoring results indicate that the program should be modified, proposed changes in the program are also discussed.

~~5.7.1.~~5.8.1. EFFLUENT CONTROL TECHNIQUES

~~5.7.1.1.~~5.8.1.1. GASEOUS AND AIRBORNE PARTICULATE EFFLUENTS

Under routine operations, the only radioactive effluent at the Crow Butte facility is the release of radon-222 gas from the production solutions. A vacuum dryer is used for drying the yellowcake product. There is no airborne effluent from the vacuum dryer system.

The radon-222 is found in the pregnant lixiviant that comes from the wellfield into the plant. The production flow is directed to the process building for separation of the uranium. The uranium is separated by passing the recovery solution through fluidized bed upflow ion exchange units. Radon gas is released from the solution in the ion exchange columns and in the injection surge tanks. The vents from the individual vessels are connected to a manifold that is exhausted outside the plant building through the plant stack.

Venting to the atmosphere outside of the plant building minimizes personnel exposure. Small amounts of radon-222 may be released in the plant building during solution spills, filter changes and maintenance activities. The plant building is equipped with exhaust fans to remove any radon that may be released in the plant building. No significant personnel exposure to radon gas has been noted during operation of the Crow Butte facility. Results of radon daughter monitoring in the process areas are discussed in Section ~~5.7.3~~5.8.3.

~~5.7.1.2.~~5.8.1.2. LIQUID EFFLUENTS

The liquid effluents from the Crow Butte Uranium Project can be classified as follows:

- **Water generated during well development** - This water is recovered groundwater and has not been exposed to any mining process or chemicals. The water is discharged directly to one of the solar evaporation ponds and silt, fines and other natural suspended matter collected during well development is settled out.

- **Liquid process waste** - The operation of the process plant results in two primary sources of liquid waste, an eluant bleed and a production bleed.

- **Aquifer restoration** - Following mining operations, restoration of the affected aquifer commences which results in the production of wastewater. The current groundwater restoration plan consists of four activities: 1) Groundwater Transfer, 2) Groundwater Sweep, 3) Groundwater Treatment, and 4) Wellfield Circulation. Only the groundwater sweep and groundwater treatment activities will generate wastewater.

  During groundwater sweep, water is extracted from the mining zone without injection causing an influx of baseline quality water to sweep the affected mining area.

  Groundwater treatment activities involve the use of process equipment to lower the ion concentration of the groundwater in the affected mining area. A reverse osmosis (RO) unit may be used to reduce the total dissolved solids of the groundwater. The RO unit produces clean water (permeate) and brine. The permeate is either injected into the formation or disposed of in the waste disposal system. The brine is sent to the wastewater disposal system. The permeate may be further treated if necessary to meet the quality requirements of the NPDES permit for land application disposal.

The existing USNRC License allows CBR to dispose of wastewater by three methods:

- Evaporation from the evaporation ponds;
- Deep well injection; and
- Land application.

The design, installation, inspection and operation criteria for the solar evaporations ponds are those found to be applicable in USNRC Regulatory Guide 3.11, "*Design, Construction and Inspection of Embankment Retention Systems For Uranium Mills*~~.~~" (Revision 2, December 1977). Each commercial pond is nominally 900 feet by 300 feet by 17 feet in depth. The ponds are membrane lined with a leak detection system under the membrane and are designed to allow the contents of any given pond to be transferred into another pond in the event of a pond problem.

Each of the ponds has the capability of being pumped for water treatment prior to discharge under the NPDES permit. A variety of treatment options exist depending upon the specific chemical contaminants identified in the wastewater. In general, a combination of chemical precipitation and reverse osmosis is adequate to restore the water to a quality that falls within the NPDES parameters.

Spill Contingency Plans

The RSO is charged with the responsibility to develop and implement appropriate procedures to handle potential spills of radioactive materials. Personnel representing the engineering and operations functions of the Crow Butte Uranium Project facility will assist the RSO in this effort. Basic responsibilities include:

- Assignment of resources and manpower.
- Responsibility for materials inventory.
- Responsibility for identifying potential spill sources.
- Establishment of spill reporting procedures and visual inspection programs.
- Review of past incidents of spills.
- Coordination of all departments in carrying out goals of containing potential spills.
- Establishment of employee emergency response training programs.
- Responsibility for program implementation and subsequent review and updating.
- Review of new construction and process changes relative to spill prevention and control.

Spills can take two forms within an in-situ uranium mining facility; surface spills such as pond leaks, piping ruptures, transportation accidents, etc., and subsurface releases such as a well excursion, in which process chemicals migrate beyond the wellfield, or a pond liner leak resulting in a release of waste solutions.

Engineering and administrative controls are in place to prevent both surface and subsurface releases to the environment and to mitigate the effects should a release occur.

- **Surface Releases** - The most common form of surface release from in-situ mining operations occurs from breaks, leaks, or separations within the piping that transfers mining fluids between the process plant and the wellfield. These are generally classified as small releases.

In general, piping from the plant to and within the wellfield is constructed of PVC, high-density polyethylene pipe with butt-welded joints or equivalent. All pipelines are pressure tested at operating pressures prior to operation. It is unlikely that a break would occur in a buried section of line because no additional stress is placed on the pipes. In addition, underground pipelines are protected from a major cause of potential failure - that of vehicles driving over the lines causing breaks. The only exposed pipes are at the process plant, the wellheads, at temporary transfer lines and in the control house in the wellfield. Trunkline flows and wellhead pressures are monitored each shift for process control. One section of underground piping that passes beneath Squaw Creek is double contained for additional protection.

- **Transportation accidents** - ~~Standard Operating Procedure C-21~~EMS Program Volume VIII, *Emergency Manual* provides the CBR emergency action plan for responding to a transportation accident involving a yellowcake shipment. The ~~SOP~~ Emergency Manual provides instructions for proper packaging, documentation, driver emergency and accident response procedures, and cleanup and recovery actions. Spill response is ~~specifically~~ also addressed in EMS Program Volume VIII, *Emergency Manual*~~SOP C-19, *Radioactive Materials Spills*~~.

- **Sub-surface releases** - Mining fluids are normally maintained in the production aquifer within the immediate vicinity of the wellfield. The function of the encircling monitor well ring is to detect any mining solutions that may migrate away from the production area due to fluid pressure imbalance. This system has been proven to function satisfactorily over many years of operating experience with in-situ mining.

  At the Crow Butte Uranium Project site, an undetected excursion is highly unlikely. All wellfields are surrounded by a ring of monitor wells located no further than 300 feet from the wellfield and screened in the ore-bearing Chadron aquifer. Additionally, monitor wells are placed in the first overlying aquifer above each wellfield segment. Sampling of these wells is done on a biweekly basis. Past experience at in-situ leach mining facilities has shown that this monitoring system is effective in detecting leachate migration. The total effect of the close proximity of the monitor wells, the low flow rate from the well patterns, and over-production of leach fluids (production bleed) makes the likelihood of an undetected excursion extremely remote.

Migration of fluids to overlying aquifers has also been considered. Several controls are in place to prevent this. First, CBR has plugged all exploration holes to prevent co-mingling of Brule and Chadron aquifers and to isolate the mineralized zone. Successful plugging was tested by conducting two hydrologic tests prior to mining. Results indicated that no leakage or communication exists between the mineralized zone and overlying aquifers. In addition, prior to start of production a well integrity test is performed on all injection/recovery wells. This requirement of the Nebraska Underground Injection Control Regulations insures that all wells are constructed properly and capable of maintaining pressure without leakage. Lastly, monitor wells completed in the overlying aquifer are also sampled on a regular basis for the presence of leach solution.

Seepage of solutions from the evaporation ponds into ground or surface water is also a potential pollution source. However, this has not been nor should it be a problem at the Crow Butte site. Construction and operational safeguards have been implemented to insure maximum competency of the synthetic liner and earthen embankments. The underdrain leak detection system allows sampling that would detect a leak. The pond soil foundation has a low ambient moisture due to its elevation, soil type and preparation, thus should the unlikely event occur of pond fluids seeping into the compacted subsoil, the liquid would be quickly absorbed and would not migrate. Pond monitor wells are also located downstream of the evaporation ponds to detect leaks into the uppermost aquifer.

In addition to the spills described above, the accumulation of sediment or erosion of existing soils can lead to potential releases of pollutants. The likelihood of significant sediment or erosion problems is greatest during construction activities, which are completed at this time. Future construction activities could include additional wellfield development, or additional pond construction. During construction, there is a possibility that sediment load may increase in Squaw Creek. If rain, producing runoff, occurs during construction, a small amount of the fill may be carried into the creek. Significant precipitation during pond construction and plant facilities might also produce the same effect. Plant cover for erosion control will be established as soon as possible on exposed areas. Little additional suspendable material should be produced during mining operations and restoration activities. Site reclamation in the future with backfilling of ponds, grading the plant site, and replacing the topsoil will also expose unsecured soil for suspension in runoff waters. The increased sediment load as a result of precipitation during future construction or reclamation activities should not significantly effect the quality of Squaw Creek as the more sensitive areas of the stream are located upstream form the point of entry of the tributary.

Runoff from precipitation events should be controlled to minimize any exposure to pollutants on the site. At the Crow Butte Uranium Project site, runoff is not considered to be a major issue given the engineering design of the facilities, as well as the existing engineering and administrative controls. Rainwater entering a pond leading to a pond overflow would be the greatest item of concern. The design and operation of the ponds precludes a runoff-induced overflow as a realistic possibility. Should there be high runoff concurrent with a pipeline failure, some contamination could be spread depending upon the relative saturation of the soils beneath the leaking area. In any event, as only minimal releases of solutions would occur in the event of a pipeline failure, and migration of pollutants due to runoff would still be minimal.

~~5.7.2.~~5.8.2. EXTERNAL RADIATION EXPOSURE MONITORING PROGRAM

~~5.7.2.1.~~5.8.2.1. GAMMA SURVEY

Program Description

External gamma radiation surveys have been performed routinely at the Crow Butte Uranium Project. The required frequency is quarterly in designated Radiation Areas and semiannually in all other areas of the plant. Surveys are performed at specified locations in worker occupied stations and areas of potential gamma sources such as tanks and filters. CBR establishes a Radiation Area if the gamma survey exceeds the action level of 5.0 mR/hr for worker occupied stations. An investigation is performed to determine the probable source and survey frequency for areas exceeding 5.0 mR/hr are increased to quarterly. Records were maintained of each investigation and the corrective action taken. If the results of a gamma survey identified areas where gamma radiation is in excess of levels that delineate a "radiation area", access to the area is restricted and the area is posted as required in 10 CFR §20.1902 (a).

External gamma surveys are performed with survey equipment that meets the following minimum specifications:

1. Range - Lowest range not to exceed 100 microRoentgens per hour (μR/hr) full-scale with the highest range to read at least 5 milliRoentgens per hour (mR/hr) full scale;

2. Battery operated and portable;

Examples of satisfactory instrumentation that meets these requirements are the ~~Eberline Instruments Corporation Model ESP-1~~Ludlum Model 3 survey meter with a ~~HP-270~~ Ludlum 44-38 probe or equivalent. Gamma survey instruments were calibrated every six months and were operated in accordance with the manufacturer's recommendations. Instrument checks were performed each day that an instrument was used.

Historical Program Results

Routine gamma surveys have been performed as required at the Crow Butte Uranium Project. A Radiation Area has been established around the injection filter system since the beginning of commercial operations due to gamma levels above 5.0 mRem/hr. Engineering controls such as lead sheeting have been employed around the filters to maintain personnel exposures ALARA.

Results of the gamma survey program are maintained at the Crow Butte Uranium Project site.

Proposed Beta and Gamma Survey Program

CBR proposes to institute the same gamma exposure-monitoring program of worker occupied stations and areas likely to have significant gamma exposure rates at the Crow Butte Uranium Project that has been performed to date with the following changes.

- Gamma survey instruments will be calibrated annually or at the manufacturers recommended frequency, whichever is more frequent.

Gamma exposure rate surveys will be performed in accordance with the instructions currently contained in ~~Standard Operating Procedure C-13, "Gamma Surveys"~~EMS Program Volume IV, *Health Physics Manual*. Gamma survey instruments will be checked each day of use in accordance with the manufacturer's instructions.

Beta surveys of specific operations that involve direct handling of large quantities of aged yellowcake will be performed as discussed in USNRC Regulatory Guide 8.30, "*Health Physics Surveys in Uranium Recovery Facilities*," Section 1.4. Beta evaluations may be substituted for surveys using radiation survey instruments. Surveys or evaluations will be performed whenever a change in equipment or procedures has occurred that may significantly affect worker exposures.

Figure ~~5.7~~5.8-1: Proposed Survey and Sampling Locations

~~5.7.2.2.~~5.8.2.2. PERSONNEL DOSIMETRY

Program Description

All employees working in the process facility or wellfield operations who are assigned full-time to the Crow Butte Uranium Project facility have been issued dosimeters for determination of external gamma exposure. Dosimeters are provided by a vendor that is accredited by NVLAP of the National Institute of Standards and Technology as required in 10 CFR § 20.1501. The dosimeters have a range of 1 mR to 1000 R. Dosimeters are exchanged and read on a quarterly basis.

Historical Program Results

Table ~~5.7~~5.8-1 contains a summary of the average and maximum annual exposure for all personnel at the Crow Butte Uranium Project facility since 1990. As can be seen in Table ~~5.7~~5.8-1, the average annual exposures at the Crow Butte Uranium Project from 1990 to 1994 have been at or below 1% of the regulatory limit of 5.0 Rem. The maximum annual individual exposure in 1994 was well below 10% of the regulatory limit and indicates that exposures at the Crow Butte Uranium Project are maintained ALARA.

Proposed Personnel Dosimetry Program

10 CFR §20.1502 (a)(1) requires exposure monitoring for "Adults likely to receive, in 1 year from sources external to the body, a dose in excess of 10 percent of the limits in §20.1201 (a)". Ten percent of the dose limit would correspond to a Deep Dose Equivalent (DDE) of 0.500 Rem. Maximum individual annual exposures at the Crow Butte Uranium Project facilities since 1987 have been well below 10 percent of the limit. CBR believes that it is unlikely that any employee will exceed 10 percent of the regulatory limit. Although monitoring of external exposure may not be required in accordance with §20.1201(a), CBR proposes to continue to issue dosimeters to all process employees and exchange them on a quarterly basis. CBR has discontinued dosimeter issuance to employees in other work categories who do not routinely enter the process plant.

Results from dosimeter monitoring will be used to determine individual Deep Dose Equivalent (DDE) for use in determining Total Effective Dose Equivalent (TEDE) in accordance with the instructions currently contained in EMS Program Volume IV, *Health Physics Manual*~~Standard Operating Procedure C-15, "External Exposure"~~.

Table ~~5.7~~5.8-1: External Radiation Exposure Monitoring Results

EXPOSURE MONITORING PERIOD	AVERAGE ANNUAL EXPOSURE (mRem/yr)[2]	MAXIMUM INDIVIDUAL ANNUAL EXPOSURE[1] (mRem/yr)[2]
Calendar Year 1990	6.3	14
Calendar Year 1991	33.3	83
Calendar Year 1992	27.8	109
Calendar Year 1993	32.3	98
Calendar Year 1994	51.2	315

Notes:
1. Annual External Exposure Limit (10 CFR § 20.1201) = 5 Rem
2. All data based upon results from Eberline Instrument Corporation; LLD = 10 mRem

~~5.7.3.~~5.8.3. IN-PLANT AIRBORNE RADIATION MONITORING PROGRAM

~~5.7.3.1.~~5.8.3.1. IN-PLANT AIRBORNE URANIUM PARTICULATE MONITORING

Program Description

Airborne particulate levels at solution mines which ship slurry yellowcake product are normally very low since the product is wet. Yellowcake drying operations began in 1993. Monitoring for airborne uranium was performed routinely at Crow Butte Uranium Project through the use of area sampling and breathing zone sampling. The monitoring programs are described below.

Area Sampling

Area samples are collected monthly at the four specified sample locations in the plant. Additionally, samples are taken in the dryer room during dryer operations and for the issuance of an RWP. Area samples are taken in accordance with the instructions currently contained in ~~SOP C-12, "Survey for Airborne Uranium"~~EMS Program Volume IV, *Health Physics Manual*. Samples are taken with a glass fiber filter and a regulated air sampler such as an Eberline RAS-1 or equivalent. Sample volume is adequate to achieve the lower limits of detection (LLD) for uranium in air. Samplers are calibrated every six months using a digital mass flowmeter or equivalent primary calibration standard.

Measurement of airborne uranium is performed by gross alpha counting of the air filters using an alpha scaler such as an Eberline MS-3 or equivalent. The Maximum Permissible Concentration (MPC) value for natural uranium of 1 E-10 μCi/ml from Appendix B to 10 CFR §§ 20.1 - 20.601 was applied to the gross alpha counting results. After implementation of the new 10 CFR 20 on January 1, 1994, the Derived Air Concentration (DAC) for soluble (D classification) natural uranium of 5 E-10 μCi/ml from Appendix B to 10 CFR §§20.1001 - 20.2401 was used. This is a conservative method because the gross alpha results include Uranium-238 and several of its daughters (notably Ra-226 and Th-230), which are alpha emitters. An action level of 25% of the MPC (DAC since 1994) for soluble natural uranium was established at the Crow Butte Uranium Project facilities. If an airborne uranium sample exceeded the MPC (DAC), an investigation was performed. The only area at the Crow Butte Uranium Project which has met the definition of an Airborne Radioactivity Area as contained in 10 CFR § 20.1003 is the dryer room during yellowcake packaging operations.

Breathing Zone Sampling

Breathing zone sampling is performed to determine individual exposure to airborne uranium during certain operations. Sampling was performed with an MSA pump or equivalent. The air filters were counted and compared to the MPC (DAC) using the same method described for area sampling. Air samplers were calibrated at least every six months.

Historical Program Results

Table ~~5.7~~5.8-2 provides the results of monitoring for airborne uranium from the period of 1990 through 1994. The annual average and maximum monthly average airborne gross alpha activity for this period are reported. The increase in the average activity in 1994 is due to the influence of the sampling results from the dryer room. All activity levels were well below 25% of the MPC or DAC.

Proposed In-Plant Airborne Uranium Monitoring Program

CBR proposes to institute the same airborne uranium-monitoring program at Crow Butte Uranium Project that has been performed to date with the following changes.

- Based upon operating experience, CBR proposes to perform air sampling at the locations shown in Figure ~~5.7~~5.8-1 for the plant. CBR believes that these locations will provide accurate monitoring of plant radiological conditions.

Airborne sampling will be performed on a monthly basis in accordance with the instructions currently contained in EMS Program Volume IV, *Health Physics Manual* ~~Standard Operating Procedures C-12, "Survey for Airborne Uranium " and C-8, "Breathing Zone Samples."~~ These ~~Standard Operating P~~procedures implement the guidance contained in USNRC Regulatory Guide 8.25, ~~"~~*Air Sampling in the Workplace*.~~"~~ Sampler calibration will be performed in accordance with the instructions currently contained in EMS Program Volume IV, *Health Physics Manual*~~Standard Operating Procedure C-6, "Radon Daughter Measurement" for MSA type samplers and Standard Operating Procedure E-7, "Environmental Air Particulate Sampling"~~.

Table ~~5.7~~5.8-2: In-plant Airborne Uranium Monitoring Results

AIRBORNE URANIUM MONITORING PERIOD	ANNUAL AVERAGE AIRBORNE ACTIVITY µCi/ml gross α (% MPC, % DAC)[1,2]	MAXIMUM MONTHLY AVERAGE AIRBORNE ACTIVITY µCi/ml gross α (% MPC, %DAC)[1,2]
Calendar Year 1990 - RO Building (twelve months of sampling data)	4.3 E-13 (0.4% MPC)	3.2 E-12 (3.2% MPC)
Calendar Year 1990 - Commercial Plant (two months of sampling data)	1.56 E-13 (0.2% MPC)	1.78 E-13 (0.2% MPC)
Calendar Year 1991 - RO Building (two months of sampling data)	5.05 E-13 (0.5% MPC)	1.0 E-12 (1.0% MPC)
Calendar Year 1991 - Commercial Plant (twelve months of sampling data)	4.53 E-13 (0.5% MPC)	2.31 E-12 (2.3% MPC)
Calendar Year 1992	5.61 E-13 (0.6% MPC)	1.18 E-12 (1.2% MPC)
Calendar Year 1993	9.67 E-13 (1.0% MPC)	6.67 E-12 (6.7% MPC)
Calendar Year 1994 (includes dryer room sample results)	3.22 E-12 (0.6% DAC)	6.07 E-12 (1.2% DAC)

Notes:
1. Samples prior to January 1, 1994 compared to MPC where MPC = 1 E-10 µCi/ml (10 CFR §§ 20.1 - 20.601 App B).
2. Samples after January 1, 1994 compared to the DAC where DAC=5 E-10 µCi/ml (10 CFR §§ 20.1001-2401 App B)

~~5.7.3.2.~~5.8.3.2. IN-PLANT RADON DAUGHTER SURVEYS

Program Description

Radon daughter surveys were conducted in the operating areas of the Crow Butte Uranium Project facilities on a monthly basis at the specified locations. Samples were collected with a low volume air pump and then analyzed with an alpha scaler using the Modified Kusnetz method described in ANSI-N13.8-1973. Air samplers are calibrated at least every six months.

Results of radon daughter sampling are expressed in Working Levels (WL) where one WL is defined as any combination of short-lived radon-222 daughters in one liter of air without regard to equilibrium that emit 1.3×10^5 MeV of alpha energy. The MPC limit from Appendix B to 10 CFR §§ 20.1 - 20.601 as well as the current DAC limit from Appendix B to 10 CFR §§ 20.1001 - 20.2402 for radon-222 with daughters present is 0.33 WL. CBR has established an action level of 25% of the DAC or 0.08 WL. Radon daughter results in excess of the action level result in an investigation of the cause and an increase in the sampling frequency to weekly until the radon daughter levels did not exceed the action level for four consecutive weeks.

Historical Program Results

Table ~~5.7~~5.8-3 provides the results of monitoring for radon daughters from the period of 1990 through 1994. The annual average and maximum values are presented. The data shows that the average radon daughter activity concentration at Crow Butte Uranium Project was consistently less than 25% of the regulatory limit.

Proposed In-Plant Radon Daughter Monitoring Program

CBR proposes to institute the same radon daughter monitoring program at Crow Butte Uranium Project that has been performed to date with the following changes.

- Based upon operating experience, CBR proposes to perform radon daughter sampling at the locations shown Figure ~~5.7~~5.8-1. CBR believes that these locations will provide accurate monitoring of plant radiological conditions.

Routine radon daughter monitoring will be performed on a monthly basis in accordance with the instructions currently contained in EMS Program Volume IV, *Health Physics Manual*~~Standard Operating Procedure C-6, "Radon Daughter Measurement."~~

Table ~~5.7~~5.8-3: In-plant Radon Daughter Monitoring Results

RADON DAUGHTER MONITORING PERIOD	ANNUAL AVERAGE RADON DAUGHTER ACTIVITY in WL (% MPC, % DAC)[1,2]	MAXIMUM MONTHLY AVERAGE RADON DAUGHTER ACTIVITY in WL (% MPC, %DAC)[1,2]
Calendar Year 1990 - RO Building (twelve months of sampling data)	0.015 (4.5% MPC)	0.022 (6.7% MPC)
Calendar Year 1990 - Commercial Plant (two months of sampling data)	0.008 (2.4% MPC)	0.009 (2.7% MPC)
Calendar Year 1991 - RO Building (two months of sampling data)	0.012 (3.6% MPC)	0.019 (5.8% MPC)
Calendar Year 1991 - Commercial Plant (twelve months of sampling data)	0.036 (11% MPC)	0.060 (18.2% MPC)
Calendar Year 1992	0.035 (10.7% MPC)	0.061 (18.5% MPC)
Calendar Year 1993	0.038 (11.8% MPC)	0.061 (18.5% MPC)
Calendar Year 1994	0.032 (9.6% DAC)	0.046 (13.9% DAC)

Notes: 1 Samples prior to January 1, 1994 compared to MPC where MPC=0.33 WL (10 CFR §§ 20.1 - 20.601 App B).

2 Samples after January 1, 1994 compared to the DAC where DAC= 0.33 WL (10 CFR §§ 20.1001-2401 App B)

Air sampler calibration will be performed in accordance with the instructions contained in EMS Program Volume IV, *Health Physics Manual*~~Standard Operating Procedure C-6~~.

~~5.7.3.3.~~5.8.3.3. RESPIRATORY PROTECTION PROGRAM

Respiratory protective equipment has been supplied by CBR for activities where engineering controls may not be adequate to maintain acceptable levels of airborne radioactive materials or toxic materials. Use of respiratory equipment at Crow Butte Uranium Project is in accordance with the procedures currently set forth in the EMS Program Volume IV, *Health Physics Manual*~~following Standard Operating Procedures:~~

- ~~Standard Operating Procedure R-1, "Respiratory Protection Program"~~
- ~~Standard Operating Procedure R-2, "Respirator Selection"~~
- ~~Standard Operating Procedure R-3, "Functional Fit Test: Positive pressure and Negative Pressure Test"~~
- ~~Standard Operating Procedure R-4, "Respirator Facepiece Fit Testing"~~
- ~~Standard Operating Procedure R-5, "Fit Test Exercises"~~
- ~~Standard Operating Procedure R-6, "Maintenance, Cleaning, Disinfection, Decontamination, and Storage of Respirators."~~

The respirator program is designed to implement the guidance contained in USNRC Regulatory Guide 8.15, "*Acceptable Programs For Respiratory Protection*". The respirator program is administered by the RSO as the Respiratory Protection Program Administrator (RPPA).

~~5.7.4.~~5.8.4. EXPOSURE CALCULATIONS

Employee internal exposure to airborne radioactive materials has been determined at the Crow Butte Uranium Project facility since commercial operations began in 1991. Since January 1, 1994, CBR has determined internal exposures based upon the requirements of 10 CFR § 20.1204. Prior to January 1, 1994, internal exposure was calculated using the MPC-Hour method based upon 10 CFR § 20.103. Following is a discussion of the exposure calculation methods and results.

~~5.7.4.1.~~5.8.4.1. NATURAL URANIUM EXPOSURE

Exposure calculations for airborne natural uranium are carried out using the intake method from USNRC Regulatory Guide 8.30, "*Health Physics Surveys in Uranium Recovery Facilities*", Revision 1, Section 2. The intake is calculated using the following equation:

$$I_u = b\sum_{i=1}^{n}\frac{X_i \times t_i}{PF}$$

where:

I_u	=	uranium intake, µg or µCi
t_i	=	time that the worker is exposed to concentrations X_i (hr)
X_i	=	average concentration of uranium in breathing zone, µg/m^3, µCi/m^3
b	=	breathing rate, 1.2 m^3/hr
PF	=	the respirator protection factor, if applicable
n	=	the number of exposure periods during the week or quarter

The intake for uranium is calculated on Time Weighted Exposure (TWE) forms. The intakes are totaled and entered onto each employee's Occupational Exposure Record.

The data required to calculate internal exposure to airborne natural uranium is determined as follows:

Time of Exposure Determination

100% occupancy time is used to determine routine worker exposures. Exposures during non-routine work are always based upon actual time.

Airborne Uranium Activity Determination

Airborne uranium activity is determined from surveys performed as described in Section ~~5.7.3.1~~5.8.3.1.

Historical Program Results

Table ~~5.7~~5.8-4 summarizes internal exposure results at Crow Butte Uranium Project from airborne uranium. The data shows that internal exposure at Crow Butte Uranium Project has been maintained ALARA. The maximum individual internal exposure to airborne uranium during the period from 1990 through 1994 was less than 1% of the allowable regulatory limit.

Proposed Airborne Uranium Exposure Monitoring Program

CBR proposes to institute the same internal airborne uranium exposure calculation methods at Crow Butte Uranium Project that have been used to date and which are currently contained in EMS Program Volume IV, *Health Physics Manual*~~Standard Operating Procedure C-16, "Internal Exposure Control and Calculations"~~. Exposures to airborne uranium will be compared to the DAC for the "D" solubility class for natural uranium from appendix B of 10 CFR §§20.1001 - 20.2401 (5 E-10 μCi/ml) for all areas of the plant.

Table ~~5.7~~5.8-~~4~~: Annual Airborne Uranium Exposure Results

AIRBORNE URANIU EXPOSURE MONITORING PERIOD	AVERAGE AIRBORNE URANIUM EXPOSURE (µCi)[1]	MAXIMUM AIRBORNE URANIUM EXPOSURE (µCi)[1]
Calendar Year 1990	3.39×10^{-4}	6.08×10^{-4}
Calendar Year 1991	7.20×10^{-4}	1.38×10^{-3}
Calendar Year 1992	7.44×10^{-4}	1.59×10^{-3}
Calendar Year 1993	6.74×10^{-4}	1.26×10^{-3}
Calendar Year 1994	3.66×10^{-3}	9.03×10^{-3}

Notes: 1 The annual uranium intake limit for calendar years 1990 through 1993 was 0.252 µCi based upon 10 CFR 20.103.

In1994, the annual limit on intake (ALI) was 1 µCi based upon "D" class natural uranium.

~~5.7.4.2.~~5.8.4.2. RADON DAUGHTER EXPOSURE

Exposure calculations for airborne radon daughters are carried out using the intake method from USNRC Regulatory Guide 8.30, "*Health Physics Surveys in Uranium Recovery Facilities*", Revision 1, Section 2. The radon daughter intake is calculated using the following equation:

$$I_r = \frac{1}{170} \sum_{i=1}^{n} \frac{W_i \times t_i}{PF}$$

where:

I_r	=	radon daughter intake, working-level months
t_i	=	time that the worker is exposed to concentrations W_i (hr)
W_i	=	average number of working levels in the air near the worker's breathing zone during the time (t_i)
170	=	number of hours in a working month
PF	=	the respirator protection factor, if applicable
n	=	the number of exposure periods during the year

The data required to calculate exposure to radon daughters is determined as follows:

<u>Time of Exposure Determination</u>

100% occupancy time is used to determine routine worker exposure times. Exposures during non-routine work are always based upon actual time.

Radon Daughter Concentration Determination

Radon-222 daughter concentrations are determined from surveys performed as described in Section ~~5.7.3.2~~5.8.3.2.

The working-level months for radon daughter exposure is calculated on the appropriate forms. The working-level months are totaled and entered onto each employee's Occupational Exposure Record.

Historical Program Results

Table ~~5.7~~5.8-5 summarizes the results of radon daughter exposure calculations at Crow Butte Uranium Project since 1990. The data shows that internal exposure due to radon daughters at Crow Butte Uranium Project has been maintained ALARA. The maximum individual internal exposure to radon daughters during the period from 1990 through 1994 was 0.502 working-level months or approximately 12.5% of the allowable regulatory limit of 4 working-level months. The maximum annual average internal exposure to radon daughters was 0.258 working-level months, which is approximately 6.5% of the regulatory limit.

Proposed Radon Daughter Exposure Monitoring Program

CBR proposes to institute the same internal radon daughter exposure calculation methods at Crow Butte Uranium Project that have been used to date and which are currently contained in EMS Program Volume IV, *Health Physics Manual* ~~Standard Operating Procedure C-16, "Internal Exposure Control and Calculations"~~. Exposures to radon daughters will be compared to the DAC for radon daughters from Appendix B of 10 CFR §§20.1001 - 20.2401 (0.33 WL).

Table ~~6.7~~5.8-5: Annual Radon Daughter Exposure Results

RADON DAUGHTER EXPOSURE MONITORING PERIOD	AVER INDIVIDUAL EXPOSURE (WORKING-LEVEL MONTHS)[1]	MAXIM INDIVIDUAL EXPOSURE (WORKING-LEVEL MONTHS)[1]
Calendar Year 1990	0.062	0.117
Calendar Year 1991	0.257	0.477
Calendar Year 1992	0.227	0.468
Calendar Year 1993	0.258	0.502
Calendar Year 1994	0.188	0.418

Notes:

1 The annual limit was 4 working-level months.

~~5.7.5.~~5.8.5. BIOASSAY PROGRAM

Program Description

CBR has implemented a urinalysis bioassay program at the Crow Butte Uranium Project facilities that meets the guidelines contained in USNRC Regulatory Guide 8.22, "*Bioassay at Uranium Mills*, Revision 1." The primary purpose of the program is to detect uranium intake in employees who are regularly exposed to uranium. The bioassay program consisted of the following elements:

1. Prior to assignment to the facility, all new employees are required to submit a baseline urinalysis sample. Upon termination, an exit bioassay is required. Additionally, bioassay samples are obtained annually from all employees.

2. During operations, urine samples are collected from workers whose routine work assignment requires them to enter areas where the potential for inhalation of yellowcake exists. Samples from these workers are collected on a quarterly frequency. Workers who have the potential for exposure to dried yellowcake are sampled on a monthly basis. Samples are analyzed by an outside analytical laboratory for uranium content. Blank and spiked samples are also submitted to the laboratory with employee samples as part of the Quality Assurance program. The measurement sensitivity for the analytical laboratory is 5 µg/l.

3. Action levels for urinalysis are established based upon Table 1 in USNRC Regulatory Guide 8.22, "*Bioassay at Uranium Mills*, Revision 1."

4. *In vivo* measurements are performed in accordance with the recommendations contained in Regulatory Guide 8.22, *Bioassay in Uranium Mills,* Revision 1. Since CBR does not produce insoluble, high-fired yellowcake (defined as yellowcake dried at greater than 400°C), no *in vivo* measurements have been required.

Historical Program Results

Following is a summary of the results of the bioassay program since 1990.

1990

All bioassay samples were reported at less than the 5 μg/l detection limit.

1991

All bioassay samples were reported at less than the 5 μg/l detection limit.

1992

All bioassay samples were reported at less than the 5 μg/l detection limit.

1993

All bioassay samples were reported at less than the 5 μg/l detection limit.

1994

All bioassay samples were reported at or less than the 5 μg/l detection limit with the exception of one sample which was 13.9 μg/l. Resamples of the individual that submitted this sample were less than 5 μg/l.

Bioassay Quality Assurance Program Description and Historical Results

Elements of the Quality Assurance requirements for the Bioassay Program are based upon the guidelines contained in USNRC Regulatory Guide 8.22, "*Bioassay in Uranium Mills*", Revision 1. These elements included the following:

1. Each batch of samples submitted to the analytical laboratory is accompanied by two blind control samples. The control samples are from persons that have not been occupationally exposed and are spiked to a uranium concentration of 10 to 20 μg/l and 40 to 60 μg/l. The results of analysis for these samples are required to be within ± 30% of the spiked value. CBR has tracked the results of the blind spike analysis since 1990. All analytical results have fallen within the acceptable range.

2. The analytical laboratory spikes 10 to 30% of all samples received with known concentrations of uranium and the recovery fraction determined. Results are reported to CBR. All results have been within ± 30%.

Proposed Bioassay Program

CBR proposes to continue to implement the Bioassay Program including urinalysis and *in vivo measurements as* described in this Section in accordance with the guidance contained in USNRC Regulatory Guide 8.22, "*Bioassay in Uranium Mills*, Revision 1" and with the instructions currently contained in EMS Program Volume IV, *Health Physics Manual*~~Standard Operating Procedure C-10, "Bioassay Sampling."~~.

~~5.7.6.~~5.8.6. CONTAMINATION CONTROL PROGRAM

CBRs contamination control program at Crow Butte Uranium Project consists of the following elements:

Surveys For Surface Contamination

CBR performs surveys for surface contamination in operating and clean areas of the Crow Butte Uranium Project facilities in accordance with the guidelines contained in USNRC Regulatory Guide 8.30, "*Health Physics Surveys in Uranium Recovery Facilities*", Revision 1. Surveys for alpha contamination in clean areas such as lunchrooms change rooms and offices are conducted weekly. An action level of 25% of the limits from USNRC Regulatory Guide 8.30 is used for clean areas.

Surveys For Contamination of Skin and Personal Clothing

All personnel leaving the restricted area are required to perform and document alpha contamination monitoring. In addition, personnel who could come in contact with potentially contaminated solutions outside a restricted area such as in the wellfields are required to monitor themselves prior to leaving the area. All personnel receive training in the performance of surveys for skin and personal contamination. Personnel are also allowed to conduct contamination monitoring of small, hand-carried items as long as all surfaces can be reached with the instrument probe and the item does not originate in yellowcake areas. All other items are surveyed as described in the next Section.

As recommended in USNRC Regulatory Guide 8.30, "*Health Physics Surveys in Uranium Recovery Facilities*" Revision 1, CBR conducts quarterly unannounced spot checks of personnel to verify the effectiveness of the surveys for personnel contamination. A spot check of the employees assigned to the mine site is conducted, concentrating on plant operators and maintenance personnel. The purpose of the surveys is to ensure that employees are adequately surveying and decontaminating themselves prior to exiting the restricted areas.

Surveys of Equipment Prior to Release to an Unrestricted Area

Surveys of all items from the restricted areas with the exception of small, hand-carried items described above are performed by the RSO, radiation safety staff or properly trained employees. The release limits are set by "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses For Byproduct, Source, or Special Nuclear Materials", NRC, May 1987 ("Annex B"). Surveys are performed with the following equipment:

1. Portable alpha count rate meter, Ludlum 2245 and a Ludlum 43-65 alpha probe, ~~Eberline MS-3~~ or equivalent.

2. Portable GM survey meter with a beta/gamma probe with an end window thickness of not more than 7 mg/cm^2, ~~Eberline Model ESP-1~~Ludlum Model 3 survey meter with ~~HP-270~~ a Ludlum 44-38 probe or equivalent.

3. Swipes for removable contamination surveys as required.

Historical Program Results

The weekly contamination survey results indicate that the contamination control program at the Crow Butte Uranium Project is effective. The quarterly spot checks performed throughout the period show that the personnel contamination program is effective. Results of the contamination surveys, spot checks and equipment release surveys are maintained at the Crow Butte Uranium Project site.

Proposed Contamination Control Program

CBR proposes to implement the same contamination control program that is currently in use. The program has proven to be effective at controlling contamination of personnel and clean areas. The program will be implemented in accordance with the instructions currently contained in EMS Program Volume IV, *Health Physics Manual*~~the following Standard Operating Procedures:~~

- ~~Survey instruments will be calibrated annually or at the manufacturers recommended frequency, whichever is more frequent. Survey instruments will be checked in accordance with the manufacturer instructions.~~

- ~~Surveys for removable and fixed contamination will be performed in accordance with the instructions contained in Standard Operating Procedure C-3, "Surface Contamination Surveys."~~

~~Surveys for alpha and beta/gamma contamination of items prior to release from restricted areas will be performed in accordance with the~~

~~instructions contained in Standard Operating Procedure C-14, "Equipment Release and Disposal."~~

- ~~Personnel monitoring will be performed in accordance with the instructions contained in Standard Operating Procedure C-17, "Entering and Leaving Restricted Areas."~~

~~5.7.7.~~5.8.7. AIRBORNE EFFLUENT AND ENVIRONMENTAL MONITORING PROGRAMS

Program Description and Historical Monitoring Results

The airborne effluent and environmental monitoring programs are designed to monitor the release of airborne radioactive effluents from the Crow Butte Uranium Project facilities. To evaluate the effectiveness of the effluent control systems, the results of the monitoring program are compared with the background levels and with regulatory limits. Table ~~5.7~~5.8-6 provides the sampling locations, types, frequency, methods, and parameters for the Crow Butte Uranium Project facilities. CBR performs environmental sampling and gamma exposure monitoring as indicated in Table ~~5.7~~5.8-6.

Radon

The radon gas effluent released to the environment is monitored at seven locations (AM-1 through AM-6 and AM-8). Monitoring is performed using Track-Etch radon cups provided by Landauer Corporation. The cups are exchanged on a quarterly basis. CBR received approval from the NRC and has changed the sampling frequency for environmental radon to semiannually effective March 1998. ~~Standard Operating Procedure E-10, "Environmental Radon Sampling and Gamma Exposure Rate Measurement"~~EMS Program Volume VI, *Environmental Manual* currently provides the instructions for radon gas monitoring. In addition to the manufacturer's Quality Assurance program, CBR exposes two duplicate radon Track Etch cups per each monitoring period at locations AB-3 and AB-6. Table ~~5.7~~5.8-7 contains the results of radon monitoring for the Crow Butte Uranium Project facility since 1991.

In addition to the environmental monitoring performed at the Crow Butte Uranium Project, release of radon from process operations is estimated and reported in the semi-annual reports required by 10 CFR § 40.65 and License SUA-1534 Condition Number 12.1. Table ~~5.7~~5.8-8 contains annual calculated radon releases from the Crow Butte Uranium Project Facility since 1991.

Air Particulate

CBR performs low volume air particulate sampling at the seven environmental monitoring stations for a minimum of two weeks per month during dryer operations. Filters are collected and then composited for analysis on a quarterly basis. The results of air particulate sampling performed since 1991 are shown in Table ~~5.7~~5.8-9.

Surface Soil

Surface soil has been sampled as described in Table ~~5.7~~5.8-6. Surface soil samples will be taken at the air monitoring locations following conclusion of operations and will be compared to the results of the preoperational monitoring program.

Subsurface Soil

Subsurface soil has been sampled at the plant as described in Table ~~5.7~~5.8-6. Subsurface soil samples will be taken following conclusion of operations and will be compared to the results of the preoperational monitoring program.

Vegetation

Vegetation samples from Crow Butte Uranium Project were collected on an annual basis in animal grazing areas in the direction of the prevailing wind as described in Table ~~5.7~~5.8-6. Sampling was normally performed during the summer months. The samples were collected using the following procedures:

- A minimum of one pound of vegetation was composited on three occasions during the grazing season. The materials collected were primarily the seed/flower head and leafy portions of grasses and forbes along with young shoots of shrubs. Vegetation was analyzed for natural uranium, radium-226, thorium-230, lead-210 and polonium-210. The results of annual vegetation sampling at the Crow Butte Uranium Project facility are presented in Table ~~5.7~~5.8-10.

Table ~~5.7~~5.8-6: Operational Environmental and Effluent Monitoring Program

Sample Type	Location	Type	Number	Frequency	Analyses
Air (Radon)	Nearest residences and in the prevalent wind direction	Continuous	6	Semiannually	Rn-222
	Environmental control station near Crawford, NE.		1		
Air (particulate)	Same locations as radon air monitoring	Continuous	7	A minimum of 2 weeks per month when dryer is in use	U-nat Ra-226 Pb-210
Surface Soil (top 5 cm)	Plant site before topsoil removal	Grab	2	Once	U-nat Ra-226
	Plant site after topsoil removal	Grab	2	Once	U-nat Ra-226
	Evaporation ponds before excavation	Grab	2	Once	U-nat Ra-226
	Air sampling stations	Grab	7	Once	U-nat Ra-226
Subsurface soil	Plant site	1/3 meter composites to one meter	1	Once	U-nat Ra-226
Groundwater	Water supply wells within 1 km of area wellfield	Grab	1	Quarterly	U-nat Ra-226

Table ~~5.7~~5.8-6: Operational Environmental and Effluent Monitoring Program

Sample Type	Location	Type	Number	Frequency	Analyses
Surface water	Each stream passing through wellfield area (one upstream and one downstream)	Grab	2	Quarterly	U-nat Ra-226
	Each water impoundment in wellfield area	Grab	1	Quarterly	U-nat Ra-226
Direct Radiation	Air sampling stations	Continuous	7	Quarterly exchange of dosimeters	External gamma
Sediment	Each body of water where surface water sampling is performed	Grab upstream and downstream of wellfields	1 or 2	Annually	U-nat Ra-226 Pb-210

Table ~~5.7~~5.8-7: Ambient Radon Gas Monitoring Results (pCi\L)

	MONITORING LOCATION								
MONITORING PERIOD	AM-1	AM-2	AM-3	AM-4	AM-5	AM-6	AM-8	AB-3 (AM-3)	AB-6 (AM-6)
First Quarter, 1991	0.3	0.3	0.5	0.5	0.4	0.5	0.3	0.3	0.4
Second Quarter, 1991	0.3	0.3	0.3	0.5	0.3	0.3	0.3	0.3	0.3
Third Quarter, 1991	0.3	0.6	0.3	0.9	0.4	1.0	0.6	0.3	0.5
Fourth Quarter, 1991	0.3	0.5	0.6	0.9	0.7	0.3	0.4	0.4	0.6
First Quarter, 1992	0.5	0.5	0.5	0.7	0.7	0.6	< 0.3	0.5	0.7
Second Quarter, 1992	0.7	0.4	0.3	0.7	0.4	0.6	0.7	0.6	< 0.3
Third Quarter, 1992	< 0.3	0.3	< 0.3	0.5	0.4	< 0.3	0.5	< 0.3	< 0.3
Fourth Quarter, 1992	0.4	0.4	0.5	0.7	0.9	0.7	0.7	0.6	0.3
First Quarter, 1993	0.5	0.4	0.5	< 0.3	0.5	< 0.3	< 0.3	< 0.3	< 0.3
Second Quarter, 1993	0.4	0.6	< 0.3	0.4	0.5	0.4	0.6	< 0.3	< 0.3
Third Quarter, 1993	0.5	1.0	0.6	1.0	0.6	0.4	0.4	0.4	0.5
Fourth Quarter, 1993	0.7	0.9	0.6	0.6	1.1	0.7	0.8	0.6	0.7
First Quarter, 1994	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Second Quarter, 1994	0.6	0.6	0.4	0.5	0.6	< 0.3	0.6	0.5	0.4
Third Quarter, 1994	0.9	0.7	0.9	0.7	0.8	0.8	0.8	0.5	0.7
Fourth Quarter, 1994	0.5	0.5	0.4	0.5	0.8	0.3	0.7	< 0.3	0.5

Notes: All values are given in units of pCi/L.
Monitoring Locations AB-3 and AB-6 are co-located with stations AM-3 and AM-6.

Table ~~5.7~~5.8-~~8~~: Radon Release to the Environment (Curies)

Year	1991	1992	1993	1994
First Quarter	0	325	600	753
Second Quarter	308	435	637	776
Startup	13	16	11	7
Semi-Annual Total	321	776	1248	1536
Third Quarter	334	527	673	793
Fourth Quarter	329	572	700	808
Startup	0	0	6	16
Semi-Annual Total	663	1099	1379	1617
Annual Total	984	1875	2627	3153

Table ~~5.7~~5.8-9: Environmental Air Particulate Monitoring Results

Station	Period	U-Nat (10^{-16} µCi/ml)	Th-230 (10^{-16} µCi/ml)	Ra-226 (10^{-16} µCi/ml)	Pb-210 (10^{-16} µCi/ml)	Volume of Air Sampled M^3
AM-1	First Quarter, 1991	< 1.00	< 1.00	10.1	175	2810
AM-1	Second Quarter, 1991	< 1.00	< 1.00	2.17	91.2	2610
AM-1	Third Quarter, 1991	4.38	< 1.00	< 1.00	151	2590
AM-1	Fourth Quarter, 1991	9.61	< 1.00	9.98	45.5	2560
AM-1	First Quarter, 1992	< 1.00	< 1.00	1.46	300	2590
AM-1	Second Quarter, 1992	7.33	< 1.00	1.47	88.3	2590
AM-1	Third Quarter, 1992	None	None	None	None	None
AM-1	Fourth Quarter, 1992	None	None	None	None	None
AM-1	First Quarter, 1993	None	None	None	None	None
AM-1	Second Quarter, 1993	None	None	None	None	None
AM-1	Third Quarter, 1993	None	None	None	None	None
AM-1	Fourth Quarter, 1993	17.9	< 1.00	7.63	171	2120
AM-1	First Quarter, 1994	5.56	< 1.00	15.0	187	2220
AM-1	Second Quarter, 1994	5.73	< 1.00	11.9	134	2160
AM-1	Third Quarter, 1994	70.9	<1.00	8.87	193	2140
AM-1	Fourth Quarter, 1994	2.7	<1.00	< 1.00	200	2110
AM-2	First Quarter, 1991	< 1.00	< 1.00	< 1.00	224	2810
AM-2	Second Quarter, 1991	< 1.00	< 1.00	4.34	88.9	2610

Table ~~5.7~~5.8-9: Environmental Air Particulate Monitoring Results

Station	Period	U-Nat (10^{-16} µCi/ml)	Th-230 (10^{-16} µCi/ml)	Ra-226 (10^{-16} µCi/ml)	Pb-210 (10^{-16} µCi/ml)	Volume of Air Sampled M^3
AM-2	Third Quarter, 1991	4.35	< 1.00	< 1.00	99.4	2600
AM-2	Fourth Quarter, 1991	4.81	< 1.00	< 1.00	71.8	2560
AM-2	First Quarter, 1992	2.19	< 1.00	< 1.00	246	2590
AM-2	Second Quarter, 1992	2.56	< 1.00	8.43	99.6	2590
AM-2	Third Quarter, 1992	None	None	None	None	None
AM-2	Fourth Quarter, 1992	None	None	None	None	None
AM-2	First Quarter, 1993	None	None	None	None	None
AM-2	Second Quarter, 1993	None	None	None	None	None
AM-2	Third Quarter, 1993	None	None	None	None	None
AM-2	Fourth Quarter, 1993	9.7	< 1.00	4.85	127	2150
AM-2	First Quarter, 1994	4.2	< 1.00	8.4	205	2260
AM-2	Second Quarter, 1994	6.65	< 1.00	8.42	105	2140
AM-2	Third Quarter, 1994	8.02	< 1.00	4.46	193	2130
AM-2	Fourth Quarter, 1994	5.1	< 1.00	< 1.00	210	2050
AM-3	First Quarter, 1991	< 1.00	< 1.00	< 1.00	266	2810
AM-3	Second Quarter, 1991	< 1.00	< 1.00	4.39	77.5	2580
AM-3	Third Quarter, 1991	58.2	< 1.00	< 1.00	137	2600
AM-3	Fourth Quarter, 1991	4.81	< 1.00	1.48	51.4	2560

Table ~~5.7~~5.8-9: Environmental Air Particulate Monitoring Results

Station	Period	U-Nat (10^{-16} µCi/ml)	Th-230 (10^{-16} µCi/ml)	Ra-226 (10^{-16} µCi/ml)	Pb-210 (10^{-16} µCi/ml)	Volume of Air Sampled M^3
AM-3	First Quarter, 1992	2.19	< 1.00	2.92	141	2580
AM-3	Second Quarter, 1992	< 1.00	< 1.00	1.84	121	2590
AM-3	Third Quarter, 1992	None	None	None	None	None
AM-3	Fourth Quarter, 1992	None	None	None	None	None
AM-3	First Quarter, 1993	None	None	None	None	None
AM-3	Second Quarter, 1993	None	None	None	None	None
AM-3	Third Quarter, 1993	None	None	None	None	None
AM-3	Fourth Quarter, 1993	6.56	< 1.00	4.81	104	2170
AM-3	First Quarter, 1994	14.6	< 1.00	< 1.00	190	2280
AM-3	Second Quarter, 1994	7.45	< 1.00	6.57	129	2170
AM-3	Third Quarter, 1994	4.85	< 1.00	2.20	238	2160
AM-3	Fourth Quarter, 1994	< 1.00	< 1.00	< 1.00	162	2170
AM-4	First Quarter, 1991	< 1.00	< 1.00	4.78	275	2770
AM-4	Second Quarter, 1991	< 1.00	< 1.00	5.11	< 20	2590
AM-4	Third Quarter, 1991	< 1.00	< 1.00	< 1.00	167	2600
AM-4	Fourth Quarter, 1991	4.81	< 1.00	< 1.00	20.7	2560
AM-4	First Quarter, 1992	2.2	< 1.00	< 1.00	178	2580
AM-4	Second Quarter, 1992	< 1.00	< 1.00	< 1.00	63.2	2580

Table ~~5.7~~5.8-9: Environmental Air Particulate Monitoring Results

Station	Period	U-Nat (10^{-16} µCi/ml)	Th-230 (10^{-16} µCi/ml)	Ra-226 (10^{-16} µCi/ml)	Pb-210 (10^{-16} µCi/ml)	Volume of Air Sampled M^3
AM-4	Third Quarter, 1992	None	None	None	None	None
AM-4	Fourth Quarter, 1992	None	None	None	None	None
AM-4	First Quarter, 1993	None	None	None	None	None
AM-4	Second Quarter, 1993	None	None	None	None	None
AM-4	Third Quarter, 1993	None	None	None	None	None
AM-4	Fourth Quarter, 1993	5.86	< 1.00	4.18	156	2270
AM-4	First Quarter, 1994	7.58	< 1.00	1.00	198	2380
AM-4	Second Quarter, 1994	5.79	< 1.00	12.5	114	2130
AM-4	Third Quarter, 1994	10.8	< 1.00	7.17	296	2120
AM-4	Fourth Quarter, 1994	2.67	< 1.00	< 1.00	233	2140
AM-5	First Quarter, 1991	67.7	< 1.00	< 1.00	277	2780
AM-5	Second Quarter, 1991	< 1.00	< 1.00	4.35	< 20	2610
AM-5	Third Quarter, 1991	< 1.00	< 1.00	3.63	160	2600
AM-5	Fourth Quarter, 1991	4.82	< 1.00	1.11	36.6	2560
AM-5	First Quarter, 1992	< 1.00	< 1.00	1.46	178	2590
AM-5	Second Quarter, 1992	2.56	< 1.00	9.52	127	2590
AM-5	Third Quarter, 1992	None	None	None	None	None
AM-5	Fourth Quarter, 1992	None	None	None	None	None

Table ~~5.7~~5.8-9: Environmental Air Particulate Monitoring Results

Station	Period	U-Nat (10^{-16} µCi/ml)	Th-230 (10^{-16} µCi/ml)	Ra-226 (10^{-16} µCi/ml)	Pb-210 (10^{-16} µCi/ml)	Volume of Air Sampled M^3
AM-5	First Quarter, 1993	None	None	None	None	None
AM-5	Second Quarter, 1993	None	None	None	None	None
AM-5	Third Quarter, 1993	None	None	None	None	None
AM-5	Fourth Quarter, 1993	1	< 1.00	1.00	164	2290
AM-5	First Quarter, 1994	12.3	< 1.00	1.00	217	2400
AM-5	Second Quarter, 1994	3.1	< 1.00	12.8	161	2150
AM-5	Third Quarter, 1994	4.9	< 1.00	4.01	252	2130
AM-5	Fourth Quarter, 1994	2.69	< 1.00	1.00	235	2120
AM-6	First Quarter, 1991	23.5	< 1.00	6.12	275	2780
AM-6	Second Quarter, 1991	< 1.00	< 1.00	2.17	< 20	2610
AM-6	Third Quarter, 1991	8.72	< 1.00	< 1.00	129	2600
AM-6	Fourth Quarter, 1991	4.81	< 1.00	< 1.00	76.1	2560
AM-6	First Quarter, 1992	< 1.00	< 1.00	< 1.00	286	2590
AM-6	Second Quarter, 1992	< 1.00	< 1.00	4.02	103	2600
AM-6	Third Quarter, 1992	None	None	None	None	None
AM-6	Fourth Quarter, 1992	None	None	None	None	None
AM-6	First Quarter, 1993	None	None	None	None	None
AM-6	Second Quarter, 1993	None	None	None	None	None

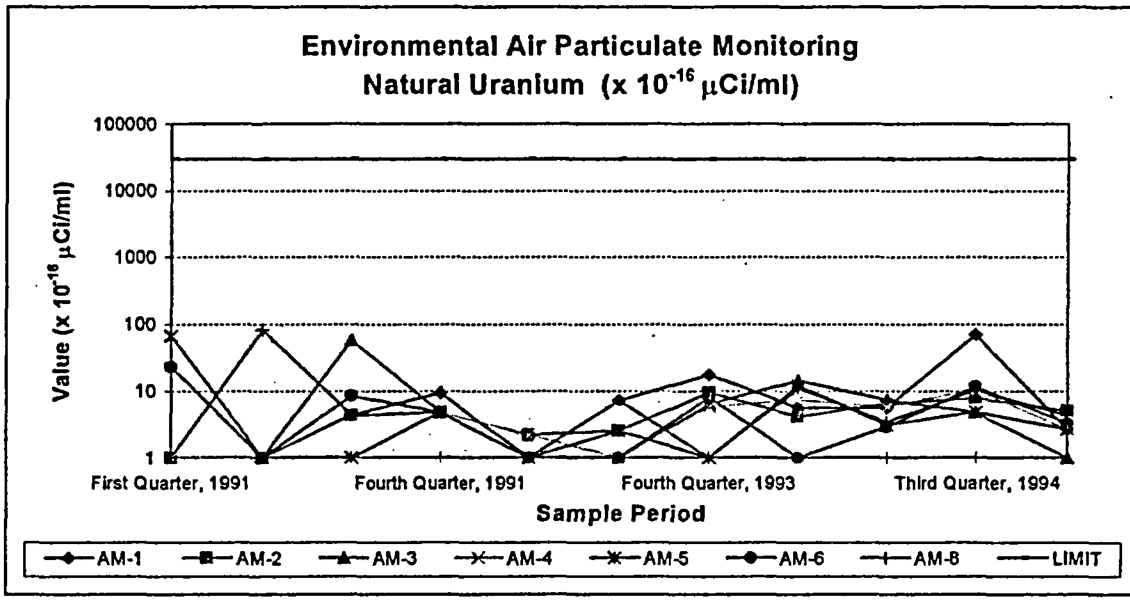
Table ~~5.7~~5.8-9: Environmental Air Particulate Monitoring Results

Station	Period	U-Nat (10^{-16} µCi/ml)	Th-230 (10^{-16} µCi/ml)	Ra-226 (10^{-16} µCi/ml)	Pb-210 (10^{-16} µCi/ml)	Volume of Air Sampled M^3
AM-6	Third Quarter, 1993	None	None	None	None	None
AM-6	Fourth Quarter, 1993	8.27	< 1.00	6.10	146	2180
AM-6	First Quarter, 1994	< 1.00	< 1.00	2.49	173	2290
AM-6	Second Quarter, 1994	2.92	< 1.00	12.5	130	2280
AM-6	Third Quarter, 1994	11.9	< 1.00	2.54	233	2240
AM-6	Fourth Quarter, 1994	3.36	< 1.00	< 1.00	208	2270
AM-8	First Quarter, 1991	< 1.00	< 1.00	6.05	253	2810
AM-8	Second Quarter, 1991	82.5	< 1.00	3.62	< 20	2610
AM-8	Third Quarter, 1991	4.36	< 1.00	< 1.00	109	2600
AM-8	Fourth Quarter, 1991	4.82	< 1.00	1.48	43.4	2560
AM-8	First Quarter, 1992	< 1.00	< 1.00	4.38	290	2590
AM-8	Second Quarter, 1992	7.33	< 1.00	< 1.00	95.7	2590
AM-8	Third Quarter, 1992	None	None	None	None	None
AM-8	Fourth Quarter, 1992	None	None	None	None	None
AM-8	First Quarter, 1993	None	None	None	None	None
AM-8	Second Quarter, 1993	None	None	None	None	None
AM-8	Third Quarter, 1993	None	None	None	None	None
AM-8	Fourth Quarter, 1993	1.00	< 1.00	2.11	173	2250

Table ~~5.7~~5.8-9: Environmental Air Particulate Monitoring Results

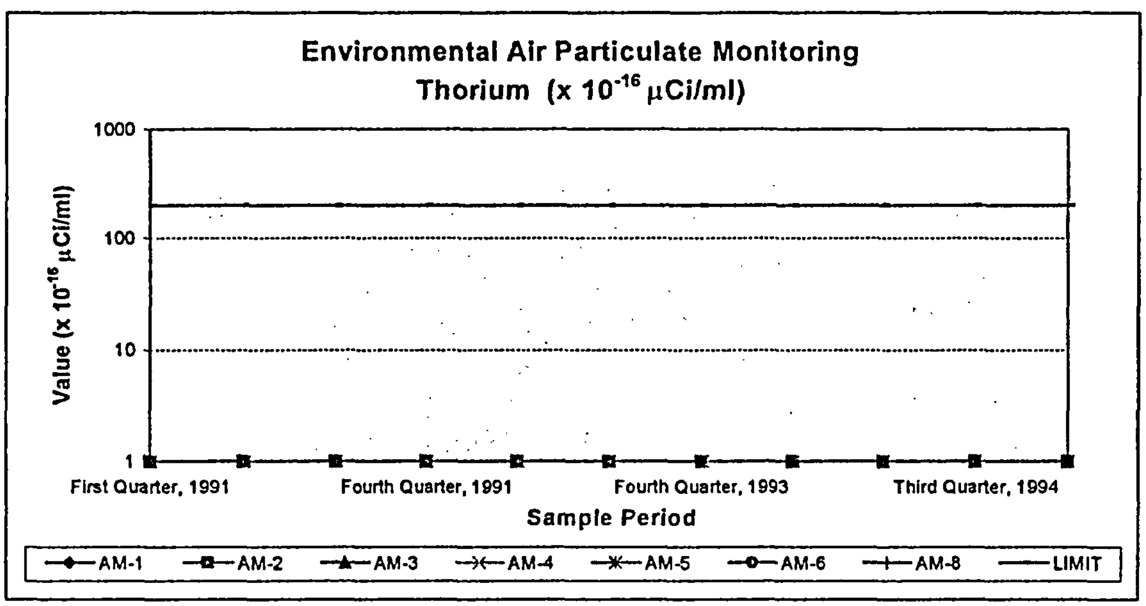
Station	Period	U-Nat (10^{-16} µCi/ml)	Th-230 (10^{-16} µCi/ml)	Ra-226 (10^{-16} µCi/ml)	Pb-210 (10^{-16} µCi/ml)	Volume of Air Sampled M^3
AM-8	First Quarter, 1994	11.3	< 1.00	33.9	147	2360
AM-8	Second Quarter, 1994	3.51	< 1.00	57.4	149	2170
AM-8	Third Quarter, 1994	10.6	< 1.00	4.85	317	2160
AM-8	Fourth Quarter, 1994	4.36	< 1.00	< 1.00	165	2180

Figure ~~5.7~~5.8-2: Environmental Air Particulate Monitoring Trend Natural Uranium (x 10^{-16} μCi/ml)



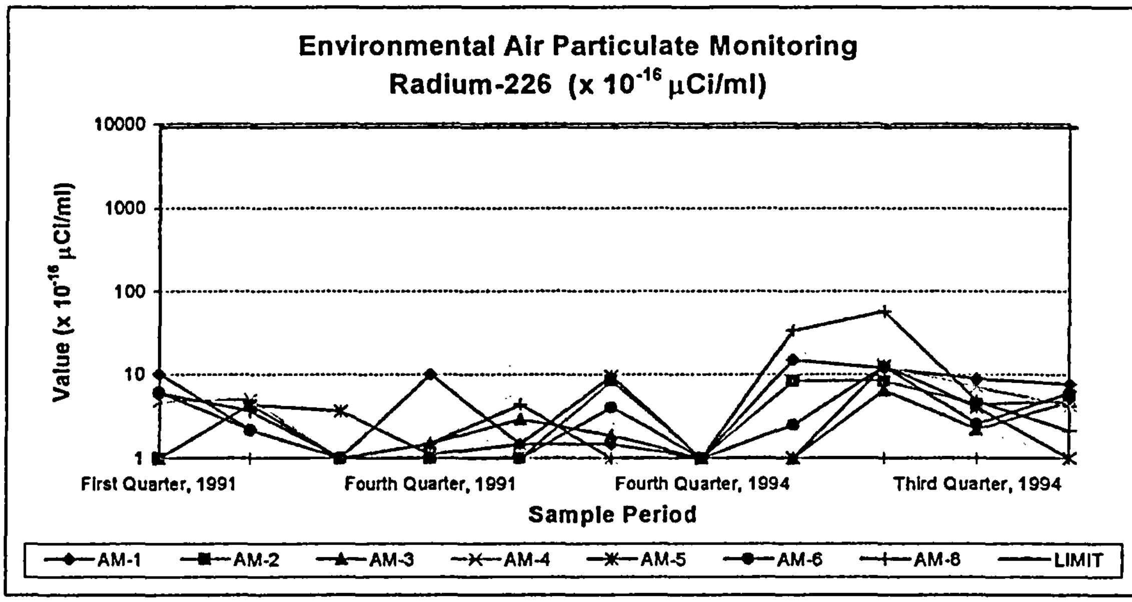
Appendix B to 10 CFR 20.1001 - 20.2401 Table 2 Effluent Concentration in Air Limit is 3.0 x 10^{-12} μCi/ml. This chart is presented on a log scale to accommodate this limit.

Figure ~~5.7~~5.8-3: Environmental Air Particulate Monitoring Trend Thorium (x 10^{-16} μCi/ml)



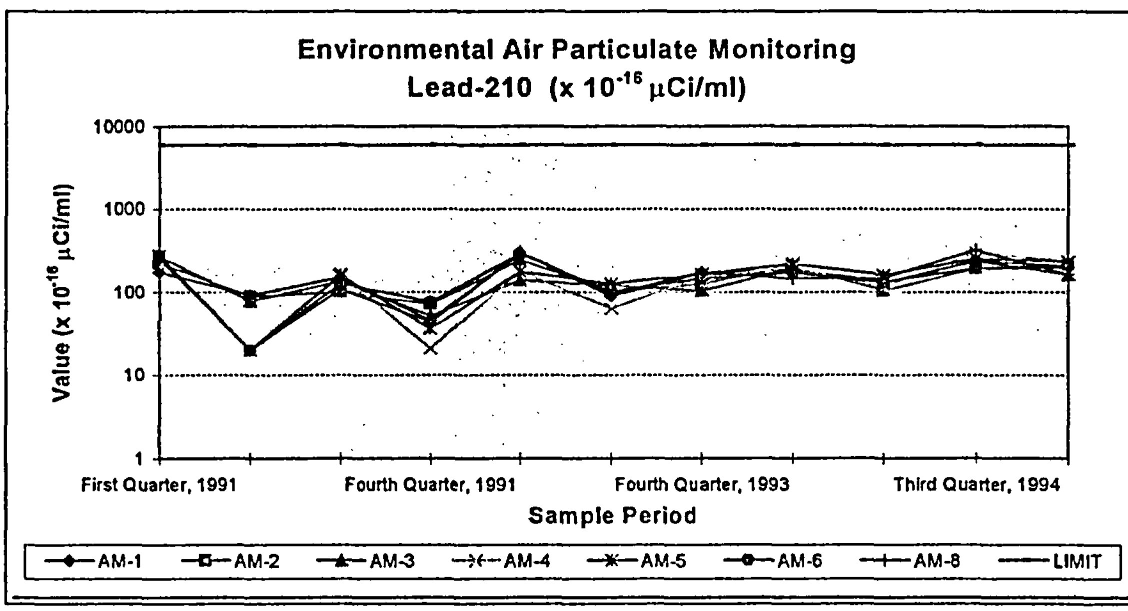
Appendix B to 10 CFR 20.1001 - 20.2401 Table 2 Effluent Concentration in Air Limit is 2.0 x 10^{-14} μCi/ml. This chart is presented on a log scale to accommodate this limit.

Figure ~~5.7~~5.8-4: Environmental Air Particulate Monitoring Trend Radium-226 (x 10^{-16} µCi/ml)



Appendix B to 10 CFR 20.1001 - 20.2401 Table 2 Effluent Concentration in Air Limit is 9.0 x 10^{-13} µCi/ml. This chart is presented on a log scale to accommodate this limit.

Figure ~~5.7~~5.8-5: Environmental Air Particulate Monitoring Lead-210 (x 10^{-16} µCi/ml)

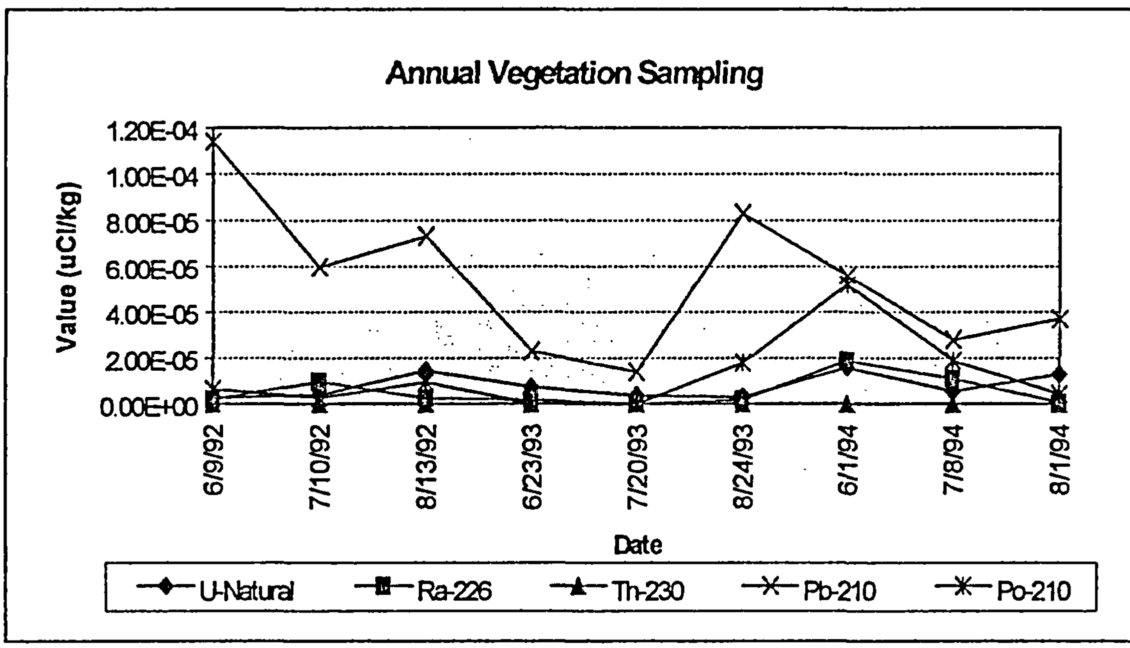


Appendix B to 10 CFR 20.1001 - 20.2401 Table 2 Effluent Concentration in Air Limit is 6.0 x 10^{-13} µCi/ml. This chart is presented on a log scale to accommodate this limit.

Table ~~5.7~~5.8-10: Annual Vegetation Sampling Program Results

SAMPLE DATE	U-Natural uCi/kg	Ra-226 uCi/kg	Th-230 uCi/kg	Pb-210 uCi/kg	Po-210 uCi/kg
6/9/92	2.90E-06	2.16E-06	< 1.00E-07	1.14E-04	6.44E-06
7/10/92	4.06E-06	9.67E-06	< 9.67E-08	5.98E-05	2.76E-06
8/13/92	1.47E-05	2.71E-06	9.34E-09	7.34E-05	9.43E-06
6/23/93	7.30E-06	1.80E-06	< 7.50E-08	2.30E-05	< 3.80E-07
7/20/93	3.90E-06	< 3.10E-08	< 3.10E-08	1.40E-05	< 1.60E-07
8/24/93	3.10E-06	1.80E-06	1.70E-08	8.30E-05	1.80E-05
6/1/94	1.60E-05	1.90E-05	< 8.00E-08	5.60E-05	5.20E-05
7/8/94	5.70E-06	1.10E-05	< 6.00E-08	2.80E-05	1.90E-05
8/1/94	1.30E-05	7.00E-07	< 4.30E-08	3.70E-05	4.40E-06

Figure ~~5.7~~5.8-6: Annual Vegetation Sampling Trend



Direct Radiation

Environmental gamma radiation levels are monitored continuously at the seven air quality monitoring stations. Gamma radiation is monitored using dosimeters obtained from a qualified vendor. Environmental dosimeters are exchanged on a quarterly basis. Results of the annual gamma radiation monitoring are shown in Table ~~5.7~~5.8-11.

Sediment

Sediment in Squaw Creek was sampled at two locations on a semiannual basis for one year prior to any construction in the area. Samples have been taken as described in Table ~~5.7~~5.8-6 annually. Samples are taken upstream and downstream of the Crow Butte Uranium Project site and analyzed for natural uranium, radium-226, thorium-230, and lead-210. The results of sediment sampling are shown in Table ~~5.7~~5.8-12.

Proposed Airborne Effluent and Environmental Monitoring Program

CBR proposes to continue to implement the Airborne Effluent and Environmental Monitoring Program described in this Section with the following changes.

- CBR has eliminated vegetation sampling in accordance with the provisions of USNRC Regulatory Guide 4.14, "*Radiological Effluent and Environmental Monitoring at Uranium Mills*". Footnote (o) to Table 2 requires that "vegetation and forage sampling need be carried out only if dose calculations indicate that the ingestion pathway from grazing animals is a potentially significant exposure pathway..." defined as a pathway which would expose an individual to a dose in excess of 5% of the applicable radiation protection standard. This pathway was evaluated by MILDOS-Area and is discussed further in Section 7.3.

- CBR has changed the frequency of radon detector exchange from quarterly to semiannually. This change will allow CBR to meet the 0.2 pCi/l sensitivity recommended in Regulatory Guide 4.14 and meet the reporting requirements from 10 CFR 40.65 and annual dose requirements from 10 CFR Part 20.

- CBR has discontinued analysis for thorium-230 in air particulate and sediment samples. The design of the vacuum dryer and historical data over seven years of commercial operation have been one percent or less of the 10 CFR 20 limit. Sediment concentrations have also been consistently low.

Table ~~5.7~~5.8-11: Area Monitoring Results (mRem)

DATE	1000	1001	1002	1003	1005	1006	1007	1008	1009	1010	1011	1012
	CONT	AM-1	AM-2	AM-6	R&D	WELL	WELL	AM-8	AM-3	AM-4	AM-5	COMM
4/24/91	23.8	30.2	30.6	30	29.2	31.8	34	28	28.2	31.2	33	
7/11/91	27.6	29.4	27.6	26.6	28.6	32.2	31.6	27.4	30	30.2	28.2	30.6
10/10/91	23.8	30.8	27.2	25.8	29.6	34.4	31.4	23.2	30.8	30.2	29.2	29
1/14/92	36.2	43.2	43.4	46.6	44	41.4	54.8	41.6	45.2	41.8	46.6	40.4
4/16/92	26.6	30	31.8	30.6	29.8	34	34	41.8		34.2	35	32.2
7/9/92	34.6	30.4	29.6	31	32	33	32.4	29.8	32.6	30.2	33.2	31
10/14/92	35.8	31.4	32.6	30	31.2	30.4	33.4	27.4	36.2	31.6	30.6	33
1/13/93	36.4	28.2	33.4	32.6	35	35.4	39.8	35.4	33.6	30.4	35.6	31.2
4/16/93	42.6	38.4	34	33.6	37	35.8	40.6	33.2	32.4	36.8	36.8	33.6
7/13/93	43.6	29.2	31.6	30.8	29.8	34.4	34.4	31	31.6	25.8	33.6	30.8
10/11/93	39.8	29	27.2	27.6	31.6	29.8	32.8	26.4	31.4	30	28	26.4
1/14/94	49.4	35.8	32	34.2	34.4	38.4	33.8	32.2	33.2	29.8	32.2	44.4
4/15/94	46.8	33	32.6	42.2	32.2	27.2	40	36.2	40.2	16.4	39.4	35.4
7/19/94	59.2	35.8	37	36.8	38.6	42.6	45.8	36	38.2	43.2	40	41.2
10/14/94	57.2	29.8	29.4	39.6	38.8	16	32.8	32.2	36.8	35.8	39.2	37.2

Sample Locations: 1000: Control 1005: R&D Pond Gate 1006: Wellfield
1007: Wellfield 1012: Commercial Pond Gate

Figure ~~5.7~~5.8-7: Area Monitoring Trend (mRem)

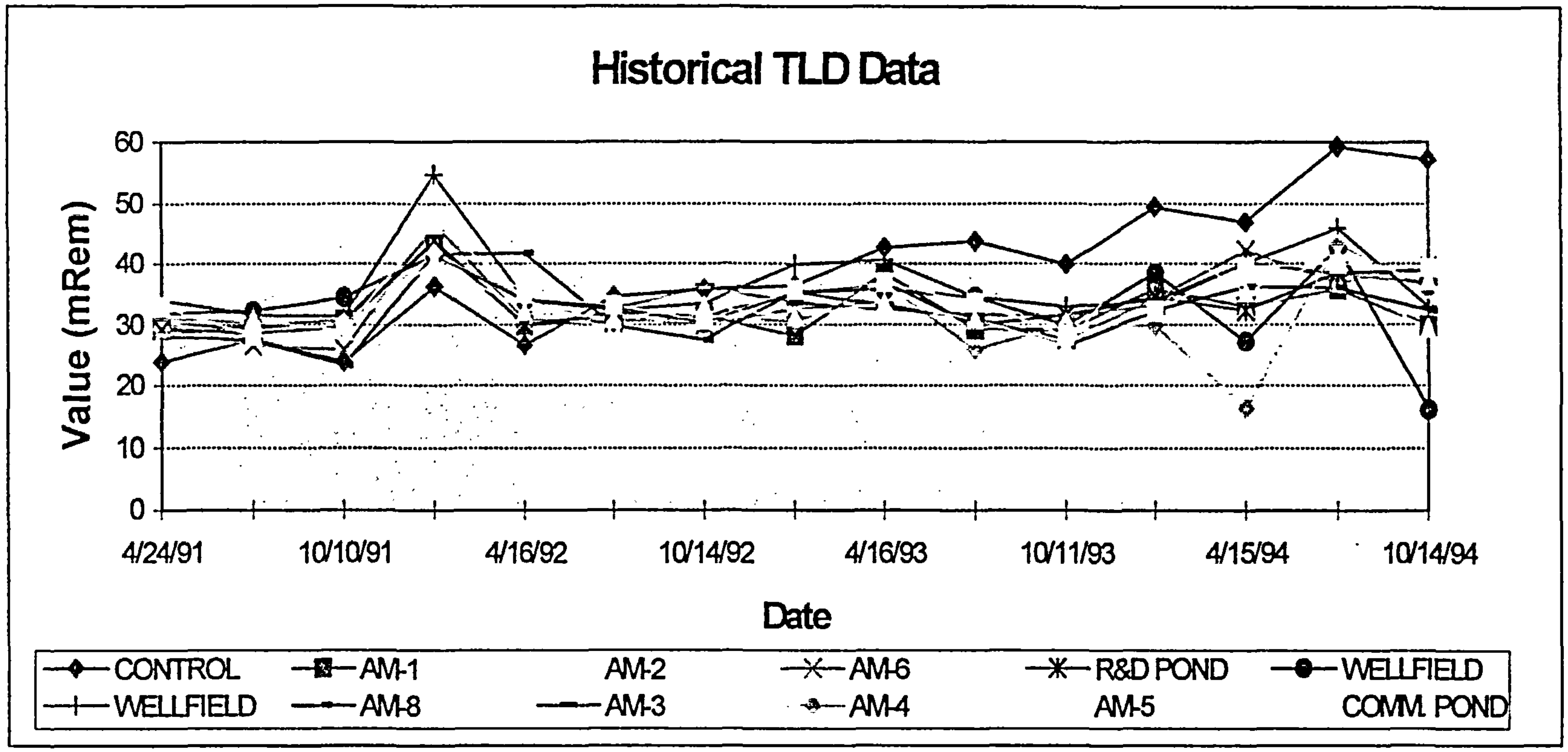


Table ~~5.7~~5.8-12: Annual Sediment Sampling Results

Station	Date	U-Natural pCi/g	Radium-226 pCi/g	Th-230 pCi/g	Pb-210 pCi/g
S-2	11/5/92	0.5	0.1		
	11/5/93	< 0.2	0.7	< 0.2	0.3
	10/13/94	0.5	0.4	0.4	1.9
S-3	11/5/92	0.3	0.1		
	11/5/93	0.1	0.4	< 0.2	0.3
	10/13/94	0.3	0.4	< 0.2	1.4

Notes: No analysis done for Th-230 and Pb-210 in 1992.

Figure ~~5.7~~5.8-8: Annual Sediment Sampling Trend- Location S-2

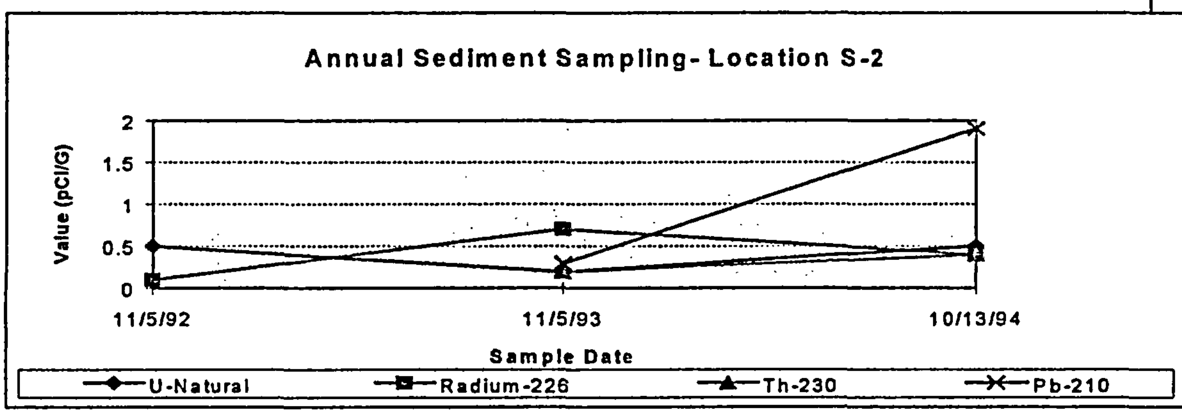
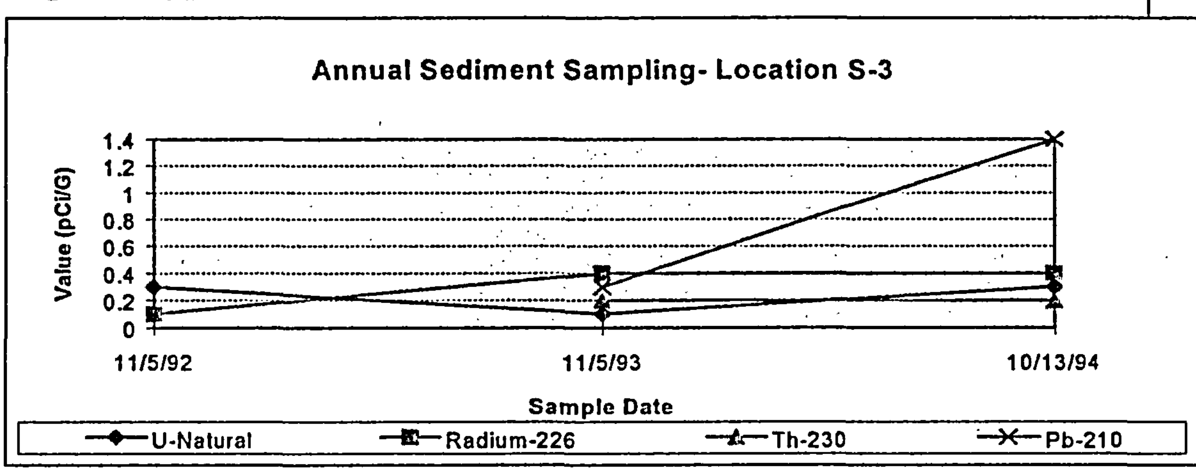


Figure ~~5.7~~5.8-9: Annual Stream Sediment Sampling Trend- Location S-3



~~5.7.8.~~5.8.8. GROUNDWATER/SURFACE WATER MONITORING PROGRAM

Program Description

During operations at the Crow Butte Uranium Project facilities, a detailed water-sampling program is conducted to identify any potential impacts to water resources of the area. CBRs operational water monitoring program includes the evaluation of groundwater on a regional basis, groundwater within the permit or licensed area and surface water on a regional and site specific basis. An overview of the groundwater and surface water monitoring programs at the Crow Butte Uranium Project can be found in Table ~~5.7~~5.8-6.

~~5.7.8.1.~~5.8.8.1. GROUNDWATER MONITORING

The groundwater excursion-monitoring program is designed to detect excursions of lixiviant into the ore zone aquifer outside of the wellfield being leached and into the overlying water bearing strata. The Pierre Shale below the ore zone is over 1200 feet thick and contains no water bearing strata. Therefore, it is not necessary to monitor any water bearing strata below the ore zone.

All private wells and surface waters within one kilometer of the wellfield area boundary are sampled on a quarterly basis. Surface water samples are taken in accordance with the instructions contained in ~~Standard Operating Procedure E-5, "Routine Groundwater Monitoring."~~EMS Program Volume VI, *Environmental Manual.* Samples are analyzed for natural uranium and radium-226. The results of this sampling ~~since~~ from 1991 to 1994 for uranium are shown in Table ~~5.7~~5.8-13 and for radium in Table ~~5.7~~5.8-14.

Monitor Well Baseline Water Quality

After delineation of the production unit boundaries, monitor wells are installed approximately 300 feet from the wellfield boundary. After completion, wells are washed out and developed (by air flushing or pumping) until water quality in terms of pH and specific conductivity appear stable and consistent with the anticipated quality of the area. After development, wells are sampled to obtain baseline water quality. For baseline sampling, all wells are purged until field parameters are stable. Quarterly monitor well results are shown for uranium in Table ~~5.7~~5.8-15 and for radium in Table ~~5.7~~5.8-16. All monitor wells including ore zone and overlying monitor wells are sampled three times at least 14 days apart. The first, second and third samples are analyzed for the excursion indicator parameters (~~sodium,~~ chloride, ~~sulfate,~~ conductivity, and alkalinity). CBR analyzes one sample for the baseline parameters shown in Table ~~5.7~~5.8-17.

Results from the samples are averaged arithmetically to obtain a baseline value as well as an average value for determine upper control limits for excursion detection.

Upper Control Limits and Excursion Monitoring

After baseline water quality is established for the monitor wells for a particular production unit, upper control limits (UCLs) are set for certain chemical constituents which would be indicative of a migration of lixiviant from the well field. The constituents chosen for indicators of lixiviant migration and for which UCLs are set are chloride, conductivity, ~~sodium, sulfate,~~ and total alkalinity. Chloride was chosen due to its low natural levels in the native groundwater and because chloride is introduced into the lixiviant from the ion exchange process (uranium is exchanged for chloride on the ion exchange resin). Chloride is also a very mobile constituent in the groundwater and will show up very quickly in the case of a lixiviant migration to a monitor well. Conductivity was chosen because it is an excellent general indicator of overall groundwater quality. Total alkalinity concentrations should be affected during an excursion, as bicarbonate is the major constituent added to the lixiviant during mining. Water levels are obtained and recorded prior to each well sampling. However, levels were not used as an excursion indicator. All wells are purged until field parameters are stable prior to collection of the sample. Upper control limits are set at 20% above the maximum baseline concentration for the excursion indicator. For excursion indicators with a baseline average below 50 mg/l, the UCL may be determined by adding 5 standard deviations or 15 mg/l to the baseline average for the indicator.

Operational monitoring consists of sampling the monitor wells no more than 14 days apart and analyzing the samples for the excursion indicators chloride, conductivity, ~~sodium, sulfate~~ and total alkalinity. In special circumstances including inclement weather, wellhead mechanical failure, conditions which place an employee at risk while sampling, and conditions which could cause damage to the environment if sampling was performed, the sampling could be delayed by a period not to exceed 5 days. The circumstances requiring postponement of the sampling will be documented.

Excursion Verification and Corrective Action

During routine sampling, if two of the ~~five~~three UCL values are exceeded in a monitor well, or if one UCL value is exceeded by 20 percent, the well is resampled within 48 hours and analyzed for the excursion indicators. If the second sample does not exceed the UCLs, a third sample is taken within 48. If neither the second or third sample results exceeded the UCLs, the first sample is considered in error.

If the second or third sample verifies an exceedance, the well in question is placed on excursion status. Upon verification of the excursion, the USNRC Project Manager is notified by telephone within ~~24~~48 hours and notified in writing within ~~seven (7)~~thirty (30) days.

If an excursion is verified, the following methods of corrective action are instituted (not necessarily in the order given; dependent upon the circumstances):

- A preliminary investigation is completed to determine the probable cause.
- Production and/or injection rates in the vicinity of the monitor well are adjusted as necessary to increase the net over recovery, thus forming a hydraulic gradient toward the production zone.
- Individual wells are pumped to enhance recovery of mining solutions.

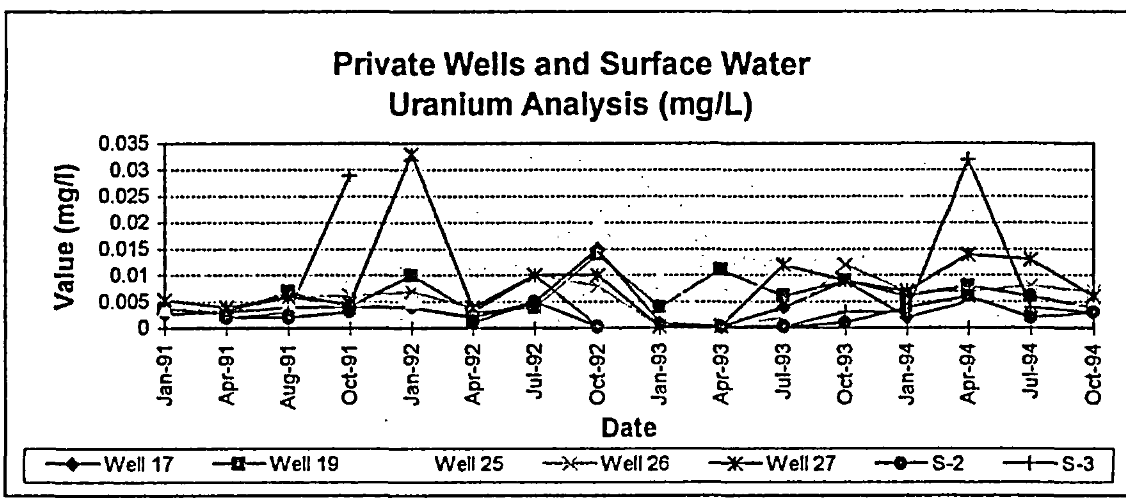
Injection into the well field area adjacent to the monitor well may be suspended. Recovery operations continue thus increasing the overall bleed rate and the recovery of wellfield solutions.

In addition to the above corrective actions, sampling frequency of the monitor well on excursion status is increased to weekly. An excursion is considered concluded when the concentrations of excursion indicators do not exceed the criteria defining an excursion for three consecutive one-week samples.

Table ~~5.7~~5.8-13: Private Wells and Surface Water Monitoring Results Uranium Analysis (mg/L)

Date	Well 17	Well 19	Well 25	Well 26	Well 27	S-2	S-3
Jan-91	0.0027	0.0036	0.0036	0.0045	0.0054		
Apr-91	0.003	0.003	0.014	0.003	0.004	0.002	0.002
Aug-91	0.0039	0.0069	0.0049	0.0059	0.0059	0.002	0.003
Oct-91	0.0041	0.0041	0.0041	0.0062	0.0047	0.0031	0.029
Jan-92	0.004	0.01	0.005	0.007	0.033		
Apr-92	0.002	0.003	0.004	0.004	0.004	0.001	0.003
Jul-92	0.005	0.004	0.008	0.01	0.01	0.005	0.01
Oct-92	0.015	0.014	0.02	0.008	0.01	< 0.0003	<0.0003
Jan-93	0.001	0.004	0.01	< 0.0003	< 0.0003		
Apr-93	< 0.0003	0.011	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
Jul-93	0.004	0.006	0.013	0.002	0.012	< 0.0003	< 0.0003
Oct-93	0.009	0.009	0.008	0.012	0.009	0.001	0.003
Jan-94	0.002	0.006	0.025	0.007	0.007	0.004	0.003
Apr-94	0.005	0.008	0.005	0.007	0.014	0.006	0.032
Jul-94	0.003	0.006	0.003	0.008	0.013	0.002	0.004
Oct-94	0.005	0.004	0.005	0.007	0.006	0.003	0.003

Figure ~~5.7~~5.8-10: Private Wells and Surface Water Trend-Uranium Analysis (mg/L)

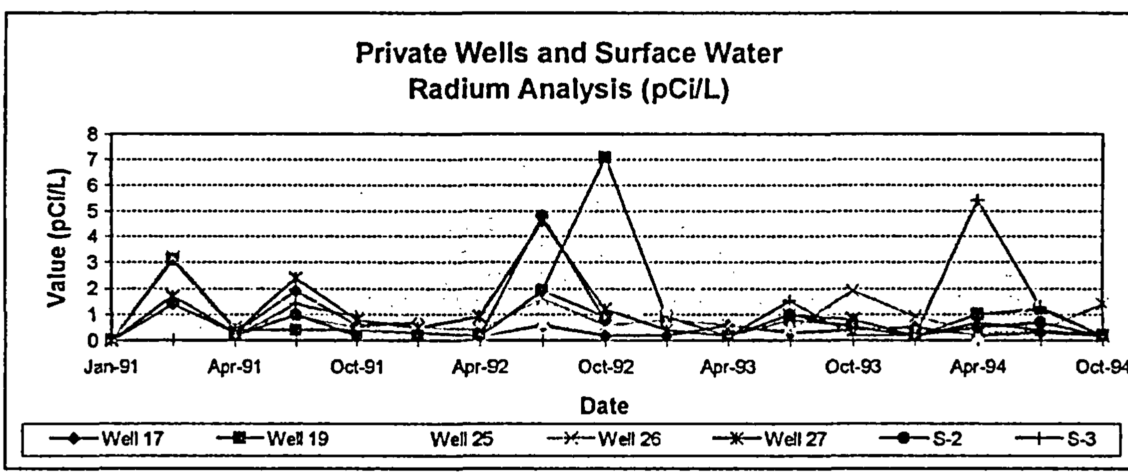


Note: Gaps in chart are due to missing data points.

Table ~~5.7~~5.8-14: Private Wells and Surface Water Monitoring Results Radium Analysis (pCi/L)

Date	Well 17	Well 19	Well 25	Well 26	Well 27	S-2	S-3
Jan-91	1.4	3.1	2	3.2	1.7		
Apr-91	0.3	0.4	2.3	0.5	0.3	< 0.2	< 0.2
Aug-91	1.9	0.4	1.3	0.9	2.4	1	1.4
Oct-91	0.6	0.4	1.7	0.5	0.8	0.2	0.9
Jan-92	0.7	0.3	0.7	0.5	0.5		
Apr-92	< 0.2	< 0.2	< 0.2	0.4	0.9	< 0.2	< 0.2
Jul-92	0.6	1.9	0.7	1.6	4.6	4.8	1.9
Oct-92	< 0.2	7.1	0.8	0.6	1.2	0.8	0.9
Jan-93	< 0.2	0.9	1.2	0.8	0.4		
Apr-93	< 0.6	< 0.2	2.7	0.6	< 0.2	< 0.2	< 0.2
Jul-93	< 0.3	0.8	0.5	0.4	1	1	1.5
Oct-93	< 0.4	0.6	0.5	1.9	0.8	0.5	< 0.2
Jan-94	0.5	< 0.2	0.3	0.9	< 0.2	< 0.2	< 0.2
Apr-94	0.2	1	0.2	0.3	0.7	0.5	< 5.4
Jul-94	0.3	1.2	1.5	0.4	0.4	0.7	1.3
Oct-94	< 0.2	< 0.2	< 0.2	1.4	< 0.2	< 0.2	< 0.2

Figure ~~5.7~~5.8-11: Private Wells and Surface Water Trend Radium Analysis (pCi/L)



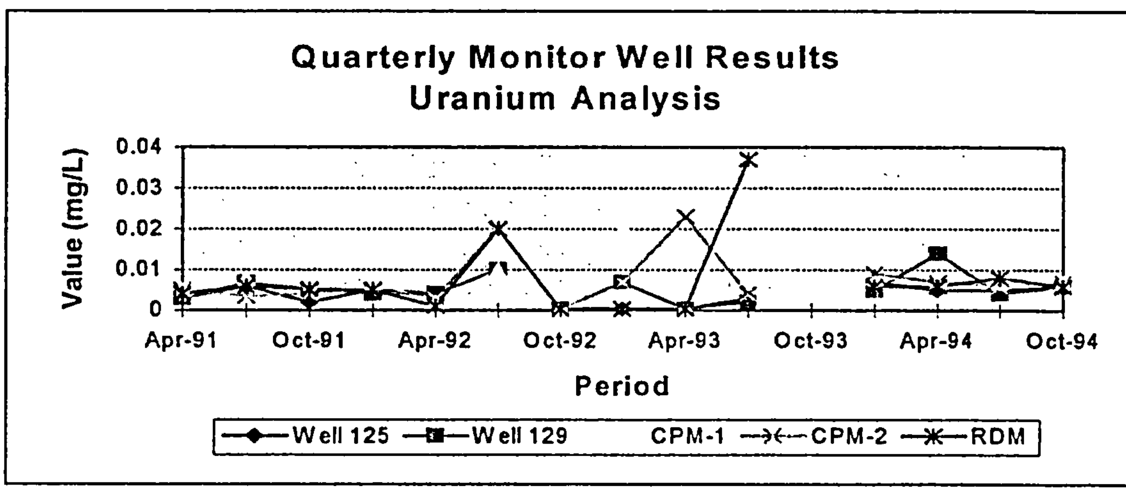
Note: Gaps in chart are due to missing data points.

Table ~~5.7~~5.8-15: Quarterly Monitor Well Results
Uranium Analysis (mg/L)

Date	Well 125	Well 129	CPM-1	CPM-2	RDM
Apr-91	0.003	0.003	0.005	0.005	0.004
Aug-91	0.0059	0.0069	0.0079	0.0035	0.0059
Oct-91	0.0021	0.0052	0.0073	0.0041	0.0052
Jan-92	0.005	0.004	0.007	0.005	0.005
Apr-92	0.004	0.004	0.002	0.003	0.001
Jul-92	0.01	0.01	0.01	0.02	0.02
Oct-92	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
Jan-93	< 0.0003	0.007	0.02	0.007	< 0.0003
Apr-93	< 0.0003	< 0.0003	< 0.0003	0.023	< 0.0003
Jul-93	0.003	0.002	0.008	0.004	0.037
Oct-93					
Jan-94	0.007	0.005	0.008	0.009	0.006
Apr-94	0.005	0.014	0.008	0.007	0.006
Jul-94	0.005	0.004	0.007	0.006	0.008
Oct-94	0.006	0.006	0.007	0.007	0.006

Notes:
CPM-1 is the Commercial Pond No. 1 Monitor Well.
CPM-2 is the Commercial Pond No. 2 Monitor Well.
RDM is the Research and Development Pond Monitor Well.

Figure ~~5.7~~5.8-12: Quarterly Monitor Well Trend
Uranium Analysis (mg/L)



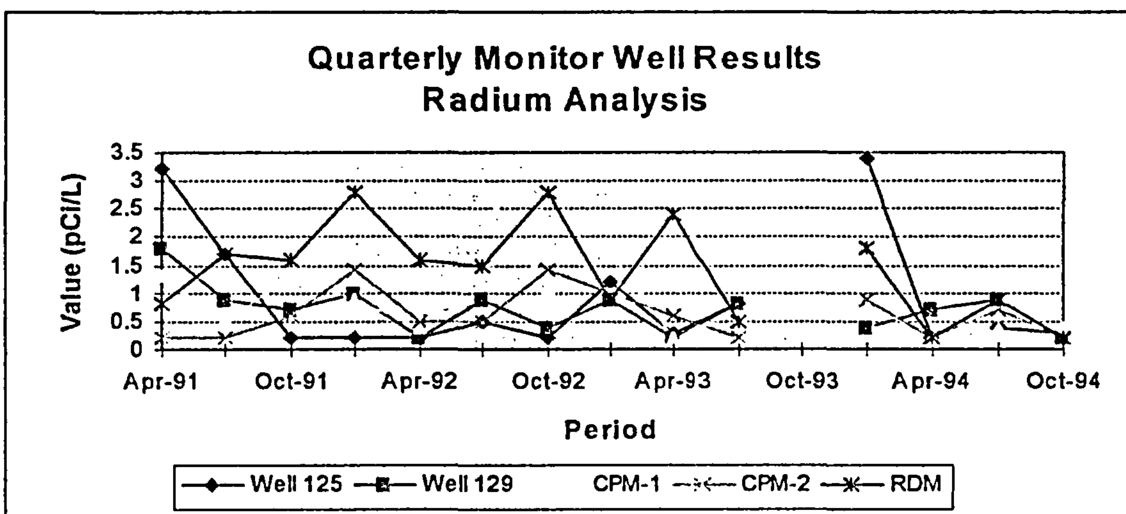
Note: Gaps in chart are due to missing data points.

**Table ~~5.7~~5.8-16: Quarterly Monitor Well Results
Radium Analysis (pCi/L)**

Date	Well 125	Well 129	CPM-1	CPM-2	RDM
Apr-91	3.2	1.8	1.3	< 0.2	0.8
Aug-91	1.7	0.9	0.5	< 0.2	1.7
Oct-91	0.2	0.7	1.3	0.6	1.6
Jan-92	< 0.2	1	0.9	1.4	2.8
Apr-92	< 0.2	< 0.2	0.4	0.5	1.6
Jul-92	0.5	0.9	2.9	0.5	1.5
Nov-92	< 0.2	0.4	1.1	1.4	2.8
Jan-93	1.2	0.9	1.7	1	0.9
Apr-93	0.3	< 0.2	< 0.2	0.6	2.4
Jul-93	0.8	0.8	< 0.2	< 0.2	0.5
Oct-93					
Jan-94	3.4	0.4	0.8	0.9	1.8
Apr-94	< 0.2	0.7	< 0.2	< 0.2	0.2
Jul-94	0.4	0.9	0.4	0.7	0.9
Oct-94	0.3	< 0.2	0.4	< 0.2	< 0.2

Notes: CPM-1 is the Commercial Pond Monitor No. 1 Well.
CPM-2 is the Commercial Pond Monitor No. 2 Well.
RDM is the R&D Pond Monitor Well.

**Figure ~~5.7~~5.8-13: Quarterly Monitor Well Trend
Radium Analysis (pCi/L)**



Note: Gaps in chart are due to missing data points.

Table ~~5.7~~5.8-17: Baseline Water Quality Indicators

Physical Indicators

Specific Conductivity	Alkalinity	Total Dissolved
Temperature	pH	Solids

Common Constituents

Ammonia	Chloride	Silica
~~Bicarbonate~~	Magnesium	Sodium
Calcium	Nitrate	Sulfate
Total Carbonate	Nitrite	Potassium

Trace and Minor Elements

Arsenic	Fluoride	Nickel
~~Boron~~	Iron	Selenium
Barium	Lead	Vanadium
Cadmium	Manganese	Zinc
~~Chromium~~	Mercury	
Copper	Molybdenum	

Radionuclides

Radium-226	Uranium

~~5.7.8.2.~~5.8.8.2. SURFACE WATER MONITORING

The pre-operational water quality-monitoring program assessed water quality and quantity for Squaw Creek. CBR samples two surface water locations for Squaw Creek. The CBR SERP approved Mine Unit 6 on March 6, 1998. This expansion required that the downstream Squaw Creek monitoring location be relocated. The new sample point was designated as S-5. Sampling at the previous downstream location, S-3 was discontinued.

With the approval of Mine Unit 6, operational surface water sampling was also begun at the English Creek upstream and downstream locations. The upstream sample is a composite of the springs that are the sources of English Creek and were identified as E-1 and E-2 during the preoperational monitoring program. Preoperational monitoring location E-3 was not used for downstream monitoring since its location is well beyond the Mine Unit 6 wellfield. Instead, a new downstream location designated E-4 was chosen immediately outside the Mine Unit boundary and sampling was begun.

With the addition of Mine Unit 8, downstream sampling on English Creek was moved to location E-5. Additionally, the expansion to Mine Unit 8 ~~will~~ requires sampling of the impoundments identified as I-3 and I-4 in the preoperational monitoring program when ~~it is~~they are located within the wellfield. Samples from all locations are obtained quarterly. Surface water samples are analyzed for the parameters given in Table ~~5.7~~5.8-6. Surface monitoring results are submitted in the semi-annual activity and monitoring reports submitted to NRC. A summary table of regional surface water monitoring results can be found in Table ~~5.7~~5.8-13 and Table ~~5.7~~5.8-14.

~~5.7.8.3.~~5.8.8.3. EVAPORATION POND LEAK DETECTION MONITORING

The evaporation ponds are lined and equipped with a leak detection system. During operations, the leak detection standpipes are checked for evidence of leakage. Visual inspection of the pond embankments, fences, and liners and the measurement of pond freeboard are also performed during normal operations. A minimum freeboard of 5 feet is allowed for the commercial ponds during normal operations. Anytime six (6) inches or more of fluid is detected in a leak detection system standpipe, it is analyzed for specific conductivity. Should the analyses indicate that the liner is leaking (by comparison to chemical analyses of pond water), the following actions are taken:

- The USNRC Project Manager is notified by telephone within 48 hours of leak verification.

- The level of the leaking pond is lowered by transferring its contents into an adjacent pond. While lowering the water level in the pond, inspections of the liner are made to determine the cause and location of the leakage. The area of investigation first centers on the pond area specific for the particular standpipe that contains fluid.

- Once the source of the leakage is found, the liner is repaired and water is reintroduced to the pond.

- A written report is submitted to the USNRC within 30 days of leak verification. The report includes analytical data and describes the cause of the leakage, corrective actions taken and the results of those actions.

~~5.7.9.~~5.8.9. QUALITY ASSURANCE PROGRAM

A quality assurance program is in place at Crow Butte Uranium Project for all relevant operational monitoring and analytical procedures. The objective of the program is to identify any deficiencies in the sampling techniques and measurement processes so that corrective action can be taken and to obtain a level of confidence in the results of the monitoring programs. The QA program provides assurance to both regulatory agencies and the public that the monitoring results are valid.

The QA program addresses the following:

- Formal delineation of organizational structure and management responsibilities. Responsibility for both review/approval of written procedures and monitoring data/reports is provided.

- Minimum qualifications and training programs for individuals performing radiological monitoring and those individuals associated with the QA program.

- Written procedures for QA activities. These procedures include activities involving sample analysis, calibration of instrumentation, calculation techniques, data evaluation, and data reporting.

- Quality control (QC) in the laboratory. Procedures cover statistical data evaluation, instrument calibration, and duplicate and spike sample programs. Outside laboratory QA/QC programs are included.

- Provisions for periodic management audits to verify that the QA program is effectively implemented, to verify compliance with applicable rules, regulations and license requirements, and to protect employees by maintaining effluent releases and exposures ALARA.

The ~~Standard Operating Procedures~~EMS Program developed by CBR ~~are~~is a critical step to insuring that quality assurance objectives are met. Current ~~SOPs~~ procedures exist for a variety of areas, including but not limited to:

1. Environmental monitoring procedures.
2. Testing procedures.
3. Exposure procedures.
4. Equipment operation and maintenance procedures.
5. Employee health and safety procedures.
6. Incident response procedures.
7. Laboratory procedures.

~~5.7.10.~~5.8.10. MONITORING PROGRAM SUMMARY

Section ~~5.7~~5.8 of this renewal application has reviewed the radiological monitoring data produced at Crow Butte Uranium Project for the years of 1990 through 1994. Each Section has discussed the historical results of the data with an emphasis on regulatory compliance and trend analysis to determine whether CBRs ALARA goals are being met. Where the data indicated that some adjustments in the monitoring program were indicated, CBR has noted those changes in the "Proposed Program" portion of each Section. In order to aid the reviewer in comparing the elements of the current monitoring program with those of the proposed program, Table ~~5.7~~5.8-18 provides a tabular summary of both programs as well as the regulatory guidance provided in USNRC Regulatory Guide 8.30, "*Health Physics Surveys In Uranium Recovery Facilities*", Revision 1.

Table ~~5.7~~5.8-18: Radiological Monitoring Program Summary

Type of Survey	Type of Area	Current Frequency	Proposed Frequency	Reg. Guide 8.30 Recommended Frequency
Airborne Uranium	• Airborne radioactivity areas • Other indoor process areas • Special maintenance involving high airborne concentrations of yellowcake	• Weekly grab samples[1] • Monthly grab samples • Extra breathing zone grab samples	• Weekly grab samples[1] • Monthly grab samples • Extra breathing zone grab samples	• Weekly grab samples • Monthly grab samples • Extra breathing zone grab samples
Radon daughters	• Areas that exceed 0.08WL • Areas that exceed 0.03WL • Areas below 0.03WL	• Weekly radon daughter grab samples • Monthly radon daughter grab samples • Monthly radon daughter grab samples	• Weekly radon daughter grab samples • Monthly radon daughter grab samples • Monthly radon daughter grab samples	• Weekly radon daughter grab samples • Monthly radon daughter grab samples • Quarterly radon daughter grab samples
External radiation: gamma	• Throughout mill • Radiation areas	• Semiannually • Quarterly	• Semiannually • Quarterly	• Semiannually • Quarterly
External radiation: beta	• Where workers are in close contact with yellowcake	• Survey by operation done once plus whenever procedures change	• Survey by operation done once plus whenever procedures change	• Survey by operation done once plus whenever procedures change
Surface contamination	• Yellowcake areas • Eating rooms, change rooms, control rooms, office	• Daily walkthrough • Weekly	• Daily walkthrough • Weekly	• Daily • Weekly
Skin and personal clothing	• Yellowcake workers who shower • Yellowcake workers who do not shower	• Each exit from controlled area[2] • Each exit from controlled area[2]	• Each exit from controlled area[2] • Each exit from controlled area[2]	• Quarterly • Each day before leaving
Equipment to be released	• Equipment to be released that may be contaminated	• Detailed survey before release	• Detailed survey before release	• Once before release

Table ~~5.7~~5.8-18: Radiological Monitoring Program Summary

Type of Survey	Type of Area	Current Frequency	Proposed Frequency	Reg. Guide 8.30 Recommended Frequency
Packages containing yellowcake	• Packages	• Detailed survey before release	• Detailed survey before release	• Spot check before release
Ventilation	• All areas with airborne radioactivity	• Daily walkthrough	• Daily walkthrough	• Daily
Respirators	• Respirator face pieces and hoods	• Before reuse	• Before reuse	• Before reuse

Notes: [1] Increased sampling frequency based upon administrative action level of 25% of the MPC or DAC; Sampling is performed in the dryer room during dryer operation.
[2] All employees required to survey upon exit; Quarterly spot checks of >25% process staff also conducted.

mobilized. As the plant is operated in the pH range of 6.5 to 9.0, mobilization of the organics and coloring of the leach solution is avoided.

6.1.3 RESTORATION GOALS

The primary goal of the groundwater restoration program is to return groundwater affected by mining operations to baseline values on a mine unit average. The secondary goal is to return the groundwater to a quality consistent with premining use or uses. The restoration values set by the Nebraska Department of Environmental Quality (NDEQ) in the UIC Permit are these secondary goals. Restoration values for each mine unit have been specified by the NDEQ for groundwater restoration efforts. Prior to mining in each mine unit, baseline groundwater quality is determined. This data is established in each mine unit at the minimum density of one production or injection well per four acres.

The baseline data support establishment of the upper control limits and restoration standards for each mine unit. The upper control limits and restoration standards for each Mine Unit, beginning with Mine Unit 6, are determined by the Safety and Environmental Review Panel (SERP) during the approval process for the new Mine Unit. The NDEQ restoration values are established as the average plus two standard deviations for any parameter that exceeds the applicable drinking water standard. If a drinking water standard exists for a parameter, and baseline is below that standard, the drinking water standard is used to establish the restoration value. If there is no drinking water standard for an element, for example vanadium, the restoration value will be based on best practicable technology. The restoration value for the major cations (Ca, Mg, K, Na) should allow for the concentrations of these cations to vary by as much as one order of magnitude as long as the TDS restoration value is met. The total carbonate restoration criteria should allow for the total carbonate to be less than 50% of the TDS. The TDS restoration value is set at the average plus one standard deviation.

Mine Unit restoration values are contained in Tables 6.1-1 through 6.1-~~8~~9 as follows:

- Mine unit averages and secondary goals for Mine Units 1 through 5 are given in Tables 6.1-1 through 6.1-5. These restoration values were approved by NRC based on submittals before operation of the Mine Unit.
- The mine unit average and NDEQ restoration values for Mine Unit 6 are given in Table 6.1-6. The CBR SERP determined these restoration values on March 4, 1998.
- The mine unit average and NDEQ restoration values for Mine Unit 7 are given in Table 6.1-7. The CBR SERP determined these restoration values on July 9, 1999.

Before the water can be processed by the reverse osmosis unit, the soluble uranium must be removed by the ion exchange system. The water is then filtered, the pH lowered for decarbonation to prevent calcium carbonate plugging of the membranes, and then pressurized by a pump. The reverse osmosis unit contains membranes which pass about 60 to 75 percent of the water through, leaving 60 to 90 percent of the dissolved salts in the water that will not pass the membrane. Table 6.1-11 shows typical manufacturers specification data for removal of ion constituents. The clean water, called permeate, will be re-injected, sent to storage for use in the mining process, or sent to the waste disposal system. The twenty-five to forty percent of water that is rejected, referred to as the brine, contains the majority of dissolved salts that contaminate the groundwater and is sent for disposal in the wastewater system.

The sulfide reductant that may be added to the injection stream during this stage will reduce the oxidation-reduction potential (Eh) of the aquifer. During mining operations certain trace elements are oxidized. By adding a reductant, the Eh of the aquifer is lowered thereby decreasing the solubility of these elements. A comprehensive safety plan regarding reductant use will be implemented should it be utilized.

The number of pore volumes treated and re-injected during the groundwater treatment stage will depend on the efficiency of the reverse osmosis unit in removing total dissolved solids and the reductant in lowering the uranium and trace element concentrations.

~~6.1.5STABILIZATION PHASE~~

~~Upon completion of restoration, a groundwater stabilization monitoring program will begin in which the restoration wells and any monitor wells on excursion status during the mining operations will be sampled and assayed. Sampling frequency will be one sample per month for a period of six months, and if all six samples show that restoration values for all wells are maintained during the stabilization period, restoration shall be deemed complete.~~

6.1.5 STABILIZATION PHASE

Upon completion of restoration, a groundwater stabilization monitoring program will begin in which the restoration wells and any monitor wells on excursion status during mining operations will be sampled and analyzed for the restoration parameters. Sampling frequency will be one sample per month for a period of 6 months. The stabilization data will be reviewed to determine whether the restoration goals are met and for significant increasing trends in the monitored parameters. The stabilization samples will be collected on the following schedule:

6.1.5.1 INITIAL STABILIZATION SAMPLE

CBR will sample and analyze discrete grab samples from each individual restoration well during the post-restoration (i.e., first round of stabilization) sampling. These samples will be analyzed for the restoration parameters. A physical composite sample will also be prepared from the individual well samples as discussed in Section 6.1.5.2 and included with the discrete grab samples for analysis.

6.1.5.2 SUBSEQUENT STABILIZATION SAMPLES

In subsequent monthly stabilization sampling, each designated restoration well will be sampled. A composite sample of these individual well samples will be prepared in the CBR laboratory and submitted to the contract laboratory for analysis of the restoration parameters. The individual samples from the restoration wells will be properly preserved and retained at the CBR laboratory until analytical results are received from the contract laboratory. If the analytical results indicate increasing trends in any monitored parameter(s), individual well samples may be sent to the contract laboratory to determine whether the changes are due to increases in specific areas of the mine unit.

In addition to the composite sampling, CBR will analyze the discrete grab samples from each individual restoration well approximately three months after the post-restoration (i.e., first round of stabilization) sampling. A physical composite sample of the individual wells will also be included with these discrete grab samples.

6.1.5.3 FINAL STABILIZATION SAMPLE

During the final stabilization sample, CBR will sample and analyze discrete grab samples from each individual restoration well for the restoration parameters. A physical composite sample will also be prepared from the individual well samples as discussed in Section 6.1.5.2 and included with the discrete grab samples for analysis.

6.1.5.4 STABILIZATION DETERMINATION

The data from the stabilization period will be evaluated to confirm that the mine unit has remained stable during the monitoring period. If the stabilization samples show that the restoration standards are met during the stabilization period and that there are no significant increasing trends, restoration shall be deemed complete.

If one or more of the monitored constituents exhibit significant increasing trends after the 6-month stability monitoring period, quarterly grab sample monitoring will continue until no significant increasing trends are observed or until continued restoration is initiated. Individual monitored constituents that exhibit no significant increasing trends after the 6-month stability monitoring period may be removed from the sampling plan upon approval by the regulatory agency.

6.1.6 REPORTING

During the restoration process, Crow Butte Resources will perform daily, weekly, and monthly analysis as needed to track restoration progress. These analyses will be provided to NDEQ in Monthly Restoration Reports and the USNRC in the Semiannual Radiological Effluent and Environmental Monitoring Report. This information will also be included in the final restoration report.

Upon completion of restoration activities and before stabilization, all designated restoration wells in the mine unit will be sampled for the restoration parameters. Analytical results will be reviewed by the CBR SERP. If restoration activities have returned the wellfield average of the restoration parameters to concentrations at or below the standards approved by the NRC in License Condition 10.3, the CBR SERP will recommend initiation of the stabilization phase of restoration. The results of restoration and notification of the initiation of the Stabilization Stage will be submitted to the NDEQ. The NDEQ Director will either accept or deny initiation of stabilization based on the results of restoration. If approved by the NDEQ Director and the CBR SERP, the Stabilization Stage will be initiated. SERP evaluations are summarized in an annual report to the NRC.

During stabilization, all designated restoration wells will be sampled monthly and analyzed according to the schedule in Section 6.1.5. At the end of a six-month stabilization period, CBR will compile all water quality data obtained during restoration and stabilization and submit a final report to the regulatory agencies.

If one or more of the monitored constituents exhibit significant increasing trends after the 6-month stability monitoring period, additional stabilization monitoring will be performed as discussed in Section 6.1.5.4. When all parameters are stable and the restoration criteria is met as discussed in Section 6.1.5, CBR will submit final reports to the regulatory agencies and request that the mine unit be declared restored.

~~Upon completion of restoration activities and prior to stabilization, all designated restoration wells in the mine unit will be sampled for the required constituents listed in Tables 6.1-1 through 6.1-9. These samples may be split with NDEQ if required. Assay results will be submitted to NDEQ and USNRC as required. If restoration activities have returned the wellfield average of restoration parameters to concentrations at or below those approved by the regulatory agencies, Crow Butte Resources will notify the regulatory agencies it is commencing the stabilization phase of restoration.~~

~~During stabilization all designated restoration wells will be sampled monthly for the required constituents listed in Table 6.1-1 through 6.1-9. At the end of a six month stabilization period Crow Butte Resources will compile all water quality data obtained during restoration and stabilization and submit a final report to the regulatory agencies. At that time, Crow Butte Resources would request that the mine unit be declared restored.~~

6.4.2 FINAL SURETY ARRANGEMENTS

Crow Butte Resources maintains a NRC-approved financial surety arrangement consistent with 10 CFR 40, Appendix A, Criterion 9 to cover the estimated costs of reclamation activities. Crow Butte maintains an Irrevocable Letter of Credit ~~No. 0748/S17668~~ issued by the Royal Bank of Canada during ~~2002~~2003 in favor of the State of Nebraska in the present amount of $~~12,355,260~~14,909,670.

CROW BUTTE RESOURCES, INC.

License Renewal Application

Affected Pages (replacement pages)

2004 SERP Actions

Proposed License Renewal Application Page Changes

(Replacement Pages Version)

5. OPERATIONS

Crow Butte Resources, Inc. (CBR) operates a commercial scale in-situ leach uranium mine (the Crow Butte Uranium Project) near Crawford, Nebraska. CBR maintains a headquarters in Denver, Colorado where site-licensing actions originate. All CBR operations, including the Crow Butte Uranium Project operations, are conducted in conformance with applicable laws, regulations, and requirements of the various regulatory agencies. The responsibilities described below have been designed to both ensure compliance and further implement CBRs policy for providing a safe working environment with cost effective incorporation of the philosophy of maintaining radiation exposures as low as is reasonably achievable (ALARA).

5.1. CORPORATE ORGANIZATION/ADMINISTRATIVE PROCEDURES

CBR will maintain a performance-based approach to the management of the environment and employee health and safety, including radiation safety. The Environmental Management System (EMS) Program encompasses licensing, compliance, environmental monitoring, industrial hygiene, and health physics programs under one umbrella, and it includes involvement for all employees from the individual worker to senior management. This EMS program will allow CBR to operate efficiently and maintain an effective environment, health and safety program.

Figure 5.1-1 is a partial organization chart for CBR with respect to the operation of the Crow Butte Uranium Project and associated operations and represents the management levels that play a key part in the EMS Program. The personnel identified are responsible for the development, review, approval, implementation, and adherence to operating procedures, radiation safety programs, environmental and groundwater monitoring programs as well as routine and non-routine maintenance activities. These individuals may also serve a functional part of the Safety and Environmental Review Panel (SERP) described under Section 5.3.3.

Specific responsibilities of the organization are provided below.

5.1.1. BOARD OF DIRECTORS

The Board of Directors has the ultimate responsibility and authority for radiation safety and environmental compliance for CBR. The Board of Directors sets corporate policy and provides procedural guidance in these areas. The Board of Directors provides operational direction to the President of CBR.

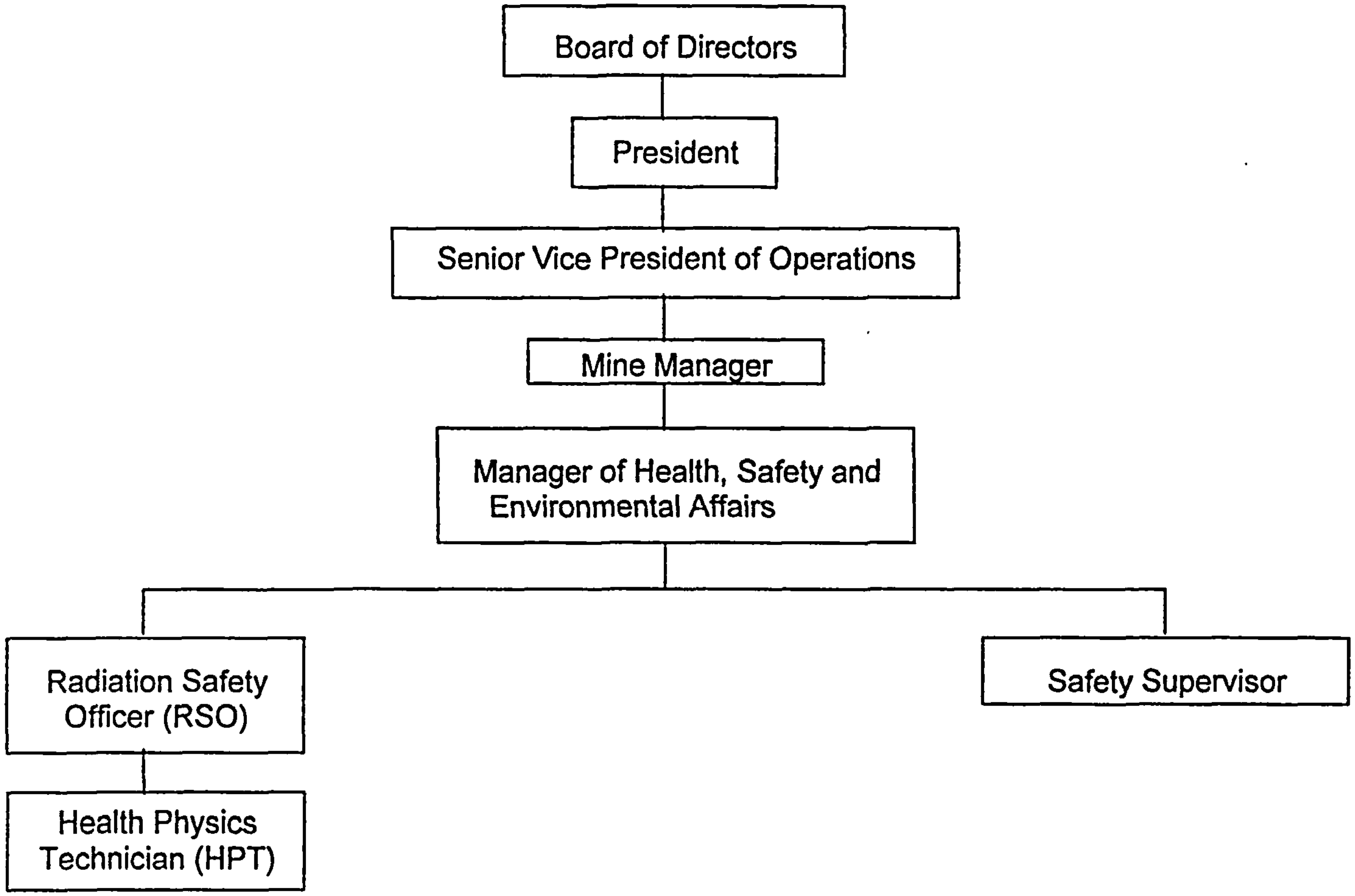
5.1.2. PRESIDENT

The President is responsible for interpreting and acting upon the Board of Directors policy and procedural decisions. The President directly supervises the Senior Vice President of Operations. The President is empowered by the Board of Directors to have the responsibility and authority for the radiation safety and environmental compliance programs. The President is responsible for ensuring that the operations staff is complying with all applicable regulations and permit/license conditions through direct supervision of the Senior Vice President of Operations.

5.1.3. SENIOR VICE PRESIDENT - OPERATIONS

The overall responsibility for the radiation, environmental, and safety activities of the Crow Butte Facility rests with the Senior Vice President of Operations. The Senior Vice President of Operations reports to the President and is directly responsible for ensuring that CBR personnel comply with industrial safety, radiation safety, and environmental protection programs as established in the EMS Program. The Senior Vice President of Operations is also responsible for company compliance with all regulatory license conditions/stipulations, regulations and reporting requirements. The Senior Vice President of Operations has the responsibility and authority to terminate immediately any activity that is determined to be a threat to employees or public health, the environment, or potentially a violation of state or federal regulations. The Senior Vice President of Operations is also responsible for license development and license modifications.

Figure 5.1-1: Crow Butte Resources Organizational Chart



5.1.4. MINE MANAGER

The Mine Manager is responsible for all uranium production activity at the project site. The Mine Manager is also responsible for implementing any industrial and radiation safety and environmental protection programs associated with operations. The Mine Manager is authorized to immediately implement any action to correct or prevent hazards. The Mine Manager has the responsibility and the authority to suspend, postpone or modify, immediately if necessary, any activity that is determined to be a threat to employees, public health, the environment, or potentially a violation of state or federal regulations. The Mine Manager cannot unilaterally override a decision for suspension, postponement or modification if that decision is made by the Senior Vice President of Operations and/or the Manager of Health, Safety and Environmental Affairs. The Mine Manager reports directly to the Senior Vice President of Operations.

5.1.5. MANAGER OF HEALTH, SAFETY, AND ENVIRONMENTAL AFFAIRS

The Manager of Health, Safety, and Environmental Affairs is responsible for all radiation protection, health and safety, and environmental programs as stated in the EMS Program and for ensuring that CBR complies with all applicable regulatory requirements. The Manager of Health, Safety, and Environmental Affairs reports directly to the Mine Manager and supervises the RSO to ensure that the radiation safety and environmental monitoring and protection programs are conducted in a manner consistent with regulatory requirements. This position assists in the development and review of radiological and environmental sampling and analysis procedures and is responsible for routine auditing of the programs. The Manager of Health, Safety, and Environmental Affairs has no production-related responsibilities. The Manager of Health, Safety, and Environmental Affairs also has the responsibility to advise the Senior Vice President of Operations on matters involving radiation safety and to implement changes and/or corrective actions involving radiation safety authorized by the Senior Vice President of Operations.

5.1.6. RADIATION SAFETY OFFICER

The RSO is responsible for the development, administration, and enforcement of all radiation safety programs. The RSO 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 RSO is responsible for the implementation of all on-site environmental programs, including emergency procedures. The RSO inspects facilities to verify compliance with all applicable requirements in the areas of radiological health and safety. The RSO works closely with all supervisory personnel to insure that established programs are maintained. The RSO is also responsible for the collection and interpretation of employee exposure related monitoring, including data from radiological safety. The RSO makes recommendations to improve any and all radiological safety related controls. The RSO has no production-related responsibilities. The RSO will report to the Manager of Health, Safety, and Environmental Affairs

5.1.7. HEALTH PHYSICS TECHNICIAN

The Health Physics Technician (HPT) assists the RSO with the implementation of the radiological and industrial safety programs. The HPT is responsible for the orderly collection and interpretation of all monitoring data, to include data from radiological safety and environmental programs. The HPT reports directly to the RSO.

5.1.8. SAFETY SUPERVISOR

The Safety Supervisor is responsible for the non-radiation related health and safety programs. The Safety Supervisor is authorized to conduct inspections and to immediately order any change necessary to preclude or eliminate safety hazards and/or maintain regulatory compliance. Responsibilities include the development and implementation of health and safety programs in compliance with Mine Safety and Health Administration (MSHA) regulations. Responsibilities of the Safety Supervisor include development of industrial safety and health programs and procedures, coordination with the RSO where industrial and radiological safety concerns are interrelated, safety and health training of new and existing employees, and the maintenance of appropriate records to document compliance with regulations. The Safety Supervisor may also be a qualified HPT and may function in that capacity when needed. The Safety Supervisor reports directly to the Manager of Health, Safety and Environmental Affairs.

5.2. ALARA POLICY

The purpose of the ALARA (As Low As Reasonably Achievable) Policy is to keep exposures to all radioactive materials and other hazardous material as low as possible and to as few personnel as possible, taking into account the state of technology and the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to the utilization of atomic energy in the public interest.

In order for an ALARA Policy to correctly function, all individuals including management, supervisors, health physics staff, and workers, must take part in and share responsibility for keeping all exposures as low as reasonably achievable. This policy addresses this need and describes the responsibilities of each level in the organization.

5.2.1. MANAGEMENT RESPONSIBILITIES

Consistent with Regulatory Guide 8.31 *Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Recovery Facilities Will Be As Low As Reasonably Achievable* (Revision 1, May 2002), the licensee management is responsible for the development, implementation, and enforcement of applicable rules, policies, and procedures as directed by regulatory agencies and company policies. These shall include the following:

1 The development of a strong commitment to and continuing support of the implementation and operations of the ALARA program;
2 An Annual Audit Program which reviews radiation monitoring results, procedural, and operational methods;
3 A continuing evaluation of the Health Physics Program including adequate staffing and support; and
4 Proper training and discussions that address the ALARA program and its function to all facility employees and, when appropriate, to contractors and visitors.

5.2.2. RADIATION SAFETY OFFICER RESPONSIBILITY

The RSO shall be charged with ensuring the technical adequacy of the radiation protection program, implementation of proper radiation protection measures, and the overall surveillance and maintenance of the ALARA program. The RSO shall be assigned the following:

1. The responsibility for the development and administration of the ALARA program;
2. Sufficient authority to enforce regulations and administrative policies that affect any radiological aspect of the EMS Program;
3. Assist with the review and approval of new equipment, process changes or operating procedures to ensure that the plans do not adversely affect the radiological aspects of the EMS Program;
4. Maintain equipment and surveillance programs to assure continued implementation of the ALARA program;

5. Assist with conducting an Annual ALARA Audit as discussed in Section 5.4.4 to determine the effectiveness of the program and make any appropriate recommendations or changes as may be dictated by the ALARA philosophy;
6. Review annually all existing operating procedures involving or potentially involving any handling, processing, or storing of radioactive materials to ensure the procedures are ALARA and do not violate any newly established or instituted radiation protection practices; and
7. Conduct or designate daily inspections of pertinent facility areas to observe that general radiation control practices, hygiene, and housekeeping practices are in line with the ALARA principle.

5.2.3. SUPERVISOR RESPONSIBILITY

Supervisors shall be the front line for implementing the ALARA program. Each supervisor shall be trained and instructed in the general radiation safety practices and procedures. Their responsibilities include:

1. Adequate training to implement the general philosophy behind the ALARA program;
2. Provide direction and guidance to subordinates in ways to adhere to the ALARA program;
3. Enforcement of rules and policies as directed by the EMS Program, which implement the requirements of regulatory agencies and company management; and
4. Seeking additional help from management and the RSO should radiological problems be deemed by the supervisor to be outside their sphere of training.

5.2.4. WORKER RESPONSIBILITY

Because success of both the radiation protection and ALARA programs are contingent upon the cooperation and adherence to those policies by the workers themselves, the facility employees must be responsible for certain aspects of the program in order for the program to accomplish its goal of keeping exposures as low as possible. Worker responsibilities include:

1. Adherence to all rules, notices, and operating procedures as established by management and the RSO through the EMS Program;
2. Making valid suggestions which might improve the radiation protection and ALARA programs;
3. Reporting promptly, to immediate supervisor, any malfunction of equipment or violation of procedures which could result in an increased radiological hazard;

4. Proper use of protective equipment;
5. Proper performance of required contamination surveys.

5.3. MANAGEMENT CONTROL PROGRAM

5.3.1. ENVIRONMENTAL MANAGEMENT SYSTEM

CBR's Environmental Management System (EMS) Program formalizes the Company's approach to environmental, health, and safety management to ensure consistency across its operations. The EMS Program is a key element in assuring that all employees demonstrate "due diligence" in addressing environmental, health, and safety issues and describes how the operations of the facility will comply with the requirements of the CBR Environmental, Health, and Safety Policy (EH&S) Policy and regulatory requirements.

The CBR EMS Program:

1. Assures that sound management practices and processes are in place to ensure that strong environmental, health, and safety performance is sustainable.
2. Clearly sets out and formalizes the expectations of management.
3. Provides a systematic approach to the identification of issues and ensures that a system of risk identification and management is in place.
4. Provides a framework for personal, site and corporate responsibility and leadership.
5. Provides a systematic approach for the attainment of CBR's objectives.
6. Ensures continued improvement of programs and performance.

The EMS Program has the following characteristics:

1. The system is compatible with the ISO 14001 Environment Management System.
2. The system is straightforward in design and is intended as an effective management tool for all types of activities and operations, and is capable of implementation at all levels of the organization.
3. The system is supported by standards that clearly spell out CBR's expectations, while leaving the means by which these are attained as a responsibility of line management.
4. The system is readily auditable.
5. The system is designed to provide a practical tool to assist the operations in identifying and achieving their objectives while satisfying CBR's governance requirements.

The EMS Program uses a series of standards that align with specific management processes and sets out the minimum expectations for performance. The standards consist of management processes that consist of assessment, planning, implementation (including training, corrective actions, safe work programs, and emergency response), checking (including auditing, incident investigation, compliance management, and reporting), and management review.

5.3.1.1. OPERATING PROCEDURES

CBR has developed procedures consistent with the corporate policies and standards and regulatory requirements to implement these management controls. The EMS Program consists of the following standards and operating procedures contained in eight volumes:

Volume 1 – *Standards*
Volume 2 – *Management Procedures*
Volume 3 – *Operating Manual* (SOPs)
Volume 4 – *Health Physics Manual*
Volume 5 – *Industrial Safety Manual*
Volume 6 – *Environmental Manual*
Volume 7 – *Training Manual*
Volume 8 – *Emergency Manual*

Written operating procedures have been developed for all process activities including those activities involving radioactive materials for the Crow Butte Uranium Project. Where radioactive material handling is involved, pertinent radiation safety practices are incorporated into the operating procedure. Additionally, written operating procedures have been developed for non-process activities including environmental monitoring, health physics procedures, emergency procedures, and general safety.

The procedures enumerate pertinent radiation safety procedures to be followed. A copy of the written procedure will be kept in the area where it is used. All procedures involving radiation safety will be reviewed and approved in writing by the RSO or another individual with similar qualifications prior to being implemented. The RSO will also perform a documented review of the operating procedures annually.

5.3.1.2. RADIATION WORK PERMITS

In the case that employees are required to conduct activities of a nonroutine nature where there is the potential for significant exposure to radioactive materials and for which no operating procedure exists, a Radiation Work

Permit (RWP) will be required. The RWP will describe the scope of the work, precautions necessary to maintain radiation exposures to ALARA, and any supplemental radiological monitoring and sampling to be conducted during the work. The RWP shall be reviewed and approved in writing by the RSO (or qualified designee in the absence of the RSO) prior to initiation of the work.

The RSO may also issue Standing Radiation Work Permits (SRWPs) for periodic tasks that require similar radiological protection measures (e.g., maintenance work on a specified plant system). The SRWP will describe the scope of the work, precautions necessary to maintain radiation exposures to ALARA, and any supplemental radiological monitoring and sampling to be conducted during the work. The SRWP shall be reviewed and approved in writing by the RSO (or qualified designee in the absence of the RSO) prior to initiation of the work.

5.3.2. PERFORMANCE BASED LICENSE CONDITION

This license application is the basis of the Performance Based License (PBL) originally issued in 1998. Under that license CBR may, without prior NRC approval or the need to obtain a License Amendment:

1. Make changes to the facility or process, as presented in the license application (as updated).
2. Make changes in the procedures presented in the license application (as updated).
3. Conduct tests or experiments not presented in the license application (as updated).

A License Amendment and/or NRC approval will be necessary prior to implementing a proposed change, test or experiment if the change, test or experiment would:

1. Result in any appreciable increase in the frequency of occurrence of an accident previously evaluated in the license application (as updated);
2. Result in any appreciable increase in the likelihood of occurrence of a malfunction of a structure, system, or component (SSC) important to safety previously evaluated in the license application (as updated);
3. Result in any appreciable increase in the consequences of an accident previously evaluated in the license application (as updated);
4. Result in any appreciable increase in the consequences of a malfunction of an SSC previously evaluated in the license application (as updated);
5. Create a possibility for an accident of a different type than any previously evaluated in the license application (as updated);
6. Create a possibility for a malfunction of an SSC with a different result than previously evaluated in the license application (as updated);

7. Result in a departure from the method of evaluation described in the license application (as updated) used in establishing the final safety evaluation report (FSER) or the environmental assessment (EA) or technical evaluation reports (TERs) or other analysis and evaluations for license amendments.
8. For purposes of this paragraph as applied to this license, SSC means any SSC that has been referenced in a staff SER, TER, EA, or environmental impact statement (EIS) and supplements and amendments thereof.

Additionally CBR must obtain a license amendment unless the change, test, or experiment is consistent with the NRC conclusions, or the basis of, or analysis leading to, the conclusions of actions, designs, or design configurations analyzed and selected in the site or facility SER, TERs, and EIS or EA. This would include all supplements and amendments, and TERs, EAs, and EISs issued with amendments to this license.

5.3.3. SAFETY AND ENVIRONMENTAL REVIEW PANEL (SERP)

A Safety and Environmental Review Panel (SERP) will make the determination of compliance concerning the conditions discussed in Section 5.3.2. The SERP will consist of a minimum of three individuals. One member of the SERP will have expertise in management and will be responsible for managerial and financial approval for changes; one member will have expertise in operations and/or construction and will have expertise in implementation of any changes; and one member will be the Radiation Safety Officer (RSO), or equivalent. Other members of the SERP may be utilized as appropriate, to address technical aspects of the change, experiment or test, in several areas, such as health physics, groundwater hydrology, surface water hydrology, specific earth sciences, and others. Temporary members, or permanent members other than the three identified above, may be consultants.

The SERP is responsible for monitoring any proposed change in the facility or process, making changes in procedures, and conducting tests or experiments not contained in the current NRC license. As such, they are responsible for insuring that any such change results in no degradation in the essential safety or environmental commitments of CBR.

5.3.3.1. SAFETY AND ENVIRONMENTAL REVIEW PANEL REVIEW PROCEDURES

The CBR SERP will implement the following review procedures for the evaluation of all appropriate changes to the facility operations. The SERP may delegate any portion of these responsibilities to a committee of two or more members of the SERP. Any committees so constituted will report their findings to the full SERP for a determination of compliance with Section 5.3.2 of this chapter. In their documented review of whether a potential change, test, or experiment (hereinafter called the change) is allowed under the PBL (or Performance Based License Condition (PBLC)) without a license amendment, the SERP shall consider the following:

- Current NRC License Requirements

The SERP will conduct a review of the most current NRC license conditions to assess which, if any, conditions will have an impact on or be impacted by the potential SERP action. If the SERP action will conflict with a specific license requirement, then a license amendment is necessary before initiating the change. This review includes information included in the approved license application.

- Ability to Meet NRC Regulations

The SERP will determine if the change, test, or experiment conflicts with applicable NRC regulations (example: 10 CFR Parts 20 and 40 requirements). If the SERP action conflicts with NRC regulations, a license amendment is necessary.

- Licensing Basis

The SERP will review whether the change, test, or experiment is consistent with NRC's conclusions regarding actions analyzed and selected in the licensing basis. Documents that the SERP must review in conducting this evaluation include the SER and EA prepared in support of the license renewal application (February 1998) and any SERs, TERs, EAs, or EISs prepared to support amendments to the license. The RSO will maintain a current copy of all pertinent documents for review by the SERP during these evaluations.

- Financial Surety

The SERP will review the proposed action to determine if any adjustment to financial surety arrangement or approved amount is required. If the proposed action will require an increase to the existing surety amount, the financial surety instrument must be increased accordingly before the change can be approved. The surety estimate must be updated either through a license amendment or through the course of the annual surety update to the NRC. The NRC incorporates the annual surety update by license amendment.

- Essential Safety and Environmental Commitments

The SERP will assure that there is no degradation in the essential safety or environmental commitment in the license application, or as provided by the approved reclamation plan.

5.3.3.2. DOCUMENTATION OF SERP REVIEW PROCESS

After the SERP conducts the review process for a proposed action, it will document its findings, recommendations, and conclusions in a written report format. All members of the SERP shall sign concurrence on the final report. If the report concludes that the action meets the appropriate PBL or PBLC requirements and does not require a license amendment, the proposed action may then be implemented. If the report concludes that a license amendment is necessary before implementing the action, the report will document the reasons why, and what course CBR plans to pursue. The SERP report shall include the following:

- A description of the proposed change, test, or experiment (proposed action);
- A listing of all SERP members conducting the review and their qualifications (if a consultant or other member not previously qualified);
- The evaluation of the proposed action including all aspects of the SERP review procedures listed above;
- Conclusions and recommendations;
- Signatory approvals of the SERP members; and
- Any attachments such as all applicable technical, environmental, or safety evaluations, reports, or other relevant information including consultant reports.

All SERP reports and associated records of any changes made pursuant to the PBL or PBLC shall be maintained through termination of the NRC license.

On an annual basis, CBR will submit a report to the NRC that describes all changes, tests, or experiments made pursuant to the PBL or PBLC. The report will include a summary of the SERP evaluation of each change. In addition, CBR will annually submit any pages of the license renewal application to reflect changes to the License Renewal Application or supplementary information. Each replacement page shall include both a change indicator for the area of change, (e.g., bold marking vertically in the margin adjacent to the portion actually change), and a page change identification, (date of change or change number, or both).

5.4. MANAGEMENT AUDIT AND INSPECTION PROGRAM

The following internal inspections, audits, and reports are performed for the Crow Butte Uranium Project operations:

5.4.1. DAILY INSPECTIONS

The RSO, HPT or a qualified designated operator conducts a daily walkthrough inspection of the plant. The inspection entails a visual examination of compliance or other problems that are reviewed with the Operations Superintendent. Results of the Daily Inspections are documented.

5.4.2. WEEKLY RSO INSPECTIONS

On a weekly basis, the RSO and Operations Superintendent (or designees in their absence) will conduct an inspection of all facility areas to observe general radiation control practices and review required changes in procedures and equipment.

5.4.3. MONTHLY RSO REPORT

The RSO provides a written summary of the month's radiological activities at the Crow Butte Uranium Project facilities. The report includes a review of all monitoring and exposure data for the month, a summary of the daily and weekly inspections, a summary of worker protection activities, a summary of all pertinent radiation survey records, a discussion of any trends in the ALARA program, and a review of adequacy of the implementation of the USNRC license conditions. Recommendations are made for any corrective actions or improvements in the process or safety programs.

5.4.4. ANNUAL ALARA AUDITS

CBR will conduct annual audits of the radiation safety and ALARA programs. The Manager of Health, Safety, and Environmental Affairs may conduct these audits. Alternatively, CBR may use qualified personnel from other uranium recovery facilities or an outside radiation protection auditing service to conduct these audits. The purpose of the audits is to provide assurance that all radiation health protection procedures and license condition requirements are being conducted properly at the Crow Butte Uranium Project facility. Any outside personnel used for this purpose will be qualified in radiation safety procedures as well as environmental aspects of solution mining operations. Whether conducted internally or through the use of an audit service, the auditor will meet the minimum qualifications for education and experience as for the RSO as described in Section 5.5.

The audit of the radiation protection and ALARA program is conducted in accordance with the recommendations contained in Regulatory Guide 8.31, *Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Recovery Facilities Will Be As Low As Reasonably Achievable* (Revision 1, May 2002). A written report of the results is submitted to corporate management. The RSO may accompany the auditor but may not participate in the conclusions.

The annual ALARA audit report summarizes the following data:

1. Employee exposure records
2. Bioassay results
3. Inspection log entries and summary reports of mine and process inspections
4. Documented training program activities
5. Applicable safety meeting reports
6. Radiological survey and sampling data
7. Reports on any overexposure of workers
8. Operating procedures that were reviewed during this time period

The ALARA audit report specifically discusses the following:

1. Trends in personnel exposures
2. Proper use, maintenance and inspection of equipment used for exposure control
3. Recommendations on ways to further reduce personnel exposures from uranium and its daughters.

The ALARA audit report is submitted to and reviewed by the Senior Vice President of Operations and Mine Manager. Implementations of the recommendations to further reduce employee exposures, or improvements to the ALARA program, are discussed with the ALARA auditor.

An audit of the Quality Assurance/Quality Control (QA/QC) program is also conducted on an annual basis. An individual qualified in analytical and monitoring techniques who does not have direct responsibilities in the areas being audited performs the audit. The results of the QA/QC audit are documented with the ALARA Audit. The RSO has the primary responsibility for the implementation of the radiological QA/QC programs at the Crow Butte Uranium Project facilities.

5.5. HEALTH PHYSICS QUALIFICATIONS

CBR project staff is highly experienced in the management of uranium development, mining, and operations. The following minimum personnel specifications and qualifications are strictly adhered to.

5.5.1. RADIATION SAFETY OFFICER QUALIFICATIONS

The minimum qualifications for the Radiation Safety Officer (RSO) are as follows:

- Education - A Bachelor's Degree in the physical sciences, industrial hygiene, environmental technology or engineering from an accredited college or university or an equivalent combination of training and relevant experience in uranium mill/solution mining radiation protection.

- Health Physics Experience - A minimum of 1 year of work experience relevant to uranium mill/solution mining operations in applied health physics, radiation protection, industrial hygiene or similar work.

- Specialized Training - A formalized, specialized course(s) in health physics specifically applicable to uranium milling/solution mining operations, of at least 4 weeks duration. The RSO attends refresher training on uranium mill health physics every two years.

- Specialized Knowledge - The RSO, through classroom training and on-the-job experience, possesses a thorough knowledge of the proper application and use of all health physics equipment used in the operation, the procedures used for radiological sampling and monitoring, methods used to calculate personnel exposures to uranium and its daughters, and a thorough understanding of the solution mining process and equipment used and how hazards are generated and controlled during the process.

5.5.2. HEALTH PHYSICS TECHNICIAN QUALIFICATIONS

The Health Physics Technician (HPT) will have one of the following combinations of education, training, and experience:

1. Education - An associate degree or 2 years or more of study in the physical sciences, engineering, or a health-related field.

   Training - At least a total of 4 weeks of generalized training in radiation health protection applicable to uranium mills/solution mining operations.

   Experience - One year of work experience using sampling and analytical laboratory procedures that involve health physics, industrial hygiene, or industrial safety measures to be applied in a uranium mill/solution mining operation.

2. Education - A high school diploma.

   Training - A total of at least 3 months of specialized training in radiation protection relevant to uranium mills of which up to 1 month may be on-the-job training.

   Experience - Two years of relevant work experience in applied radiation protection.

5.6. TRAINING

All site employees and contractor personnel at the Crow Butte Uranium Project are administered a training program based upon the EHS Management System covering radiation safety, radioactive material handling, and radiological emergency procedures. This training program is administered in keeping with standard radiological protection guidelines and the guidance provided in USNRC Regulatory Guide 8.29, *Instructions Concerning Risks From Occupational Radiation Exposure* (Revision 1, February 1996); Regulatory Guide 8.31, *Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Recovery Facilities Will Be As Low As Reasonably Achievable* (Revision 1, May 2002); and Regulatory Guide 8.13, *Instruction Concerning Prenatal Radiation Exposure* (Revision 3, June 1999). The technical content of the training program is under the direction of the RSO. The RSO or a qualified designee conducts all radiation safety training.

5.6.1. TRAINING PROGRAM CONTENT

5.6.1.1. VISITORS

Visitors to the Crow Butte Uranium Project who have not received training are escorted by on site personnel properly trained and knowledgeable about the hazards of the facility. At a minimum, visitors are instructed specifically on what they should do to avoid possible hazards in the area of the facility that they are visiting.

5.6.1.2. CONTRACTORS

Any contractors having work assignments at the facility are given appropriate radiological safety training. Contract workers who will be performing work on heavily contaminated equipment receive the same training normally required of Crow Butte workers as discussed in Section **Error! Reference source not found.**.

5.6.1.3. CROW BUTTE RESOURCES EMPLOYEES

The CBR EMS Program Volume VII, *Training Manual*, incorporates the following topics recommended in USNRC Regulatory Guide 8.31, *Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Recovery Facilities Will Be As Low As Reasonably Achievable* (Revision 1, May 2002):

<u>Fundamentals of health protection</u>

- The radiological and toxic hazards of exposure to uranium and its daughters.
- How uranium and its daughters enter the body (inhalation, ingestion, and skin penetration.
- Why exposures to uranium and its daughters should be kept as low as reasonably achievable (ALARA).

<u>Personal Hygiene at Uranium Mines</u>

- Wearing protective clothing
- Using respirators when appropriate.
- Eating, drinking and smoking only in designated areas.

- Using proper methods for decontamination.

Facility-provided protection

- Cleanliness of working space.
- Safety designed features for process equipment.
- Ventilation systems and effluent controls.
- Standard operating procedures.
- Security and access control to designated areas.

Health protection measurements

- Measurements of airborne radioactive material.
- Bioassay to detect uranium (urinalysis and in vivo counting).
- Surveys to detect contamination of personnel and equipment.
- Personnel dosimetry.

Radiation protection regulations

- Regulatory authority of NRC, MSHA and state.
- Employee rights in 10 CFR Part 19.
- Radiation protection requirements in 10 CFR Part 20.

Emergency procedures

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 documented. Every two months, all workers attend a general safety meeting.

5.6.2. TESTING REQUIREMENTS

A written test with questions directly relevant to the principals of radiation safety and health protection in the facility covered in the training course is given to each worker. The instructor reviews the test results with each worker and discusses incorrect answers to the questions with the worker until worker understanding is achieved. Workers who fail the exam are retested and test results remain on file.

5.6.3. ON-THE-JOB TRAINING

5.6.3.1. HEALTH PHYSICS TECHNICIAN

On-the-job training is provided to HPTs in radiation exposure monitoring and exposure determination programs, instrument calibration, plant inspections, posting requirements, respirator programs and health physics procedures contained in EMS Program Volume IV, *Health Physics Manual.*

5.6.4. REFRESHER TRAINING

Following initial radiation safety training, all permanent employees and long-term contractors receive on-going radiation safety training as part of the annual refresher training and, if determined necessary by the RSO, during monthly safety meetings. This on-going training is used to discuss problems and questions that have arisen, any relevant information or regulations that have changed, exposure trends and other pertinent topics.

5.6.5. TRAINING RECORDS

Records of training are kept for a period of five years for all employees trained as radiation workers (i.e., occupationally exposed employees).

5.7. SECURITY

CBR security measures for the current operation are specified in the Security Plan and Security Threat chapter in Volume VIII, *Emergency Manual.* Crow Butte Resources, Inc. (CBR) is committed to:

- Providing employees with a safe, healthful, and secure working environment;
- Maintaining control and security of NRC licensed material;

- Ensuring the safe and secure handling and transporting of hazardous materials; and
- Managing records and documents that may contain sensitive and confidential information.

The NRC requires licensees to maintain control over licensed material (i.e., natural uranium ("source material") and byproduct material defined in 10 CFR §40.4). 10 CFR 20, Subpart I, *Storage and Control of Licensed Material*, requires the following:

§20.1801 Security of Stored Material

The licensee shall secure from unauthorized removal or access licensed materials that are stored in controlled or unrestricted areas.

§20.1802 Control of Material not in Storage

The licensee shall control and maintain constant surveillance of licensed material that is in a controlled or unrestricted area and that is not in storage.

Stored material at the Crow Butte Uranium Project would include uranium packaged for shipment from the facility or byproduct materials awaiting disposal. Examples of material not in storage would include yellowcake slurry or loaded ion exchange resin removed from the restricted area for transfer to other areas.

5.7.1. PERMIT AREA AND PLANT FACILITY SECURITY

5.7.1.1. CENTRAL PROCESSING FACILITY AREA

All Central Processing facility areas where source or byproduct material is handled are fenced. The main access road is equipped with a locking gate. Strategically placed surveillance cameras monitor the access road and areas around the Central Processing facility. A 24-hour per day 7-day per week staff is on duty in the Central Processing facility.

Central Plant operators perform an inspection to ensure the proper storage and security of licensed material at the beginning of each shift. The inspection determines whether all licensed material is properly stored in a restricted area or, if in controlled or unrestricted areas, is properly secured. In particular, operators ensure that loaded ion exchange resin, slurry, drummed yellowcake, and byproduct material is properly secured. If licensed material is found outside a restricted area, the operator will ensure that it is secured, locked, moved to a restricted area, or kept under constant surveillance by direct observation by site personnel or surveillance cameras. The results of this inspection will be properly documented.

5.7.1.2. OFFICE BUILDING

There is a reception area located at the main entrance into the office building. All other entrances are locked during off-shift hours. There are a limited number of traceable keys to the office and they are given out to select employees. The main door and the door to the Central Plant facility entrance are also equipped with an access keypad.

Visitors entering the office are greeted by the receptionist and announced to the receiving person. All visitors are required to sign the access log and indicate the purpose of their visit and the employee to be visited. The person being visited is responsible to supervise the visitors at all times when they are on site. Visitors are only allowed at the facility during regular working hours unless prior approval is obtained from the Mine Manager or the Manager of Health, Safety, and Environmental Affairs.

5.7.2. TRANSPORTATION SECURITY

CBR routinely receives, stores, uses, and ships hazardous materials as defined by the U.S. Department of Transportation (DOT). In addition to the packaging and shipping requirements contained in the DOT Hazardous Materials Regulations (HMR), 49 CFR 172, Subpart I, *Security Plans*, requires that persons that offer for transportation or transport certain hazardous materials develop a Security Plan. Shipments may qualify for this DOT requirement under the following categories:

§172.800(b)(4) A shipment of a quantity of hazardous materials in a bulk package having a capacity equal to or greater than 13,248 L (3,500 gallons) for liquids or gases or more than 13.24 cubic meters (468 cubic feet) for solids;

§172.800(b)(5) A shipment in other than a bulk packaging of 2,268 kg (5,000 pounds) gross weight or more of one class of hazardous material for which placarding of a vehicle, rail car, or freight container is required for that class under the provisions of subpart F of this part;

§172.800(b)(7) A quantity of hazardous material that requires placarding under the provisions of subpart F of this part.

DOT requires that Security Plans assess the possible transportation security risks and evaluate appropriate measures to address those risks. All hazardous materials shippers and transporters subject to these standards must take measures to provide personnel security by screening applicable job applicants, prevent unauthorized access to the hazardous materials or vehicles being prepared for shipment, and provide for en route security. Companies must also train appropriate personnel in the elements of the Security Plan.

Transport of licensed/hazardous material by CBR employees will generally be restricted to transferring contaminated equipment between company facilities. This transport generally occurs over short distances through remote areas. Therefore, the potential for a security threat during transport by CBR vehicle is minimal. The goal of the driver, cargo, and equipment security measures is to ensure the safety of the driver and the security and integrity of the cargo from the point of origin to the final destination by:

- Clearly communicating general point-to-point security procedures and guidelines to all drivers and non-driving personnel;
- Providing the means and methods of protecting the drivers, vehicles, and customer's cargo while on the road; and
- Establishing consistent security guidelines and procedures that shall be observed by all personnel.

For the security of all tractors and trailers, the following will be adhered to:

- If material is stored in the vehicle, access must be secured at all openings with locks and/or tamper indicators;
- Off site tractors will always be secured when left unattended with windows closed, doors locked, the engine shut off, and no keys or spare keys in or on the vehicle;
- The unit is to be kept visible by an employee at all times when left unattended outside a restricted area.

The security guidelines and procedures apply to all transport assignments. All drivers and non-driving personnel are expected to be knowledgeable of, and adhere to, these guidelines and procedures when performing any load-related activity.

5.8. RADIATION SAFETY CONTROLS AND MONITORING

CBR has a strong corporate commitment to and support for the implementation of the radiological control program at the Crow Butte Uranium Project facility. This corporate commitment to maintaining personnel exposures as low as reasonably achievable (ALARA) has been incorporated into the radiation safety controls and monitoring programs described in the following sections. This license renewal application contains the results through 1995 of the radiological control program since 1990. Each area in this Section describes the historical program and the results of monitoring since 1990. Where the monitoring results indicate that the program should be modified, proposed changes in the program are also discussed.

5.8.1. EFFLUENT CONTROL TECHNIQUES

5.8.1.1. GASEOUS AND AIRBORNE PARTICULATE EFFLUENTS

Under routine operations, the only radioactive effluent at the Crow Butte facility is the release of radon-222 gas from the production solutions. A vacuum dryer is used for drying the yellowcake product. There is no airborne effluent from the vacuum dryer system.

The radon-222 is found in the pregnant lixiviant that comes from the wellfield into the plant. The production flow is directed to the process building for separation of the uranium. The uranium is separated by passing the recovery solution through fluidized bed upflow ion exchange units. Radon gas is released from the solution in the ion exchange columns and in the injection surge tanks. The vents from the individual vessels are connected to a manifold that is exhausted outside the plant building through the plant stack.

Venting to the atmosphere outside of the plant building minimizes personnel exposure. Small amounts of radon-222 may be released in the plant building during solution spills, filter changes and maintenance activities. The plant building is equipped with exhaust fans to remove any radon that may be released in the plant building. No significant personnel exposure to radon gas has been noted during operation of the Crow Butte facility. Results of radon daughter monitoring in the process areas are discussed in Section 5.8.3.

5.8.1.2. LIQUID EFFLUENTS

The liquid effluents from the Crow Butte Uranium Project can be classified as follows:

- **Water generated during well development** - This water is recovered groundwater and has not been exposed to any mining process or chemicals. The water is discharged directly to one of the solar evaporation ponds and silt, fines and other natural suspended matter collected during well development is settled out.

- **Liquid process waste** - The operation of the process plant results in two primary sources of liquid waste, an eluant bleed and a production bleed.

- **Aquifer restoration** - Following mining operations, restoration of the affected aquifer commences which results in the production of wastewater. The current groundwater restoration plan consists of four activities: 1) Groundwater Transfer, 2) Groundwater Sweep, 3) Groundwater Treatment, and 4) Wellfield Circulation. Only the groundwater sweep and groundwater treatment activities will generate wastewater.

  During groundwater sweep, water is extracted from the mining zone without injection causing an influx of baseline quality water to sweep the affected mining area.

  Groundwater treatment activities involve the use of process equipment to lower the ion concentration of the groundwater in the affected mining area. A reverse osmosis (RO) unit may be used to reduce the total dissolved solids of the groundwater. The RO unit produces clean water (permeate) and brine. The permeate is either injected into the formation or disposed of in the waste disposal system. The brine is sent to the wastewater disposal system. The permeate may be further treated if necessary to meet the quality requirements of the NPDES permit for land application disposal.

The existing USNRC License allows CBR to dispose of wastewater by three methods:

- Evaporation from the evaporation ponds;
- Deep well injection; and
- Land application.

The design, installation, inspection and operation criteria for the solar evaporations ponds are those found to be applicable in USNRC Regulatory Guide 3.11, *Design, Construction and Inspection of Embankment Retention Systems For Uranium Mills* (Revision 2, December 1977). Each commercial pond is nominally 900 feet by 300 feet by 17 feet in depth. The ponds are membrane lined with a leak detection system under the membrane and are designed to allow the contents of any given pond to be transferred into another pond in the event of a pond problem.

Each of the ponds has the capability of being pumped for water treatment prior to discharge under the NPDES permit. A variety of treatment options exist depending upon the specific chemical contaminants identified in the wastewater. In general, a combination of chemical precipitation and reverse osmosis is adequate to restore the water to a quality that falls within the NPDES parameters.

Spill Contingency Plans

The RSO is charged with the responsibility to develop and implement appropriate procedures to handle potential spills of radioactive materials. Personnel representing the engineering and operations functions of the Crow Butte Uranium Project facility will assist the RSO in this effort. Basic responsibilities include:

- Assignment of resources and manpower.
- Responsibility for materials inventory.
- Responsibility for identifying potential spill sources.
- Establishment of spill reporting procedures and visual inspection programs.
- Review of past incidents of spills.
- Coordination of all departments in carrying out goals of containing potential spills.
- Establishment of employee emergency response training programs.
- Responsibility for program implementation and subsequent review and updating.
- Review of new construction and process changes relative to spill prevention and control.

Spills can take two forms within an in-situ uranium mining facility; surface spills such as pond leaks, piping ruptures, transportation accidents, etc., and subsurface releases such as a well excursion, in which process chemicals migrate beyond the wellfield, or a pond liner leak resulting in a release of waste solutions.

Engineering and administrative controls are in place to prevent both surface and subsurface releases to the environment and to mitigate the effects should a release occur.

- **Surface Releases** - The most common form of surface release from in-situ mining operations occurs from breaks, leaks, or separations within the piping that transfers mining fluids between the process plant and the wellfield. These are generally classified as small releases.

  In general, piping from the plant to and within the wellfield is constructed of PVC, high-density polyethylene pipe with butt-welded joints or equivalent. All pipelines are pressure tested at operating pressures prior to operation. It is unlikely that a break would occur in a buried section of line because no additional stress is placed on the pipes. In addition, underground pipelines are protected from a major cause of potential failure - that of vehicles driving over the lines causing breaks. The only exposed pipes are at the process plant, the wellheads, at temporary transfer lines and in the control house in the wellfield. Trunkline flows and wellhead pressures are monitored each shift for process control. One section of underground piping that passes beneath Squaw Creek is double contained for additional protection.

- **Transportation accidents** - EMS Program Volume VIII, *Emergency Manual* provides the CBR emergency action plan for responding to a transportation accident involving a yellowcake shipment. The Emergency Manual provides instructions for proper packaging, documentation, driver emergency and accident response procedures, and cleanup and recovery actions. Spill response is also addressed in EMS Program Volume VIII, *Emergency Manual.*

- **Sub-surface releases** - Mining fluids are normally maintained in the production aquifer within the immediate vicinity of the wellfield. The function of the encircling monitor well ring is to detect any mining solutions that may migrate away from the production area due to fluid pressure imbalance. This system has been proven to function satisfactorily over many years of operating experience with in-situ mining.

  At the Crow Butte Uranium Project site, an undetected excursion is highly unlikely. All wellfields are surrounded by a ring of monitor wells located no further than 300 feet from the wellfield and screened in the ore-bearing Chadron aquifer. Additionally, monitor wells are placed in the first overlying aquifer above each wellfield segment. Sampling of these wells is done on a biweekly basis. Past experience at in-situ leach mining facilities has shown that this monitoring system is effective in detecting leachate migration. The total effect of the close proximity of the monitor wells, the low flow rate from the well patterns, and over-production of leach fluids (production bleed) makes the likelihood of an undetected excursion extremely remote.

Migration of fluids to overlying aquifers has also been considered. Several controls are in place to prevent this. First, CBR has plugged all exploration holes to prevent co-mingling of Brule and Chadron aquifers and to isolate the mineralized zone. Successful plugging was tested by conducting two hydrologic tests prior to mining. Results indicated that no leakage or communication exists between the mineralized zone and overlying aquifers. In addition, prior to start of production a well integrity test is performed on all injection/recovery wells. This requirement of the Nebraska Underground Injection Control Regulations insures that all wells are constructed properly and capable of maintaining pressure without leakage. Lastly, monitor wells completed in the overlying aquifer are also sampled on a regular basis for the presence of leach solution.

Seepage of solutions from the evaporation ponds into ground or surface water is also a potential pollution source. However, this has not been nor should it be a problem at the Crow Butte site. Construction and operational safeguards have been implemented to insure maximum competency of the synthetic liner and earthen embankments. The underdrain leak detection system allows sampling that would detect a leak. The pond soil foundation has a low ambient moisture due to its elevation, soil type and preparation, thus should the unlikely event occur of pond fluids seeping into the compacted subsoil, the liquid would be quickly absorbed and would not migrate. Pond monitor wells are also located downstream of the evaporation ponds to detect leaks into the uppermost aquifer.

In addition to the spills described above, the accumulation of sediment or erosion of existing soils can lead to potential releases of pollutants. The likelihood of significant sediment or erosion problems is greatest during construction activities, which are completed at this time. Future construction activities could include additional wellfield development, or additional pond construction. During construction, there is a possibility that sediment load may increase in Squaw Creek. If rain, producing runoff, occurs during construction, a small amount of the fill may be carried into the creek. Significant precipitation during pond construction and plant facilities might also produce the same effect. Plant cover for erosion control will be established as soon as possible on exposed areas. Little additional suspendable material should be produced during mining operations and restoration activities. Site reclamation in the future with backfilling of ponds, grading the plant site, and replacing the topsoil will also expose unsecured soil for suspension in runoff waters. The increased sediment load as a result of precipitation during future construction or reclamation activities should not significantly effect the quality of Squaw

Creek as the more sensitive areas of the stream are located upstream form the point of entry of the tributary.

Runoff from precipitation events should be controlled to minimize any exposure to pollutants on the site. At the Crow Butte Uranium Project site, runoff is not considered to be a major issue given the engineering design of the facilities, as well as the existing engineering and administrative controls. Rainwater entering a pond leading to a pond overflow would be the greatest item of concern. The design and operation of the ponds precludes a runoff-induced overflow as a realistic possibility. Should there be high runoff concurrent with a pipeline failure, some contamination could be spread depending upon the relative saturation of the soils beneath the leaking area. In any event, as only minimal releases of solutions would occur in the event of a pipeline failure, and migration of pollutants due to runoff would still be minimal.

5.8.2. EXTERNAL RADIATION EXPOSURE MONITORING PROGRAM

5.8.2.1. GAMMA SURVEY

Program Description

External gamma radiation surveys have been performed routinely at the Crow Butte Uranium Project. The required frequency is quarterly in designated Radiation Areas and semiannually in all other areas of the plant. Surveys are performed at specified locations in worker occupied stations and areas of potential gamma sources such as tanks and filters. CBR establishes a Radiation Area if the gamma survey exceeds the action level of 5.0 mR/hr for worker occupied stations. An investigation is performed to determine the probable source and survey frequency for areas exceeding 5.0 mR/hr are increased to quarterly. Records were maintained of each investigation and the corrective action taken. If the results of a gamma survey identified areas where gamma radiation is in excess of levels that delineate a "radiation area", access to the area is restricted and the area is posted as required in 10 CFR §20.1902 (a).

External gamma surveys are performed with survey equipment that meets the following minimum specifications:

1. Range - Lowest range not to exceed 100 microRoentgens per hour (μR/hr) full-scale with the highest range to read at least 5 milliRoentgens per hour (mR/hr) full scale;

2. Battery operated and portable;

Examples of satisfactory instrumentation that meets these requirements are the Ludlum Model 3 survey meter with a Ludlum 44-38 probe or equivalent. Gamma survey instruments were calibrated every six months and were operated in accordance with the manufacturer's recommendations. Instrument checks were performed each day that an instrument was used.

Historical Program Results

Routine gamma surveys have been performed as required at the Crow Butte Uranium Project. A Radiation Area has been established around the injection filter system since the beginning of commercial operations due to gamma levels above 5.0 mRem/hr. Engineering controls such as lead sheeting have been employed around the filters to maintain personnel exposures ALARA. Results of the gamma survey program are maintained at the Crow Butte Uranium Project site.

Proposed Beta and Gamma Survey Program

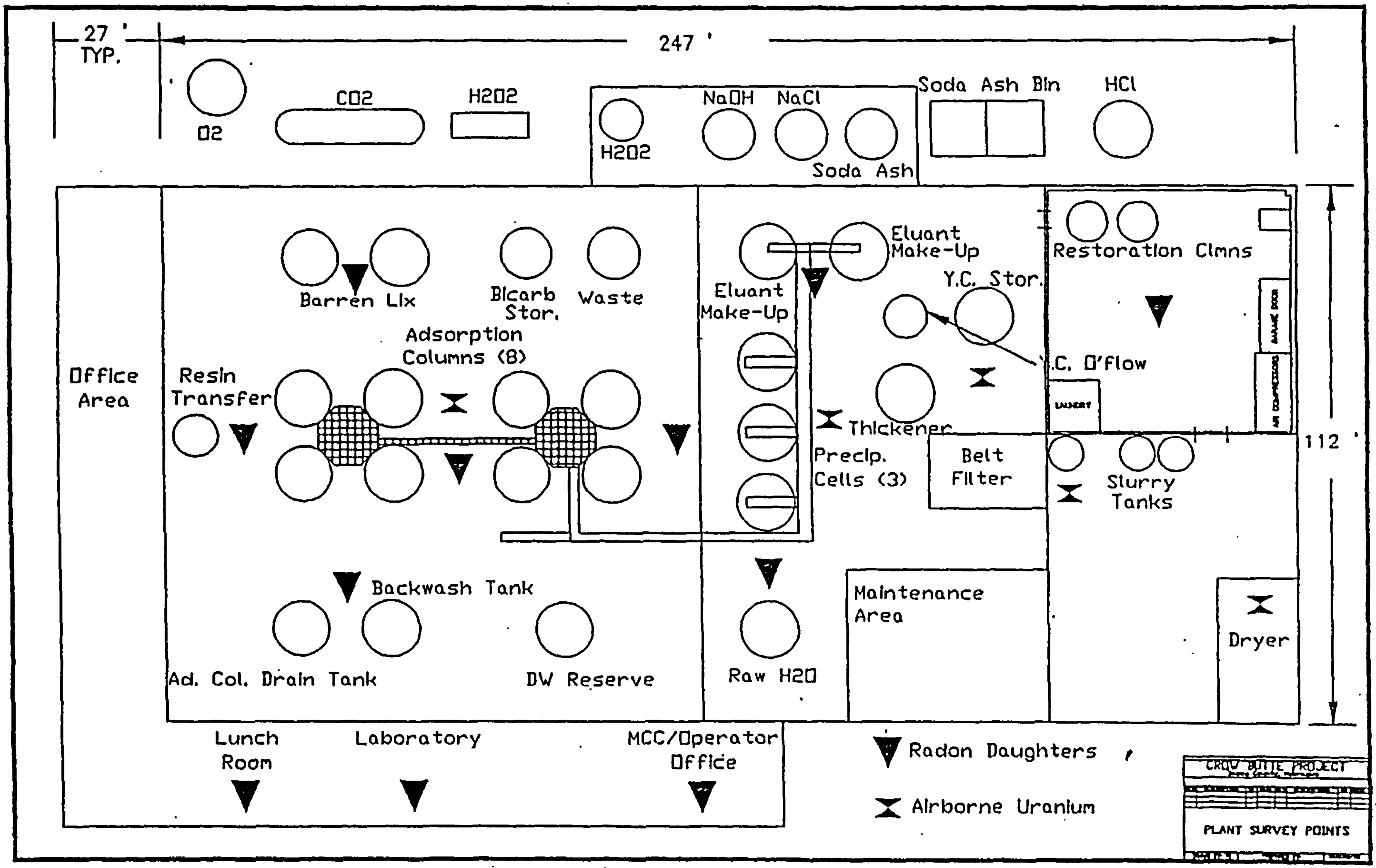
CBR proposes to institute the same gamma exposure-monitoring program of worker occupied stations and areas likely to have significant gamma exposure rates at the Crow Butte Uranium Project that has been performed to date with the following changes.

- Gamma survey instruments will be calibrated annually or at the manufacturers recommended frequency, whichever is more frequent.

Gamma exposure rate surveys will be performed in accordance with the instructions currently contained in EMS Program Volume IV, *Health Physics Manual*. Gamma survey instruments will be checked each day of use in accordance with the manufacturer's instructions.

Beta surveys of specific operations that involve direct handling of large quantities of aged yellowcake will be performed as discussed in USNRC Regulatory Guide 8.30, *Health Physics Surveys in Uranium Recovery Facilities*, Section 1.4. Beta evaluations may be substituted for surveys using radiation survey instruments. Surveys or evaluations will be performed whenever a change in equipment or procedures has occurred that may significantly affect worker exposures.

Figure 5.8-1: Proposed Survey and Sampling Locations



5.8.2.2. PERSONNEL DOSIMETRY

Program Description

All employees working in the process facility or wellfield operations who are assigned full-time to the Crow Butte Uranium Project facility have been issued dosimeters for determination of external gamma exposure. Dosimeters are provided by a vendor that is accredited by NVLAP of the National Institute of Standards and Technology as required in 10 CFR § 20.1501. The dosimeters have a range of 1 mR to 1000 R. Dosimeters are exchanged and read on a quarterly basis.

Historical Program Results

Table 5.8-1 contains a summary of the average and maximum annual exposure for all personnel at the Crow Butte Uranium Project facility since 1990. As can be seen in Table 5.8-1, the average annual exposures at the Crow Butte Uranium Project from 1990 to 1994 have been at or below 1% of the regulatory limit of 5.0 Rem. The maximum annual individual exposure in 1994 was well below 10% of the regulatory limit and indicates that exposures at the Crow Butte Uranium Project are maintained ALARA.

Proposed Personnel Dosimetry Program

10 CFR §20.1502 (a)(1) requires exposure monitoring for "Adults likely to receive, in 1 year from sources external to the body, a dose in excess of 10 percent of the limits in §20.1201 (a)". Ten percent of the dose limit would correspond to a Deep Dose Equivalent (DDE) of 0.500 Rem. Maximum individual annual exposures at the Crow Butte Uranium Project facilities since 1987 have been well below 10 percent of the limit. CBR believes that it is unlikely that any employee will exceed 10 percent of the regulatory limit. Although monitoring of external exposure may not be required in accordance with §20.1201(a), CBR proposes to continue to issue dosimeters to all process employees and exchange them on a quarterly basis. CBR has discontinued dosimeter issuance to employees in other work categories who do not routinely enter the process plant.

Results from dosimeter monitoring will be used to determine individual Deep Dose Equivalent (DDE) for use in determining Total Effective Dose Equivalent (TEDE) in accordance with the instructions currently contained in EMS Program Volume IV, *Health Physics Manual.*

Table 5.8-1: External Radiation Exposure Monitoring Results

EXPOSURE MONITORING PERIOD	AVERAGE ANNUAL EXPOSURE (mRem/yr)[2]	MAXIMUM INDIVIDUAL ANNUAL EXPOSURE[1] (mRem/yr)[2]
Calendar Year 1990	6.3	14
Calendar Year 1991	33.3	83
Calendar Year 1992	27.8	109
Calendar Year 1993	32.3	98
Calendar Year 1994	51.2	315

Notes:

1 Annual External Exposure Limit (10 CFR § 20.1201) = 5 Rem

2 All data based upon results from Eberline Instrument Corporation; LLD = 10 mRem

5.8.3. IN-PLANT AIRBORNE RADIATION MONITORING PROGRAM

5.8.3.1. IN-PLANT AIRBORNE URANIUM PARTICULATE MONITORING

Program Description

Airborne particulate levels at solution mines which ship slurry yellowcake product are normally very low since the product is wet. Yellowcake drying operations began in 1993. Monitoring for airborne uranium was performed routinely at Crow Butte Uranium Project through the use of area sampling and breathing zone sampling. The monitoring programs are described below.

Area Sampling

Area samples are collected monthly at the four specified sample locations in the plant. Additionally, samples are taken in the dryer room during dryer operations and for the issuance of an RWP. Area samples are taken in accordance with the instructions currently contained in EMS Program Volume IV, *Health Physics Manual.* Samples are taken with a glass fiber filter and a regulated air sampler such as an Eberline RAS-1 or equivalent. Sample volume is adequate to achieve the lower limits of detection (LLD) for uranium in air. Samplers are calibrated every six months using a digital mass flowmeter or equivalent primary calibration standard.

Measurement of airborne uranium is performed by gross alpha counting of the air filters using an alpha scaler such as an Eberline MS-3 or equivalent. The Maximum Permissible Concentration (MPC) value for natural uranium of 1 E-10 µCi/ml from Appendix B to 10 CFR §§ 20.1 - 20.601 was applied to the gross alpha counting results. After implementation of the new 10 CFR 20 on January 1, 1994, the Derived Air Concentration (DAC) for soluble (D classification) natural uranium of 5 E-10 µCi/ml from Appendix B to 10 CFR §§20.1001 - 20.2401 was used. This is a conservative method because the gross alpha results include Uranium-238 and several of its daughters (notably Ra-226 and Th-230), which are alpha emitters. An action level of 25% of the MPC (DAC since 1994) for soluble natural uranium was established at the Crow Butte Uranium Project facilities. If an airborne uranium sample exceeded the MPC (DAC), an investigation was performed. The only area at the Crow Butte Uranium Project that has met the definition of an Airborne Radioactivity Area as contained in 10 CFR § 20.1003 is the dryer room during yellowcake packaging operations.

Breathing Zone Sampling

Breathing zone sampling is performed to determine individual exposure to airborne uranium during certain operations. Sampling was performed with an

MSA pump or equivalent. The air filters were counted and compared to the MPC (DAC) using the same method described for area sampling. Air samplers were calibrated at least every six months.

Historical Program Results

Table 5.8-2 provides the results of monitoring for airborne uranium from the period of 1990 through 1994. The annual average and maximum monthly average airborne gross alpha activity for this period are reported. The increase in the average activity in 1994 is due to the influence of the sampling results from the dryer room. All activity levels were well below 25% of the MPC or DAC.

Proposed In-Plant Airborne Uranium Monitoring Program

CBR proposes to institute the same airborne uranium-monitoring program at Crow Butte Uranium Project that has been performed to date with the following changes.

- Based upon operating experience, CBR proposes to perform air sampling at the locations shown in Figure 5.8-1 for the plant. CBR believes that these locations will provide accurate monitoring of plant radiological conditions.

Airborne sampling will be performed on a monthly basis in accordance with the instructions currently contained in EMS Program Volume IV, *Health Physics Manual.* These procedures implement the guidance contained in USNRC Regulatory Guide 8.25, *Air Sampling in the Workplace.* Sampler calibration will be performed in accordance with the instructions currently contained in EMS Program Volume IV, *Health Physics Manual.*

Table 5.8-2: In-plant Airborne Uranium Monitoring Results

AIRBORNE URANIUM MONITORING PERIOD	ANNUAL AVERAGE AIRBORNE ACTIVITY μCi/ml gross α (% MPC, % DAC)[1,2]	MAXIMUM MONTHLY AVERAGE AIRBORNE ACTIVITY μCi/ml gross α (% MPC, %DAC)[1,2]
Calendar Year 1990 - RO Building (twelve months of sampling data)	4.3 E-13 (0.4% MPC)	3.2 E-12 (3.2% MPC)
Calendar Year 1990 - Commercial Plant (two months of sampling data)	1.56 E-13 (0.2% MPC)	1.78 E-13 (0.2% MPC)
Calendar Year 1991 - RO Building (two months of sampling data)	5.05 E-13 (0.5% MPC)	1.0 E-12 (1.0% MPC)
Calendar Year 1991 - Commercial Plant (twelve months of sampling data)	4.53 E-13 (0.5% MPC)	2.31 E-12 (2.3% MPC)
Calendar Year 1992	5.61 E-13 (0.6% MPC)	1.18 E-12 (1.2% MPC)
Calendar Year 1993	9.67 E-13 (1.0% MPC)	6.67 E-12 (6.7% MPC)
Calendar Year 1994 (includes dryer room sample results)	3.22 E-12 (0.6% DAC)	6.07 E-12 (1.2% DAC)

Notes:
1 Samples prior to January 1, 1994 compared to MPC where MPC = 1 E-10 μCi/ml (10 CFR §§ 20.1 - 20.601 App B).
2 Samples after January 1, 1994 compared to the DAC where DAC=5 E-10 μCi/ml (10 CFR §§ 20.1001-2401 App B)

5.8.3.2. IN-PLANT RADON DAUGHTER SURVEYS

Program Description

Radon daughter surveys were conducted in the operating areas of the Crow Butte Uranium Project facilities on a monthly basis at the specified locations. Samples were collected with a low volume air pump and then analyzed with an alpha scaler using the Modified Kusnetz method described in ANSI-N13.8-1973. Air samplers are calibrated at least every six months.

Results of radon daughter sampling are expressed in Working Levels (WL) where one WL is defined as any combination of short-lived radon-222 daughters in one liter of air without regard to equilibrium that emit 1.3×10^5 MeV of alpha energy. The MPC limit from Appendix B to 10 CFR §§ 20.1 - 20.601 as well as the current DAC limit from Appendix B to 10 CFR §§ 20.1001 - 20.2402 for radon-222 with daughters present is 0.33 WL. CBR has established an action level of 25% of the DAC or 0.08 WL. Radon daughter results in excess of the action level result in an investigation of the cause and an increase in the sampling frequency to weekly until the radon daughter levels did not exceed the action level for four consecutive weeks.

Historical Program Results

Table 5.8-3 provides the results of monitoring for radon daughters from the period of 1990 through 1994. The annual average and maximum values are presented. The data shows that the average radon daughter activity concentration at Crow Butte Uranium Project was consistently less than 25% of the regulatory limit.

Proposed In-Plant Radon Daughter Monitoring Program

CBR proposes to institute the same radon daughter monitoring program at Crow Butte Uranium Project that has been performed to date with the following changes.

- Based upon operating experience, CBR proposes to perform radon daughter sampling at the locations shown Figure 5.8-1. CBR believes that these locations will provide accurate monitoring of plant radiological conditions.

Routine radon daughter monitoring will be performed on a monthly basis in accordance with the instructions currently contained in EMS Program Volume IV, *Health Physics Manual*

Table 5.8-3: In-plant Radon Daughter Monitoring Results

RADON DAUGHTER MONITORING PERIOD	ANNUAL AVERAGE RADON DAUGHTER ACTIVITY in WL (% MPC, % DAC)[1,2]	MAXIMUM MONTHLY AVERAGE RADON DAUGHTER ACTIVITY in WL (% MPC, %DAC)[1,2]
Calendar Year 1990 - RO Building (twelve months of sampling data)	0.015 (4.5% MPC)	0.022 (6.7% MPC)
Calendar Year 1990 - Commercial Plant (two months of sampling data)	0.008 (2.4% MPC)	0.009 (2.7% MPC)
Calendar Year 1991 - RO Building (two months of sampling data)	0.012 (3.6% MPC)	0.019 (5.8% MPC)
Calendar Year 1991 - Commercial Plant (twelve months of sampling data)	0.036 (11% MPC)	0.060 (18.2% MPC)
Calendar Year 1992	0.035 (10.7% MPC)	0.061 (18.5% MPC)
Calendar Year 1993	0.038 (11.8% MPC)	0.061 (18.5% MPC)
Calendar Year 1994	0.032 (9.6% DAC)	0.046 (13.9% DAC)

Notes:

1 Samples prior to January 1, 1994 compared to MPC where MPC=0.33 WL (10 CFR §§ 20.1 - 20.601 App B).

2 Samples after January 1, 1994 compared to the DAC where DAC= 0.33 WL (10 CFR §§ 20.1001-2401 App B)

Air sampler calibration will be performed in accordance with the instructions contained in EMS Program Volume IV, *Health Physics Manual.*

5.8.3.3. RESPIRATORY PROTECTION PROGRAM

Respiratory protective equipment has been supplied by CBR for activities where engineering controls may not be adequate to maintain acceptable levels of airborne radioactive materials or toxic materials. Use of respiratory equipment at Crow Butte Uranium Project is in accordance with the procedures currently set forth in the EMS Program Volume IV, *Health Physics Manual*

The respirator program is designed to implement the guidance contained in USNRC Regulatory Guide 8.15, *Acceptable Programs For Respiratory Protection.* The respirator program is administered by the RSO as the Respiratory Protection Program Administrator (RPPA).

5.8.4. EXPOSURE CALCULATIONS

Employee internal exposure to airborne radioactive materials has been determined at the Crow Butte Uranium Project facility since commercial operations began in 1991. Since January 1, 1994, CBR has determined internal exposures based upon the requirements of 10 CFR § 20.1204. Prior to January 1, 1994, internal exposure was calculated using the MPC-Hour method based upon 10 CFR § 20.103. Following is a discussion of the exposure calculation methods and results.

5.8.4.1. NATURAL URANIUM EXPOSURE

Exposure calculations for airborne natural uranium are carried out using the intake method from USNRC Regulatory Guide 8.30, *Health Physics Surveys in Uranium Recovery Facilities*, Revision 1, Section 2. The intake is calculated using the following equation:

$$I_u = b\sum_{i=1}^{n}\frac{X_i \times t_i}{PF}$$

where:

I_u	=	uranium intake, µg or µCi
t_i	=	time that the worker is exposed to concentrations X_i (hr)
X_i	=	average concentration of uranium in breathing zone, µg/m^3, µCi/m^3
b	=	breathing rate, 1.2 m^3/hr
PF	=	the respirator protection factor, if applicable
n	=	the number of exposure periods during the week or quarter

The intake for uranium is calculated on Time Weighted Exposure (TWE) forms. The intakes are totaled and entered onto each employee's Occupational Exposure Record.

The data required to calculate internal exposure to airborne natural uranium is determined as follows:

Time of Exposure Determination

100% occupancy time is used to determine routine worker exposures. Exposures during non-routine work are always based upon actual time.

Airborne Uranium Activity Determination

Airborne uranium activity is determined from surveys performed as described in Section 5.8.3.1.

Historical Program Results

Table 5.8-4 summarizes internal exposure results at Crow Butte Uranium Project from airborne uranium. The data shows that internal exposure at Crow Butte Uranium Project has been maintained ALARA. The maximum individual internal exposure to airborne uranium during the period from 1990 through 1994 was less than 1% of the allowable regulatory limit.

Proposed Airborne Uranium Exposure Monitoring Program

CBR proposes to institute the same internal airborne uranium exposure calculation methods at Crow Butte Uranium Project that have been used to date and which are currently contained in EMS Program Volume IV, *Health Physics Manual.* Exposures to airborne uranium will be compared to the DAC for the "D" solubility class for natural uranium from appendix B of 10 CFR §§20.1001 - 20.2401 (5 E-10 μCi/ml) for all areas of the plant.

Table 5.8-4: Annual Airborne Uranium Exposure Results

AIRBORNE URANIU EXPOSURE MONITORING PERIOD	AVERAGE AIRBORNE URANIUM EXPOSURE (µCi)[1]	MAXIMUM AIRBORNE URANIUM EXPOSURE (µCi)[1]
Calendar Year 1990	3.39×10^{-4}	6.08×10^{-4}
Calendar Year 1991	7.20×10^{-4}	1.38×10^{-3}
Calendar Year 1992	7.44×10^{-4}	1.59×10^{-3}
Calendar Year 1993	6.74×10^{-4}	1.26×10^{-3}
Calendar Year 1994	3.66×10^{-3}	9.03×10^{-3}

Notes: [1] The annual uranium intake limit for calendar years 1990 through 1993 was 0.252 µCi based upon 10 CFR 20.103.

In1994, the annual limit on intake (ALI) was 1 µCi based upon "D" class natural uranium.

5.8.4.2. RADON DAUGHTER EXPOSURE

Exposure calculations for airborne radon daughters are carried out using the intake method from USNRC Regulatory Guide 8.30, *Health Physics Surveys in Uranium Recovery Facilities*, Revision 1, Section 2. The radon daughter intake is calculated using the following equation:

$$I_r = \frac{1}{170} \sum_{i=1}^{n} \frac{W_i \times t_i}{PF}$$

where:

I_r	=	radon daughter intake, working-level months
t_i	=	time that the worker is exposed to concentrations W_i (hr)
W_i	=	average number of working levels in the air near the worker's breathing zone during the time (t_i)
170	=	number of hours in a working month
PF	=	the respirator protection factor, if applicable
n	=	the number of exposure periods during the year

The data required to calculate exposure to radon daughters is determined as follows:

<u>Time of Exposure Determination</u>

100% occupancy time is used to determine routine worker exposure times. Exposures during non-routine work are always based upon actual time.

Radon Daughter Concentration Determination

Radon-222 daughter concentrations are determined from surveys performed as described in Section 5.8.3.2.

The working-level months for radon daughter exposure are calculated on the appropriate forms. The working-level months are totaled and entered onto each employee's Occupational Exposure Record.

Historical Program Results

Table 5.8-5 summarizes the results of radon daughter exposure calculations at Crow Butte Uranium Project since 1990. The data shows that internal exposure due to radon daughters at Crow Butte Uranium Project has been maintained ALARA. The maximum individual internal exposure to radon daughters during the period from 1990 through 1994 was 0.502 working-level months or approximately 12.5% of the allowable regulatory limit of 4 working-level months. The maximum annual average internal exposure to radon daughters was 0.258 working-level months, which is approximately 6.5% of the regulatory limit.

Proposed Radon Daughter Exposure Monitoring Program

CBR proposes to institute the same internal radon daughter exposure calculation methods at Crow Butte Uranium Project that have been used to date and which are currently contained in EMS Program Volume IV, *Health Physics Manual*. Exposures to radon daughters will be compared to the DAC for radon daughters from Appendix B of 10 CFR §§20.1001 - 20.2401 (0.33 WL).

Table 5.8-5: Annual Radon Daughter Exposure Results

RADON DAUGHTER EXPOSURE MONITORING PERIOD	AVER/ INDIVIDUAL EXPOSURE (WORKING-LEVEL MONTHS)[1]	MAXIM INDIVIDUAL EXPOSURE (WORKING-LEVEL MONTHS)[1]
Calendar Year 1990	0.062	0.117
Calendar Year 1991	0.257	0.477
Calendar Year 1992	0.227	0.468
Calendar Year 1993	0.258	0.502
Calendar Year 1994	0.188	0.418

Notes:
1 The annual limit was 4 working-level months.

5.8.5. BIOASSAY PROGRAM

Program Description

CBR has implemented a urinalysis bioassay program at the Crow Butte Uranium Project facilities that meets the guidelines contained in USNRC Regulatory Guide 8.22, *Bioassay at Uranium Mills*, Revision 1. The primary purpose of the program is to detect uranium intake in employees who are regularly exposed to uranium. The bioassay program consisted of the following elements:

1. Prior to assignment to the facility, all new employees are required to submit a baseline urinalysis sample. Upon termination, an exit bioassay is required. Additionally, bioassay samples are obtained annually from all employees.

2. During operations, urine samples are collected from workers whose routine work assignment requires them to enter areas where the potential for inhalation of yellowcake exists. Samples from these workers are collected on a quarterly frequency. Workers who have the potential for exposure to dried yellowcake are sampled on a monthly basis. Samples are analyzed by an outside analytical laboratory for uranium content. Blank and spiked samples are also submitted to the laboratory with employee samples as part of the Quality Assurance program. The measurement sensitivity for the analytical laboratory is 5 μg/l.

3. Action levels for urinalysis are established based upon Table 1 in USNRC Regulatory Guide 8.22, *Bioassay at Uranium Mills*, Revision 1.

4. *In vivo* measurements are performed in accordance with the recommendations contained in Regulatory Guide 8.22, *Bioassay in Uranium Mills*, Revision 1. Since CBR does not produce insoluble, high-fired yellowcake (defined as yellowcake dried at greater than 400°C), no *in vivo* measurements have been required.

Historical Program Results

Following is a summary of the results of the bioassay program since 1990.

1990

All bioassay samples were reported at less than the 5 µg/l detection limit.

1991

All bioassay samples were reported at less than the 5 µg/l detection limit.

1992

All bioassay samples were reported at less than the 5 µg/l detection limit.

1993

All bioassay samples were reported at less than the 5 µg/l detection limit.

1994

All bioassay samples were reported at or less than the 5 µg/l detection limit with the exception of one sample which was 13.9 µg/l. Resamples of the individual that submitted this sample were less than 5 µg/l.

Bioassay Quality Assurance Program Description and Historical Results

Elements of the Quality Assurance requirements for the Bioassay Program are based upon the guidelines contained in USNRC Regulatory Guide 8.22, *Bioassay in Uranium Mills*, Revision 1. These elements included the following:

1. Each batch of samples submitted to the analytical laboratory is accompanied by two blind control samples. The control samples are from persons that have not been occupationally exposed and are spiked to a uranium concentration of 10 to 20 µg/l and 40 to 60 µg/l. The results of analysis for these samples are required to be within ± 30% of the spiked value. CBR has tracked the results of the blind spike analysis since 1990. All analytical results have fallen within the acceptable range.

2. The analytical laboratory spikes 10 to 30% of all samples received with known concentrations of uranium and the recovery fraction determined. Results are reported to CBR. All results have been within ± 30%.

Proposed Bioassay Program

CBR proposes to continue to implement the Bioassay Program including urinalysis and *in vivo measurements* as described in this Section in accordance with the guidance contained in USNRC Regulatory Guide 8.22, *Bioassay in Uranium Mills*, Revision 1 and with the instructions currently contained in EMS Program Volume IV, *Health Physics Manual.*

5.8.6. CONTAMINATION CONTROL PROGRAM

CBR's contamination control program at Crow Butte Uranium Project consists of the following elements:

Surveys For Surface Contamination

CBR performs surveys for surface contamination in operating and clean areas of the Crow Butte Uranium Project facilities in accordance with the guidelines contained in USNRC Regulatory Guide 8.30, *Health Physics Surveys in Uranium Recovery Facilities*, Revision 1. Surveys for alpha contamination in clean areas such as lunchrooms change rooms and offices are conducted weekly. An action level of 25% of the limits from USNRC Regulatory Guide 8.30 is used for clean areas.

Surveys For Contamination of Skin and Personal Clothing

All personnel leaving the restricted area are required to perform and document alpha contamination monitoring. In addition, personnel who could come in contact with potentially contaminated solutions outside a restricted area such as in the wellfields are required to monitor themselves prior to leaving the area. All personnel receive training in the performance of surveys for skin and personal contamination. Personnel are also allowed to conduct contamination monitoring of small, hand-carried items as long as all surfaces can be reached with the instrument probe and the item does not originate in yellowcake areas. All other items are surveyed as described in the next Section.

As recommended in USNRC Regulatory Guide 8.30, *Health Physics Surveys in Uranium Recovery Facilities* Revision 1, CBR conducts quarterly unannounced spot checks of personnel to verify the effectiveness of the surveys for personnel contamination. A spot check of the employees assigned to the mine site is conducted, concentrating on plant operators and maintenance personnel. The purpose of the surveys is to ensure that employees are adequately surveying and decontaminating themselves prior to exiting the restricted areas.

Surveys of Equipment Prior to Release to an Unrestricted Area

The RSO, radiation safety staff or properly trained employees perform surveys of all items from the restricted areas with the exception of small, hand-carried items described above. The release limits are set by *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted*

Use or Termination of Licenses For Byproduct, Source, or Special Nuclear Materials, NRC, May 1987 ("Annex B"). Surveys are performed with the following equipment:

1. Portable alpha count rate meter, Ludlum 2245 and a Ludlum 43-65 alpha probe, or equivalent.

2. Portable GM survey meter with a beta/gamma probe with an end window thickness of not more than 7 mg/cm^2, Ludlum Model 3 survey meter with a Ludlum 44-38 probe or equivalent.

3. Swipes for removable contamination surveys as required.

Historical Program Results

The weekly contamination survey results indicate that the contamination control program at the Crow Butte Uranium Project is effective. The quarterly spot checks performed throughout the period show that the personnel contamination program is effective. Results of the contamination surveys, spot checks and equipment release surveys are maintained at the Crow Butte Uranium Project site.

Proposed Contamination Control Program

- CBR proposes to implement the same contamination control program that is currently in use. The program has proven to be effective at controlling contamination of personnel and clean areas. The program will be implemented in accordance with the instructions currently contained in EMS Program Volume IV, *Health Physics Manual*

5.8.7. AIRBORNE EFFLUENT AND ENVIRONMENTAL MONITORING PROGRAMS

Program Description and Historical Monitoring Results

The airborne effluent and environmental monitoring programs are designed to monitor the release of airborne radioactive effluents from the Crow Butte Uranium Project facilities. To evaluate the effectiveness of the effluent control systems, the results of the monitoring program are compared with the background levels and with regulatory limits. Table 5.8-6 provides the sampling locations, types, frequency, methods, and parameters for the Crow Butte Uranium Project facilities. CBR performs environmental sampling and gamma exposure monitoring as indicated in Table 5.8-6.

Radon

The radon gas effluent released to the environment is monitored at seven locations (AM-1 through AM-6 and AM-8). Monitoring is performed using Track-Etch radon cups provided by Landauer Corporation. The cups are exchanged on a quarterly basis. CBR received approval from the NRC and has changed the sampling frequency for environmental radon to semiannually effective March 1998. EMS Program Volume VI, *Environmental Manual* currently provides the instructions for radon gas monitoring. In addition to the manufacturer's Quality Assurance program, CBR exposes two duplicate radon Track Etch cups per each monitoring period at locations AB-3 and AB-6. Table 5.8-7 contains the results of radon monitoring for the Crow Butte Uranium Project facility since 1991.

In addition to the environmental monitoring performed at the Crow Butte Uranium Project, release of radon from process operations is estimated and reported in the semi-annual reports required by 10 CFR § 40.65 and License SUA-1534 Condition Number 12.1. Table 5.8-8 contains annual calculated radon releases from the Crow Butte Uranium Project Facility since 1991.

Air Particulate

CBR performs low volume air particulate sampling at the seven environmental monitoring stations for a minimum of two weeks per month during dryer operations. Filters are collected and then composited for analysis on a quarterly basis. The results of air particulate sampling performed since 1991 are shown in Table 5.8-9.

Surface Soil

Surface soil has been sampled as described in Table 5.8-6. Surface soil samples will be taken at the air monitoring locations following conclusion of operations and will be compared to the results of the preoperational monitoring program.

Subsurface Soil

Subsurface soil has been sampled at the plant as described in Table 5.8-6. Subsurface soil samples will be taken following conclusion of operations and will be compared to the results of the preoperational monitoring program.

Vegetation

Vegetation samples from Crow Butte Uranium Project were collected on an annual basis in animal grazing areas in the direction of the prevailing wind as described in Table 5.8-6. Sampling was normally performed during the summer months. The samples were collected using the following procedures:

- A minimum of one pound of vegetation was composited on three occasions during the grazing season. The materials collected were primarily the seed/flower head and leafy portions of grasses and forbes along with young shoots of shrubs. Vegetation was analyzed for natural uranium, radium-226, thorium-230, lead-210 and polonium-210. The results of annual vegetation sampling at the Crow Butte Uranium Project facility are presented in Table 5.8-10.

Table 5.8-6: Operational Environmental and Effluent Monitoring Program

Sample Type	Location	Type	Number	Frequency	Analyses
Air (Radon)	Nearest residences and in the prevalent wind direction	Continuous	6	Semiannually	Rn-222
	Environmental control station near Crawford, NE.		1		
Air (particulate)	Same locations as radon air monitoring	Continuous	7	A minimum of 2 weeks per month when dryer is in use	U-nat Ra-226 Pb-210
Surface Soil (top 5 cm)	Plant site before topsoil removal	Grab	2	Once	U-nat Ra-226
	Plant site after topsoil removal	Grab	2	Once	U-nat Ra-226
	Evaporation ponds before excavation	Grab	2	Once	U-nat Ra-226
	Air sampling stations	Grab	7	Once	U-nat Ra-226
Subsurface soil	Plant site	1/3 meter composites to one meter	1	Once	U-nat Ra-226
Groundwater	Water supply wells within 1 km of area wellfield	Grab	1	Quarterly	U-nat Ra-226

Table 5.8-6: Operational Environmental and Effluent Monitoring Program

Sample Type	Location	Type	Number	Frequency	Analyses
Surface water	Each stream passing through wellfield area (one upstream and one downstream)	Grab	2	Quarterly	U-nat Ra-226
	Each water impoundment in wellfield area	Grab	1	Quarterly	U-nat Ra-226
Direct Radiation	Air sampling stations	Continuous	7	Quarterly exchange of dosimeters	External gamma
Sediment	Each body of water where surface water sampling is performed	Grab upstream and downstream of wellfields	1 or 2	Annually	U-nat Ra-226 Pb-210

Table 5.8-7: Ambient Radon Gas Monitoring Results (pCi\L)

	MONITORING LOCATION								
MONITORING PERIOD	AM-1	AM-2	AM-3	AM-4	AM-5	AM-6	AM-8	AB-3 (AM-3)	AB-6 (AM-6)
First Quarter, 1991	0.3	0.3	0.5	0.5	0.4	0.5	0.3	0.3	0.4
Second Quarter, 1991	0.3	0.3	0.3	0.5	0.3	0.3	0.3	0.3	0.3
Third Quarter, 1991	0.3	0.6	0.3	0.9	0.4	1.0	0.6	0.3	0.5
Fourth Quarter, 1991	0.3	0.5	0.6	0.9	0.7	0.3	0.4	0.4	0.6
First Quarter, 1992	0.5	0.5	0.5	0.7	0.7	0.6	< 0.3	0.5	0.7
Second Quarter, 1992	0.7	0.4	0.3	0.7	0.4	0.6	0.7	0.6	< 0.3
Third Quarter, 1992	< 0.3	0.3	< 0.3	0.5	0.4	< 0.3	0.5	< 0.3	< 0.3
Fourth Quarter, 1992	0.4	0.4	0.5	0.7	0.9	0.7	0.7	0.6	0.3
First Quarter, 1993	0.5	0.4	0.5	< 0.3	0.5	< 0.3	< 0.3	< 0.3	< 0.3
Second Quarter, 1993	0.4	0.6	< 0.3	0.4	0.5	0.4	0.6	< 0.3	< 0.3
Third Quarter, 1993	0.5	1.0	0.6	1.0	0.6	0.4	0.4	0.4	0.5
Fourth Quarter, 1993	0.7	0.9	0.6	0.6	1.1	0.7	0.8	0.6	0.7
First Quarter, 1994	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Second Quarter, 1994	0.6	0.6	0.4	0.5	0.6	< 0.3	0.6	0.5	0.4
Third Quarter, 1994	0.9	0.7	0.9	0.7	0.8	0.8	0.8	0.5	0.7
Fourth Quarter, 1994	0.5	0.5	0.4	0.5	0.8	0.3	0.7	< 0.3	0.5

Notes: All values are given in units of pCi/L.
Monitoring Locations AB-3 and AB-6 are co-located with stations AM-3 and AM-6.

Table 5.8-8: Radon Release to the Environment (Curies)

Year	1991	1992	1993	1994
First Quarter	0	325	600	753
Second Quarter	308	435	637	776
Startup	13	16	11	7
Semi-Annual Total	321	776	1248	1536
Third Quarter	334	527	673	793
Fourth Quarter	329	572	700	808
Startup	0	0	6	16
Semi-Annual Total	663	1099	1379	1617
Annual Total	984	1875	2627	3153

Table 5.8-9: Environmental Air Particulate Monitoring Results

Station	Period	U-Nat (10^{-16} µCi/ml)	Th-230 (10^{-16} µCi/ml)	Ra-226 (10^{-16} µCi/ml)	Pb-210 (10^{-16} µCi/ml)	Volume of Air Sampled M^3
AM-1	First Quarter, 1991	< 1.00	< 1.00	10.1	175	2810
AM-1	Second Quarter, 1991	< 1.00	< 1.00	2.17	91.2	2610
AM-1	Third Quarter, 1991	4.38	< 1.00	< 1.00	151	2590
AM-1	Fourth Quarter, 1991	9.61	< 1.00	9.98	45.5	2560
AM-1	First Quarter, 1992	< 1.00	< 1.00	1.46	300	2590
AM-1	Second Quarter, 1992	7.33	< 1.00	1.47	88.3	2590
AM-1	Third Quarter, 1992	None	None	None	None	None
AM-1	Fourth Quarter, 1992	None	None	None	None	None
AM-1	First Quarter, 1993	None	None	None	None	None
AM-1	Second Quarter, 1993	None	None	None	None	None
AM-1	Third Quarter, 1993	None	None	None	None	None
AM-1	Fourth Quarter, 1993	17.9	< 1.00	7.63	171	2120
AM-1	First Quarter, 1994	5.56	< 1.00	15.0	187	2220
AM-1	Second Quarter, 1994	5.73	< 1.00	11.9	134	2160
AM-1	Third Quarter, 1994	70.9	<1.00	8.87	193	2140
AM-1	Fourth Quarter, 1994	2.7	<1.00	< 1.00	200	2110
AM-2	First Quarter, 1991	< 1.00	< 1.00	< 1.00	224	2810
AM-2	Second Quarter, 1991	< 1.00	< 1.00	4.34	88.9	2610

Table 5.8-9: Environmental Air Particulate Monitoring Results

Station	Period	U-Nat (10^{-16} µCi/ml)	Th-230 (10^{-16} µCi/ml)	Ra-226 (10^{-16} µCi/ml)	Pb-210 (10^{-16} µCi/ml)	Volume of Air Sampled M^3
AM-2	Third Quarter, 1991	4.35	< 1.00	< 1.00	99.4	2600
AM-2	Fourth Quarter, 1991	4.81	< 1.00	< 1.00	71.8	2560
AM-2	First Quarter, 1992	2.19	< 1.00	< 1.00	246	2590
AM-2	Second Quarter, 1992	2.56	< 1.00	8.43	99.6	2590
AM-2	Third Quarter, 1992	None	None	None	None	None
AM-2	Fourth Quarter, 1992	None	None	None	None	None
AM-2	First Quarter, 1993	None	None	None	None	None
AM-2	Second Quarter, 1993	None	None	None	None	None
AM-2	Third Quarter, 1993	None	None	None	None	None
AM-2	Fourth Quarter, 1993	9.7	< 1.00	4.85	127	2150
AM-2	First Quarter, 1994	4.2	< 1.00	8.4	205	2260
AM-2	Second Quarter, 1994	6.65	< 1.00	8.42	105	2140
AM-2	Third Quarter, 1994	8.02	< 1.00	4.46	193	2130
AM-2	Fourth Quarter, 1994	5.1	< 1.00	< 1.00	210	2050
AM-3	First Quarter, 1991	< 1.00	< 1.00	< 1.00	266	2810
AM-3	Second Quarter, 1991	< 1.00	< 1.00	4.39	77.5	2580
AM-3	Third Quarter, 1991	58.2	< 1.00	< 1.00	137	2600
AM-3	Fourth Quarter, 1991	4.81	< 1.00	1.48	51.4	2560

Table 5.8-9: Environmental Air Particulate Monitoring Results

Station	Period	U-Nat (10^{-16} µCi/ml)	Th-230 (10^{-16} µCi/ml)	Ra-226 (10^{-16} µCi/ml)	Pb-210 (10^{-16} µCi/ml)	Volume of Air Sampled M^3
AM-3	First Quarter, 1992	2.19	< 1.00	2.92	141	2580
AM-3	Second Quarter, 1992	< 1.00	< 1.00	1.84	121	2590
AM-3	Third Quarter, 1992	None	None	None	None	None
AM-3	Fourth Quarter, 1992	None	None	None	None	None
AM-3	First Quarter, 1993	None	None	None	None	None
AM-3	Second Quarter, 1993	None	None	None	None	None
AM-3	Third Quarter, 1993	None	None	None	None	None
AM-3	Fourth Quarter, 1993	6.56	< 1.00	4.81	104	2170
AM-3	First Quarter, 1994	14.6	< 1.00	< 1.00	190	2280
AM-3	Second Quarter, 1994	7.45	< 1.00	6.57	129	2170
AM-3	Third Quarter, 1994	4.85	< 1.00	2.20	238	2160
AM-3	Fourth Quarter, 1994	< 1.00	< 1.00	< 1.00	162	2170
AM-4	First Quarter, 1991	< 1.00	< 1.00	4.78	275	2770
AM-4	Second Quarter, 1991	< 1.00	< 1.00	5.11	< 20	2590
AM-4	Third Quarter, 1991	< 1.00	< 1.00	< 1.00	167	2600
AM-4	Fourth Quarter, 1991	4.81	< 1.00	< 1.00	20.7	2560
AM-4	First Quarter, 1992	2.2	< 1.00	< 1.00	178	2580
AM-4	Second Quarter, 1992	< 1.00	< 1.00	< 1.00	63.2	2580

Table 5.8-9: Environmental Air Particulate Monitoring Results

Station	Period	U-Nat (10^{-16} µCi/ml)	Th-230 (10^{-16} µCi/ml)	Ra-226 (10^{-16} µCi/ml)	Pb-210 (10^{-16} µCi/ml)	Volume of Air Sampled M^3
AM-4	Third Quarter, 1992	None	None	None	None	None
AM-4	Fourth Quarter, 1992	None	None	None	None	None
AM-4	First Quarter, 1993	None	None	None	None	None
AM-4	Second Quarter, 1993	None	None	None	None	None
AM-4	Third Quarter, 1993	None	None	None	None	None
AM-4	Fourth Quarter, 1993	5.86	< 1.00	4.18	156	2270
AM-4	First Quarter, 1994	7.58	< 1.00	1.00	198	2380
AM-4	Second Quarter, 1994	5.79	< 1.00	12.5	114	2130
AM-4	Third Quarter, 1994	10.8	< 1.00	7.17	296	2120
AM-4	Fourth Quarter, 1994	2.67	< 1.00	< 1.00	233	2140
AM-5	First Quarter, 1991	67.7	< 1.00	< 1.00	277	2780
AM-5	Second Quarter, 1991	< 1.00	< 1.00	4.35	< 20	2610
AM-5	Third Quarter, 1991	< 1.00	< 1.00	3.63	160	2600
AM-5	Fourth Quarter, 1991	4.82	< 1.00	1.11	36.6	2560
AM-5	First Quarter, 1992	< 1.00	< 1.00	1.46	178	2590
AM-5	Second Quarter, 1992	2.56	< 1.00	9.52	127	2590
AM-5	Third Quarter, 1992	None	None	None	None	None
AM-5	Fourth Quarter, 1992	None	None	None	None	None

Table 5.8-9: Environmental Air Particulate Monitoring Results

Station	Period	U-Nat (10^{-16} µCi/ml)	Th-230 (10^{-16} µCi/ml)	Ra-226 (10^{-16} µCi/ml)	Pb-210 (10^{-16} µCi/ml)	Volume of Air Sampled M^3
AM-5	First Quarter, 1993	None	None	None	None	None
AM-5	Second Quarter, 1993	None	None	None	None	None
AM-5	Third Quarter, 1993	None	None	None	None	None
AM-5	Fourth Quarter, 1993	1	< 1.00	1.00	164	2290
AM-5	First Quarter, 1994	12.3	< 1.00	1.00	217	2400
AM-5	Second Quarter, 1994	3.1	< 1.00	12.8	161	2150
AM-5	Third Quarter, 1994	4.9	< 1.00	4.01	252	2130
AM-5	Fourth Quarter, 1994	2.69	< 1.00	1.00	235	2120
AM-6	First Quarter, 1991	23.5	< 1.00	6.12	275	2780
AM-6	Second Quarter, 1991	< 1.00	< 1.00	2.17	< 20	2610
AM-6	Third Quarter, 1991	8.72	< 1.00	< 1.00	129	2600
AM-6	Fourth Quarter, 1991	4.81	< 1.00	< 1.00	76.1	2560
AM-6	First Quarter, 1992	< 1.00	< 1.00	< 1.00	286	2590
AM-6	Second Quarter, 1992	< 1.00	< 1.00	4.02	103	2600
AM-6	Third Quarter, 1992	None	None	None	None	None
AM-6	Fourth Quarter, 1992	None	None	None	None	None
AM-6	First Quarter, 1993	None	None	None	None	None
AM-6	Second Quarter, 1993	None	None	None	None	None

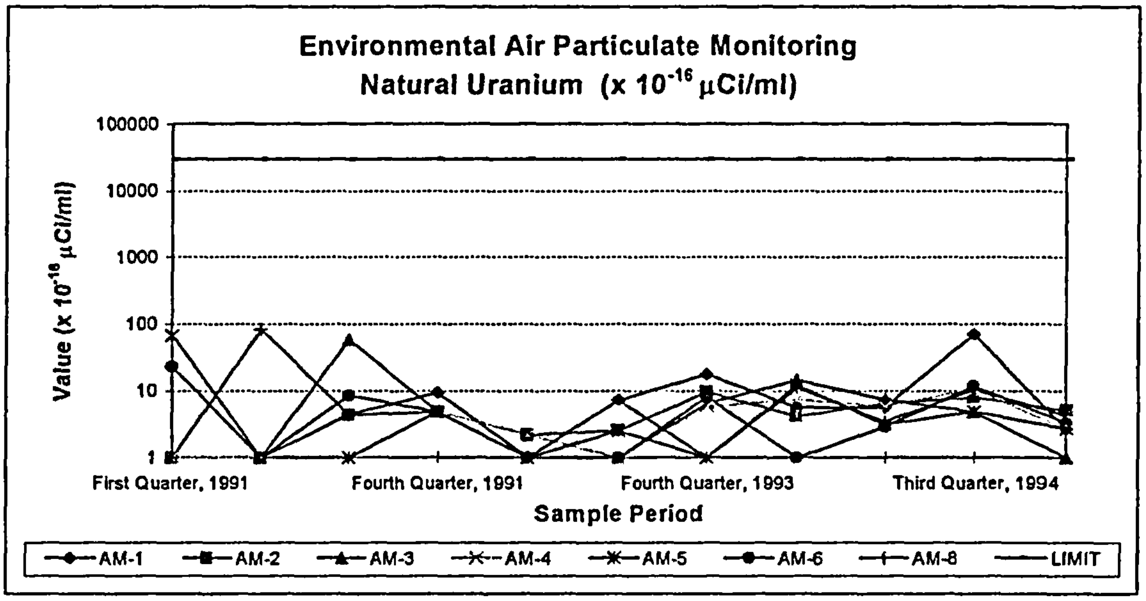
Table 5.8-9: Environmental Air Particulate Monitoring Results

Station	Period	U-Nat (10^{-16} µCi/ml)	Th-230 (10^{-16} µCi/ml)	Ra-226 (10^{-16} µCi/ml)	Pb-210 (10^{-16} µCi/ml)	Volume of Air Sampled M^3
AM-6	Third Quarter, 1993	None	None	None	None	None
AM-6	Fourth Quarter, 1993	8.27	< 1.00	6.10	146	2180
AM-6	First Quarter, 1994	< 1.00	< 1.00	2.49	173	2290
AM-6	Second Quarter, 1994	2.92	< 1.00	12.5	130	2280
AM-6	Third Quarter, 1994	11.9	< 1.00	2.54	233	2240
AM-6	Fourth Quarter, 1994	3.36	< 1.00	< 1.00	208	2270
AM-8	First Quarter, 1991	< 1.00	< 1.00	6.05	253	2810
AM-8	Second Quarter, 1991	82.5	< 1.00	3.62	< 20	2610
AM-8	Third Quarter, 1991	4.36	< 1.00	< 1.00	109	2600
AM-8	Fourth Quarter, 1991	4.82	< 1.00	1.48	43.4	2560
AM-8	First Quarter, 1992	< 1.00	< 1.00	4.38	290	2590
AM-8	Second Quarter, 1992	7.33	< 1.00	< 1.00	95.7	2590
AM-8	Third Quarter, 1992	None	None	None	None	None
AM-8	Fourth Quarter, 1992	None	None	None	None	None
AM-8	First Quarter, 1993	None	None	None	None	None
AM-8	Second Quarter, 1993	None	None	None	None	None
AM-8	Third Quarter, 1993	None	None	None	None	None
AM-8	Fourth Quarter, 1993	1.00	< 1.00	2.11	173	2250

Table 5.8-9: Environmental Air Particulate Monitoring Results

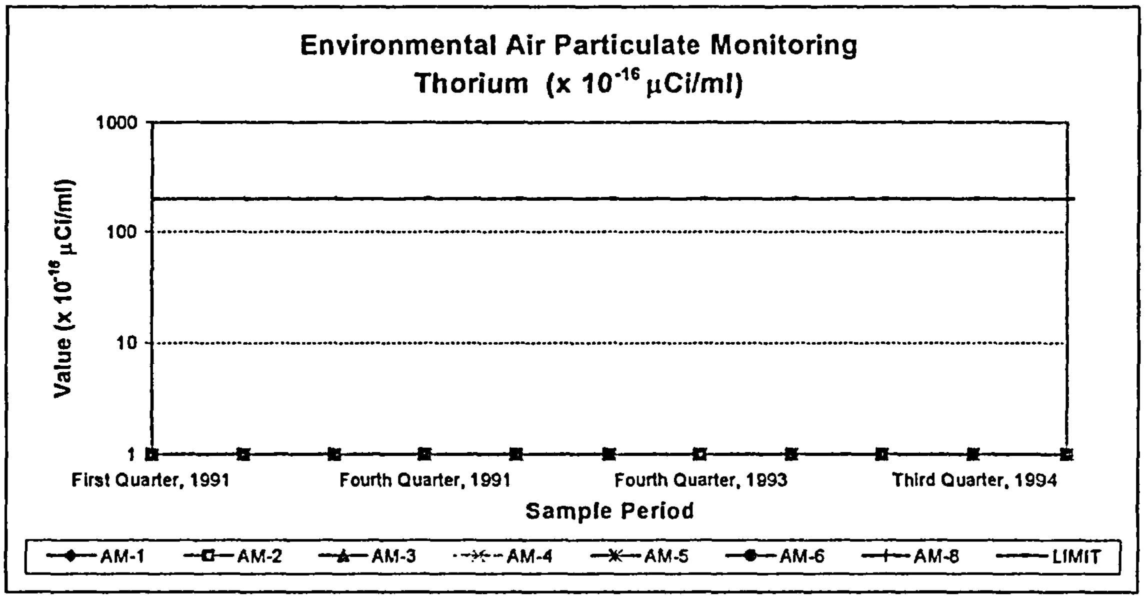
Station	Period	U-Nat (10^{-16} µCi/ml)	Th-230 (10^{-16} µCi/ml)	Ra-226 (10^{-16} µCi/ml)	Pb-210 (10^{-16} µCi/ml)	Volume of Air Sampled M^3
AM-8	First Quarter, 1994	11.3	< 1.00	33.9	147	2360
AM-8	Second Quarter, 1994	3.51	< 1.00	57.4	149	2170
AM-8	Third Quarter, 1994	10.6	< 1.00	4.85	317	2160
AM-8	Fourth Quarter, 1994	4.36	< 1.00	< 1.00	165	2180

Figure 5.8-2: Environmental Air Particulate Monitoring Trend Natural Uranium (x 10^{-16} µCi/ml)



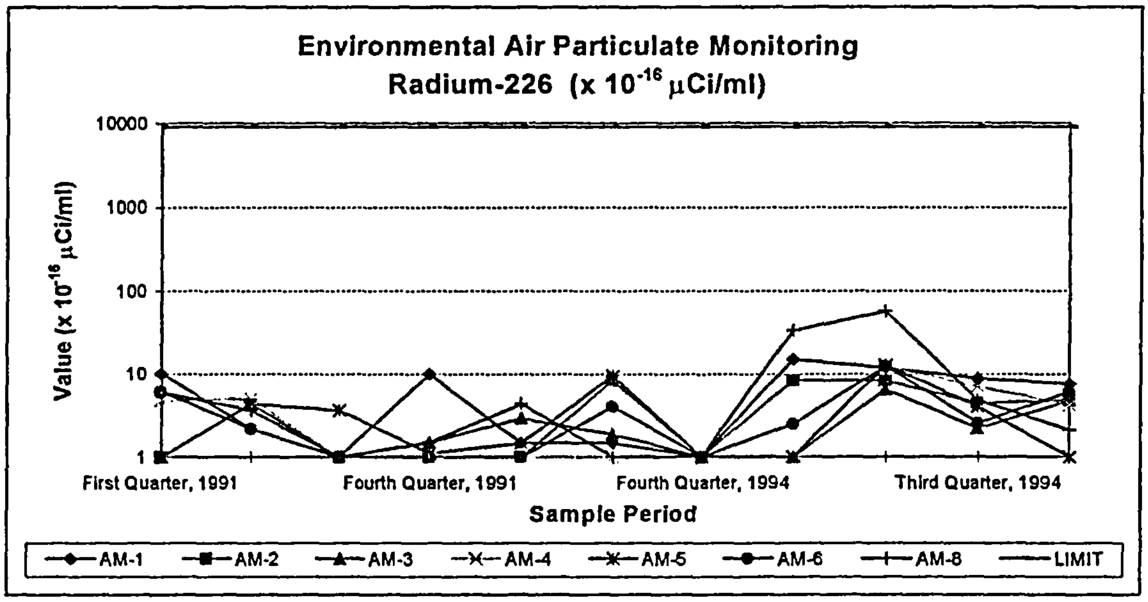
Appendix B to 10 CFR 20.1001 - 20.2401 Table 2 Effluent Concentration in Air Limit is 3.0 x 10^{-12} µCi/ml. This chart is presented on a log scale to accommodate this limit.

Figure 5.8-3: Environmental Air Particulate Monitoring Trend Thorium (x 10^{-16} µCi/ml)



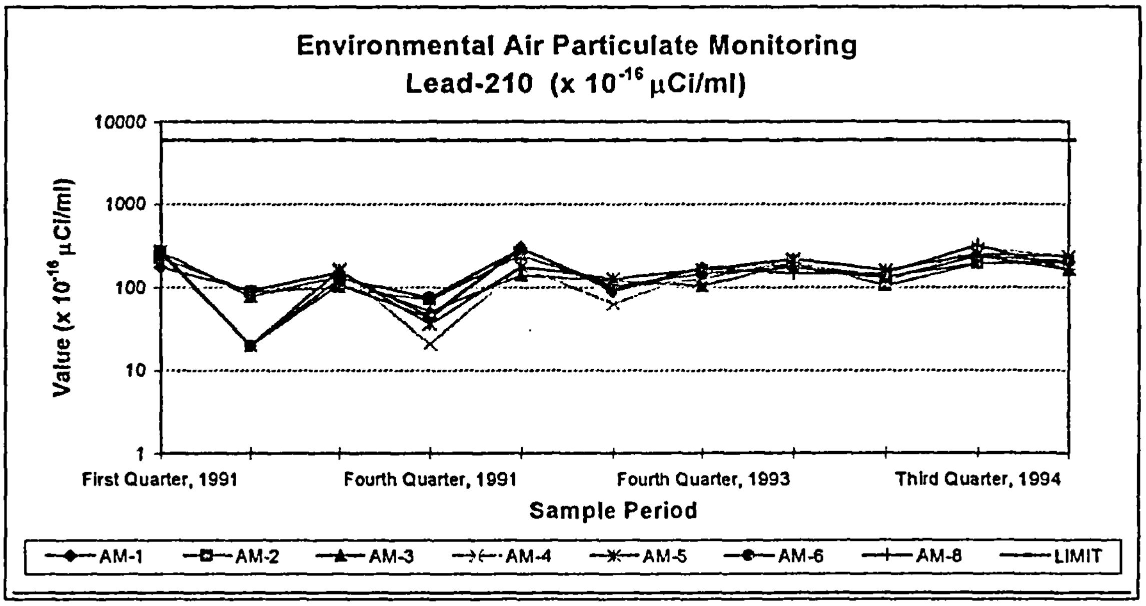
Appendix B to 10 CFR 20.1001 - 20.2401 Table 2 Effluent Concentration in Air Limit is 2.0 x 10^{-14} µCi/ml. This chart is presented on a log scale to accommodate this limit.

Figure 5.8-4: Environmental Air Particulate Monitoring Trend Radium-226 (x 10^{-16} μCi/ml)



Appendix B to 10 CFR 20.1001 - 20.2401 Table 2 Effluent Concentration in Air Limit is 9.0 x 10^{-13} μCi/ml. This chart is presented on a log scale to accommodate this limit.

Figure 5.8-5: Environmental Air Particulate Monitoring Lead-210 (x 10^{-16} μCi/ml)

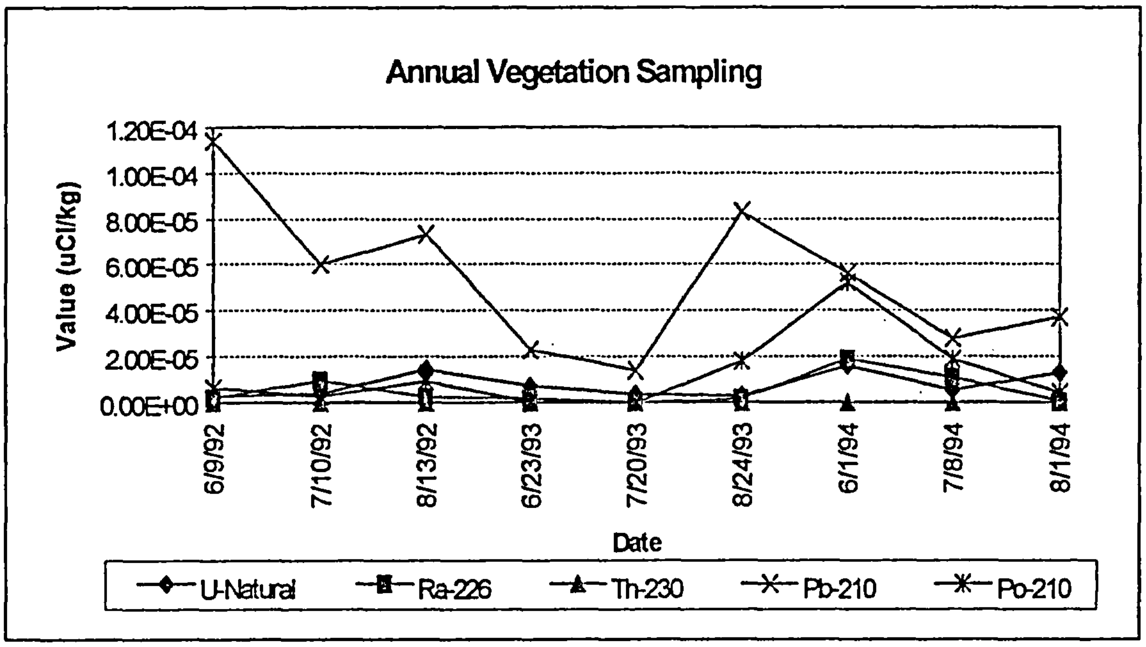


Appendix B to 10 CFR 20.1001 - 20.2401 Table 2 Effluent Concentration in Air Limit is 6.0 x 10^{-13} μCi/ml. This chart is presented on a log scale to accommodate this limit.

Table 5.8-10: Annual Vegetation Sampling Program Results

SAMPLE DATE	U-Natural uCi/kg	Ra-226 uCi/kg	Th-230 uCi/kg	Pb-210 uCi/kg	Po-210 uCi/kg
6/9/92	2.90E-06	2.16E-06	< 1.00E-07	1.14E-04	6.44E-06
7/10/92	4.06E-06	9.67E-06	< 9.67E-08	5.98E-05	2.76E-06
8/13/92	1.47E-05	2.71E-06	9.34E-09	7.34E-05	9.43E-06
6/23/93	7.30E-06	1.80E-06	< 7.50E-08	2.30E-05	< 3.80E-07
7/20/93	3.90E-06	< 3.10E-08	< 3.10E-08	1.40E-05	< 1.60E-07
8/24/93	3.10E-06	1.80E-06	1.70E-08	8.30E-05	1.80E-05
6/1/94	1.60E-05	1.90E-05	< 8.00E-08	5.60E-05	5.20E-05
7/8/94	5.70E-06	1.10E-05	< 6.00E-08	2.80E-05	1.90E-05
8/1/94	1.30E-05	7.00E-07	< 4.30E-08	3.70E-05	4.40E-06

Figure 5.8-6: Annual Vegetation Sampling Trend



Direct Radiation

Environmental gamma radiation levels are monitored continuously at the seven air quality monitoring stations. Gamma radiation is monitored using dosimeters obtained from a qualified vendor. Environmental dosimeters are exchanged on a quarterly basis. Results of the annual gamma radiation monitoring are shown in Table 5.8-11.

Sediment

Sediment in Squaw Creek was sampled at two locations on a semiannual basis for one year prior to any construction in the area. Samples have been taken as described in Table 5.8-6 annually. Samples are taken upstream and downstream of the Crow Butte Uranium Project site and analyzed for natural uranium, radium-226, thorium-230, and lead-210. The results of sediment sampling are shown in Table 5.8-12.

Proposed Airborne Effluent and Environmental Monitoring Program

CBR proposes to continue to implement the Airborne Effluent and Environmental Monitoring Program described in this Section with the following changes.

- CBR has eliminated vegetation sampling in accordance with the provisions of USNRC Regulatory Guide 4.14, *Radiological Effluent and Environmental Monitoring at Uranium Mills*. Footnote (o) to Table 2 requires that "vegetation and forage sampling need be carried out only if dose calculations indicate that the ingestion pathway from grazing animals is a potentially significant exposure pathway..." defined as a pathway which would expose an individual to a dose in excess of 5% of the applicable radiation protection standard. This pathway was evaluated by MILDOS-Area and is discussed further in Section 7.3.

- CBR has changed the frequency of radon detector exchange from quarterly to semiannually. This change will allow CBR to meet the 0.2 pCi/l sensitivity recommended in Regulatory Guide 4.14 and meet the reporting requirements from 10 CFR 40.65 and annual dose requirements from 10 CFR Part 20.

- CBR has discontinued analysis for thorium-230 in air particulate and sediment samples. The design of the vacuum dryer and historical data over seven years of commercial operation has been one percent or less of the 10 CFR 20 limit. Sediment concentrations have also been consistently low.

Table 5.8-11: Area Monitoring Results (mRem)

DATE	1000	1001	1002	1003	1005	1006	1007	1008	1009	1010	1011	1012
	CONT	AM-1	AM-2	AM-6	R&D	WELL	WELL	AM-8	AM-3	AM-4	AM-5	COMM
4/24/91	23.8	30.2	30.6	30	29.2	31.8	34	28	28.2	31.2	33	
7/11/91	27.6	29.4	27.6	26.6	28.6	32.2	31.6	27.4	30	30.2	28.2	30.6
10/10/91	23.8	30.8	27.2	25.8	29.6	34.4	31.4	23.2	30.8	30.2	29.2	29
1/14/92	36.2	43.2	43.4	46.6	44	41.4	54.8	41.6	45.2	41.8	46.6	40.4
4/16/92	26.6	30	31.8	30.6	29.8	34	34	41.8		34.2	35	32.2
7/9/92	34.6	30.4	29.6	31	32	33	32.4	29.8	32.6	30.2	33.2	31
10/14/92	35.8	31.4	32.6	30	31.2	30.4	33.4	27.4	36.2	31.6	30.6	33
1/13/93	36.4	28.2	33.4	32.6	35	35.4	39.8	35.4	33.6	30.4	35.6	31.2
4/16/93	42.6	38.4	34	33.6	37	35.8	40.6	33.2	32.4	36.8	36.8	33.6
7/13/93	43.6	29.2	31.6	30.8	29.8	34.4	34.4	31	31.6	25.8	33.6	30.8
10/11/93	39.8	29	27.2	27.6	31.6	29.8	32.8	26.4	31.4	30	28	26.4
1/14/94	49.4	35.8	32	34.2	34.4	38.4	33.8	32.2	33.2	29.8	32.2	44.4
4/15/94	46.8	33	32.6	42.2	32.2	27.2	40	36.2	40.2	16.4	39.4	35.4
7/19/94	59.2	35.8	37	36.8	38.6	42.6	45.8	36	38.2	43.2	40	41.2
10/14/94	57.2	29.8	29.4	39.6	38.8	16	32.8	32.2	36.8	35.8	39.2	37.2

Sample Locations: 1000: Control; 1005: R&D Pond Gate; 1006: Wellfield
1007: Wellfield; 1012: Commercial Pond Gate

Figure 5.8-7: Area Monitoring Trend (mRem)

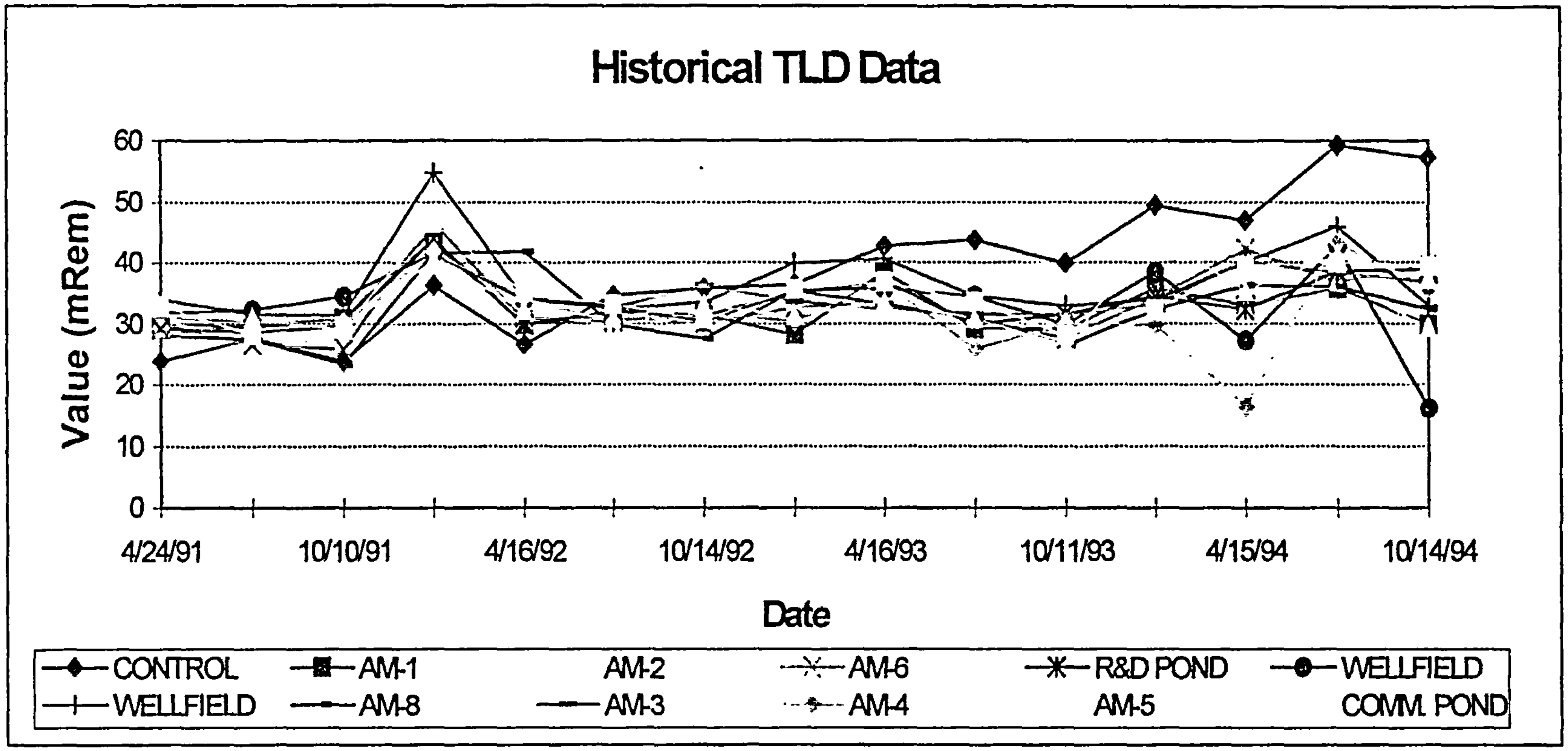


Table 5.8-12: Annual Sediment Sampling Results

Station	Date	U-Natural pCi/g	Radium-226 pCi/g	Th-230 pCi/g	Pb-210 pCi/g
S-2	11/5/92	0.5	0.1		
	11/5/93	< 0.2	0.7	< 0.2	0.3
	10/13/94	0.5	0.4	0.4	1.9
S-3	11/5/92	0.3	0.1		
	11/5/93	0.1	0.4	< 0.2	0.3
	10/13/94	0.3	0.4	< 0.2	1.4

Notes: No analysis done for Th-230 and Pb-210 in 1992.

Figure 5.8-8: Annual Sediment Sampling Trend- Location S-2

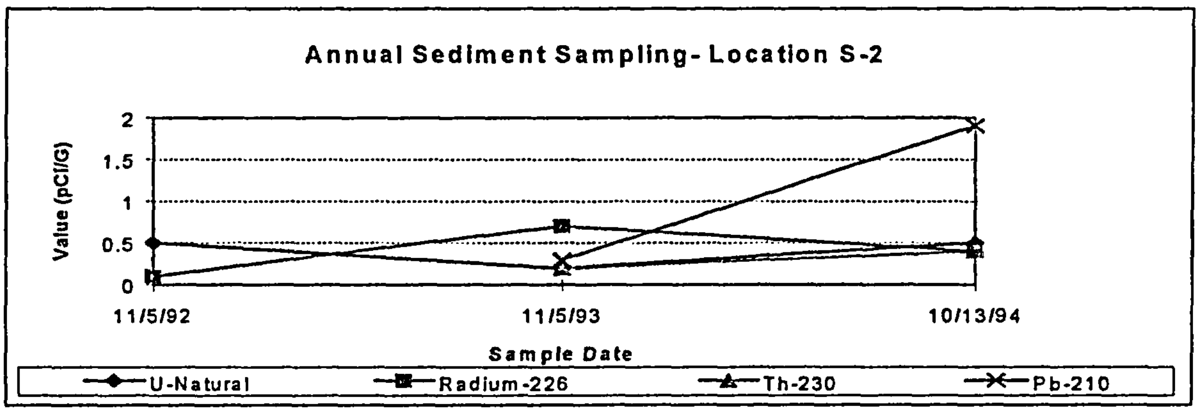
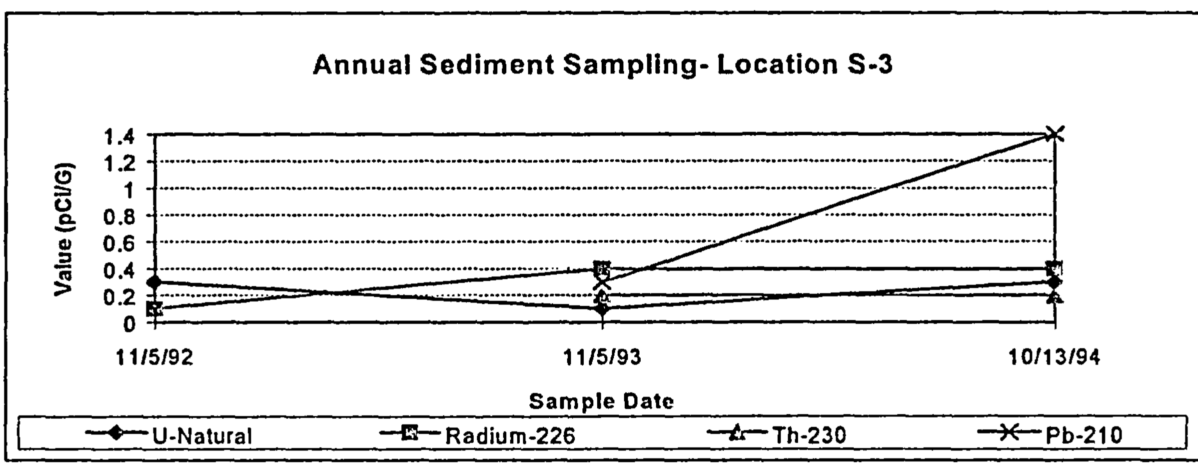


Figure 5.8-9: Annual Stream Sediment Sampling Trend- Location S-3



5.8.8. GROUNDWATER/SURFACE WATER MONITORING PROGRAM

Program Description

During operations at the Crow Butte Uranium Project facilities, a detailed water-sampling program is conducted to identify any potential impacts to water resources of the area. CBR's operational water monitoring program includes the evaluation of groundwater on a regional basis, groundwater within the permit or licensed area and surface water on a regional and site specific basis. An overview of the groundwater and surface water monitoring programs at the Crow Butte Uranium Project can be found in Table 5.8-6.

5.8.8.1. GROUNDWATER MONITORING

The groundwater excursion-monitoring program is designed to detect excursions of lixiviant into the ore zone aquifer outside of the wellfield being leached and into the overlying water bearing strata. The Pierre Shale below the ore zone is over 1200 feet thick and contains no water bearing strata. Therefore, it is not necessary to monitor any water bearing strata below the ore zone.

All private wells and surface waters within one kilometer of the wellfield area boundary are sampled on a quarterly basis. Surface water samples are taken in accordance with the instructions contained in EMS Program Volume VI, *Environmental Manual*. Samples are analyzed for natural uranium and radium-226. The results of this sampling from 1991 to 1994 for uranium are shown in Table 5.8-13 and for radium in Table 5.8-14.

Monitor Well Baseline Water Quality

After delineation of the production unit boundaries, monitor wells are installed approximately 300 feet from the wellfield boundary. After completion, wells are washed out and developed (by air flushing or pumping) until water quality in terms of pH and specific conductivity appear stable and consistent with the anticipated quality of the area. After development, wells are sampled to obtain baseline water quality. For baseline sampling, all wells are purged until field parameters are stable. Quarterly monitor well results are shown for uranium in Table 5.8-15 and for radium in Table 5.8-16. All monitor wells including ore zone and overlying monitor wells are sampled three times at least 14 days apart. The first, second and third samples are analyzed for the excursion indicator parameters (chloride, conductivity, and alkalinity). CBR analyzes one sample for the baseline parameters shown in Table 5.8-17.

Results from the samples are averaged arithmetically to obtain a baseline value as well as an average value for determine upper control limits for excursion detection.

Upper Control Limits and Excursion Monitoring

After baseline water quality is established for the monitor wells for a particular production unit, upper control limits (UCLs) are set for certain chemical constituents which would be indicative of a migration of lixiviant from the well field. The constituents chosen for indicators of lixiviant migration and for which UCLs are set are chloride, conductivity, and total alkalinity. Chloride was chosen due to its low natural levels in the native groundwater and because chloride is introduced into the lixiviant from the ion exchange process (uranium is exchanged for chloride on the ion exchange resin). Chloride is also a very mobile constituent in the groundwater and will show up very quickly in the case of a lixiviant migration to a monitor well. Conductivity was chosen because it is an excellent general indicator of overall groundwater quality. Total alkalinity concentrations should be affected during an excursion, as bicarbonate is the major constituent added to the lixiviant during mining. Water levels are obtained and recorded prior to each well sampling. However, levels were not used as an excursion indicator. All wells are purged until field parameters are stable prior to collection of the sample. Upper control limits are set at 20% above the maximum baseline concentration for the excursion indicator. For excursion indicators with a baseline average below 50 mg/l, the UCL may be determined by adding 5 standard deviations or 15 mg/l to the baseline average for the indicator.

Operational monitoring consists of sampling the monitor wells no more than 14 days apart and analyzing the samples for the excursion indicators chloride, conductivity, and total alkalinity. In special circumstances including inclement weather, wellhead mechanical failure, conditions which place an employee at risk while sampling, and conditions which could cause damage to the environment if sampling was performed, the sampling could be delayed by a period not to exceed 5 days. The circumstances requiring postponement of the sampling will be documented.

Excursion Verification and Corrective Action

During routine sampling, if two of the three UCL values are exceeded in a monitor well, or if one UCL value is exceeded by 20 percent, the well is resampled within 48 hours and analyzed for the excursion indicators. If the second sample does not exceed the UCLs, a third sample is taken within 48. If neither the second or third sample results exceeded the UCLs, the first sample is considered in error.

If the second or third sample verifies an exceedance, the well in question is placed on excursion status. Upon verification of the excursion, the USNRC Project Manager is notified by telephone within 48 hours and notified in writing within thirty (30) days.

If an excursion is verified, the following methods of corrective action are instituted (not necessarily in the order given; dependent upon the circumstances):

- A preliminary investigation is completed to determine the probable cause.
- Production and/or injection rates in the vicinity of the monitor well are adjusted as necessary to increase the net over recovery, thus forming a hydraulic gradient toward the production zone.
- Individual wells are pumped to enhance recovery of mining solutions.

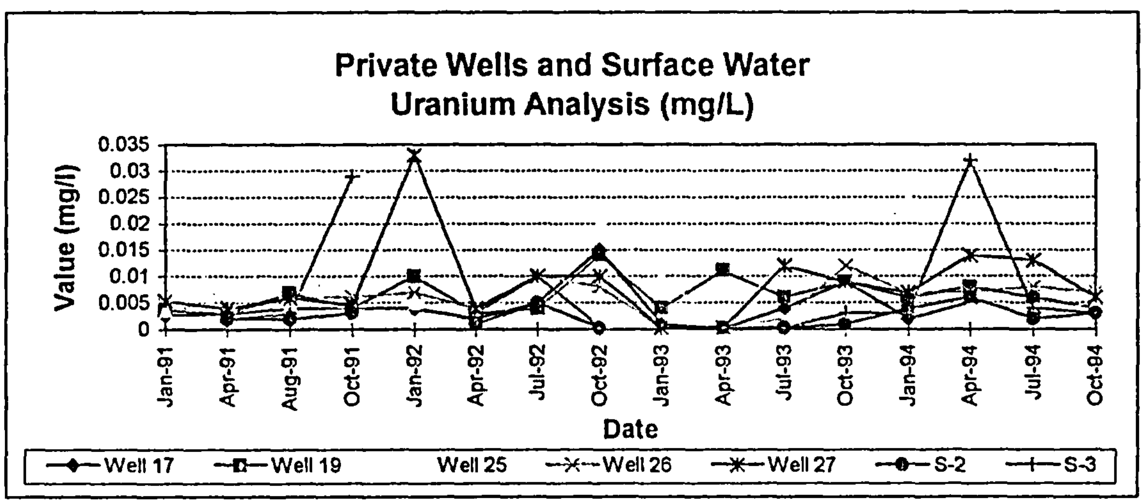
Injection into the well field area adjacent to the monitor well may be suspended. Recovery operations continue thus increasing the overall bleed rate and the recovery of wellfield solutions.

In addition to the above corrective actions, sampling frequency of the monitor well on excursion status is increased to weekly. An excursion is considered concluded when the concentrations of excursion indicators do not exceed the criteria defining an excursion for three consecutive one-week samples.

Table 5.8-13: Private Wells and Surface Water Monitoring Results Uranium Analysis (mg/L)

Date	Well 17	Well 19	Well 25	Well 26	Well 27	S-2	S-3
Jan-91	0.0027	0.0036	0.0036	0.0045	0.0054		
Apr-91	0.003	0.003	0.014	0.003	0.004	0.002	0.002
Aug-91	0.0039	0.0069	0.0049	0.0059	0.0059	0.002	0.003
Oct-91	0.0041	0.0041	0.0041	0.0062	0.0047	0.0031	0.029
Jan-92	0.004	0.01	0.005	0.007	0.033		
Apr-92	0.002	0.003	0.004	0.004	0.004	0.001	0.003
Jul-92	0.005	0.004	0.008	0.01	0.01	0.005	0.01
Oct-92	0.015	0.014	0.02	0.008	0.01	< 0.0003	<0.0003
Jan-93	0.001	0.004	0.01	< 0.0003	< 0.0003		
Apr-93	< 0.0003	0.011	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
Jul-93	0.004	0.006	0.013	0.002	0.012	< 0.0003	< 0.0003
Oct-93	0.009	0.009	0.008	0.012	0.009	0.001	0.003
Jan-94	0.002	0.006	0.025	0.007	0.007	0.004	0.003
Apr-94	0.005	0.008	0.005	0.007	0.014	0.006	0.032
Jul-94	0.003	0.006	0.003	0.008	0.013	0.002	0.004
Oct-94	0.005	0.004	0.005	0.007	0.006	0.003	0.003

Figure 5.8-10: Private Wells and Surface Water Trend- Uranium Analysis (mg/L)

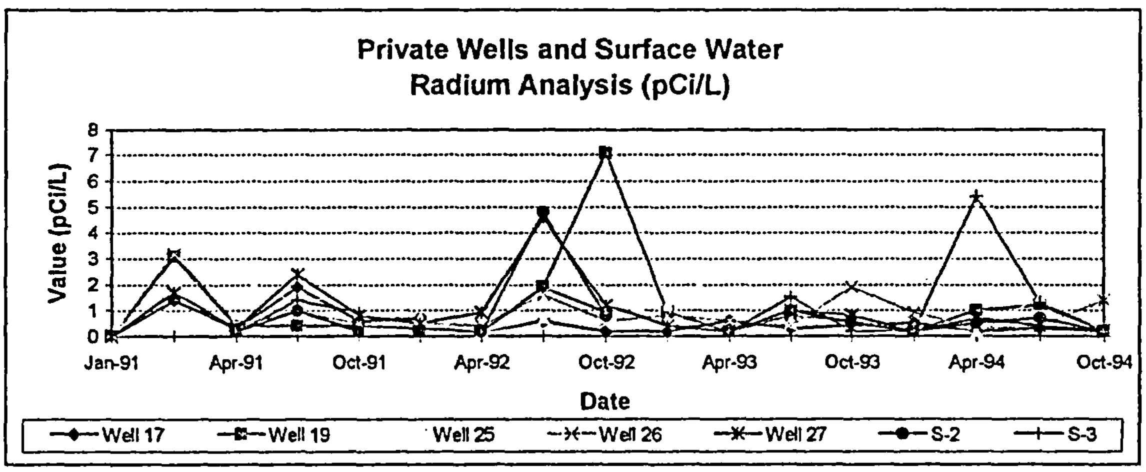


Note: Gaps in chart are due to missing data points.

Table 5.8-14: Private Wells and Surface Water Monitoring Results Radium Analysis (pCi/L)

Date	Well 17	Well 19	Well 25	Well 26	Well 27	S-2	S-3
Jan-91	1.4	3.1	2	3.2	1.7		
Apr-91	0.3	0.4	2.3	0.5	0.3	< 0.2	< 0.2
Aug-91	1.9	0.4	1.3	0.9	2.4	1	1.4
Oct-91	0.6	0.4	1.7	0.5	0.8	0.2	0.9
Jan-92	0.7	0.3	0.7	0.5	0.5		
Apr-92	< 0.2	< 0.2	< 0.2	0.4	0.9	< 0.2	< 0.2
Jul-92	0.6	1.9	0.7	1.6	4.6	4.8	1.9
Oct-92	< 0.2	7.1	0.8	0.6	1.2	0.8	0.9
Jan-93	< 0.2	0.9	1.2	0.8	0.4		
Apr-93	< 0.6	< 0.2	2.7	0.6	< 0.2	< 0.2	< 0.2
Jul-93	< 0.3	0.8	0.5	0.4	1	1	1.5
Oct-93	< 0.4	0.6	0.5	1.9	0.8	0.5	< 0.2
Jan-94	0.5	< 0.2	0.3	0.9	< 0.2	< 0.2	< 0.2
Apr-94	0.2	1	0.2	0.3	0.7	0.5	< 5.4
Jul-94	0.3	1.2	1.5	0.4	0.4	0.7	1.3
Oct-94	< 0.2	< 0.2	< 0.2	1.4	< 0.2	< 0.2	< 0.2

Figure 5.8-11: Private Wells and Surface Water Trend Radium Analysis (pCi/L)



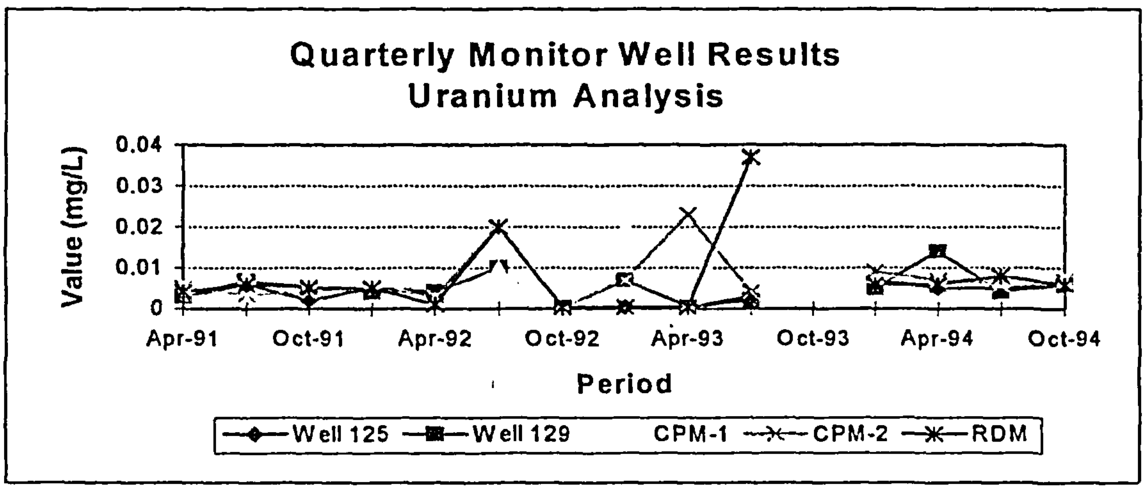
Note: Gaps in chart are due to missing data points.

Table 5.8-15: Quarterly Monitor Well Results
Uranium Analysis (mg/L)

Date	Well 125	Well 129	CPM-1	CPM-2	RDM
Apr-91	0.003	0.003	0.005	0.005	0.004
Aug-91	0.0059	0.0069	0.0079	0.0035	0.0059
Oct-91	0.0021	0.0052	0.0073	0.0041	0.0052
Jan-92	0.005	0.004	0.007	0.005	0.005
Apr-92	0.004	0.004	0.002	0.003	0.001
Jul-92	0.01	0.01	0.01	0.02	0.02
Oct-92	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
Jan-93	< 0.0003	0.007	0.02	0.007	< 0.0003
Apr-93	< 0.0003	< 0.0003	< 0.0003	0.023	< 0.0003
Jul-93	0.003	0.002	0.008	0.004	0.037
Oct-93					
Jan-94	0.007	0.005	0.008	0.009	0.006
Apr-94	0.005	0.014	0.008	0.007	0.006
Jul-94	0.005	0.004	0.007	0.006	0.008
Oct-94	0.006	0.006	0.007	0.007	0.006

Notes: CPM-1 is the Commercial Pond No. 1 Monitor Well.
CPM-2 is the Commercial Pond No. 2 Monitor Well.
RDM is the Research and Development Pond Monitor Well.

Figure 5.8-12: Quarterly Monitor Well Trend
Uranium Analysis (mg/L)



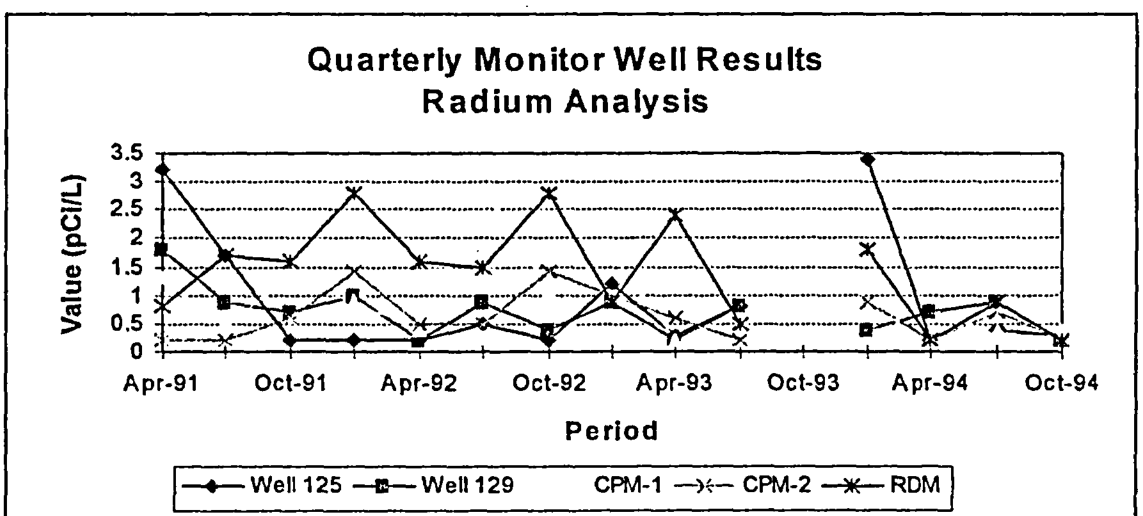
Note: Gaps in chart are due to missing data points.

Table 5.8-16: Quarterly Monitor Well Results Radium Analysis (pCi/L)

Date	Well 125	Well 129	CPM-1	CPM-2	RDM
Apr-91	3.2	1.8	1.3	< 0.2	0.8
Aug-91	1.7	0.9	0.5	< 0.2	1.7
Oct-91	0.2	0.7	1.3	0.6	1.6
Jan-92	< 0.2	1	0.9	1.4	2.8
Apr-92	< 0.2	< 0.2	0.4	0.5	1.6
Jul-92	0.5	0.9	2.9	0.5	1.5
Nov-92	< 0.2	0.4	1.1	1.4	2.8
Jan-93	1.2	0.9	1.7	1	0.9
Apr-93	0.3	< 0.2	< 0.2	0.6	2.4
Jul-93	0.8	0.8	< 0.2	< 0.2	0.5
Oct-93					
Jan-94	3.4	0.4	0.8	0.9	1.8
Apr-94	< 0.2	0.7	< 0.2	< 0.2	0.2
Jul-94	0.4	0.9	0.4	0.7	0.9
Oct-94	0.3	< 0.2	0.4	< 0.2	< 0.2

Notes: CPM-1 is the Commercial Pond Monitor No. 1 Well.
CPM-2 is the Commercial Pond Monitor No. 2 Well.
RDM is the R&D Pond Monitor Well.

Figure 5.8-13: Quarterly Monitor Well Trend Radium Analysis (pCi/L)



Note: Gaps in chart are due to missing data points.

Table 5.8-17: Baseline Water Quality Indicators

Physical Indicators

Specific Conductivity	Alkalinity	Total Dissolved Solids
Temperature	pH	

Common Constituents

Ammonia	Chloride	Silica
	Magnesium	Sodium
Calcium	Nitrate	Sulfate
Total Carbonate	Nitrite	Potassium

Trace and Minor Elements

Arsenic	Fluoride	Nickel
	Iron	Selenium
Barium	Lead	Vanadium
Cadmium	Manganese	Zinc
	Mercury	
Copper	Molybdenum	

Radionuclides

Radium-226	Uranium

5.8.8.2. SURFACE WATER MONITORING

The pre-operational water quality-monitoring program assessed water quality and quantity for Squaw Creek. CBR samples two surface water locations for Squaw Creek. The CBR SERP approved Mine Unit 6 on March 6, 1998. This expansion required that the downstream Squaw Creek monitoring location be relocated. The new sample point was designated as S-5. Sampling at the previous downstream location, S-3 was discontinued.

With the approval of Mine Unit 6, operational surface water sampling was also begun at the English Creek upstream and downstream locations. The upstream sample is a composite of the springs that are the sources of English Creek and were identified as E-1 and E-2 during the preoperational monitoring program. Preoperational monitoring location E-3 was not used for downstream monitoring since its location is well beyond the Mine Unit 6 wellfield. Instead, a new downstream location designated E-4 was chosen immediately outside the Mine Unit boundary and sampling was begun.

With the addition of Mine Unit 8, downstream sampling on English Creek was moved to location E-5. Additionally, the expansion to Mine Unit 8 requires sampling of the impoundments identified as I-3 and I-4 in the preoperational monitoring program when they are located within the wellfield. Samples from all locations are obtained quarterly. Surface water samples are analyzed for the parameters given in Table 5.8-6. Surface monitoring results are submitted in the semi-annual activity and monitoring reports submitted to NRC. A summary table of regional surface water monitoring results can be found in Table 5.8-13 and Table 5.8-14.

5.8.8.3. EVAPORATION POND LEAK DETECTION MONITORING

The evaporation ponds are lined and equipped with a leak detection system. During operations, the leak detection standpipes are checked for evidence of leakage. Visual inspection of the pond embankments, fences, and liners and the measurement of pond freeboard are also performed during normal operations. A minimum freeboard of 5 feet is allowed for the commercial ponds during normal operations. Anytime six (6) inches or more of fluid is detected in a leak detection system standpipe, it is analyzed for specific conductivity. Should the analyses indicate that the liner is leaking (by comparison to chemical analyses of pond water), the following actions are taken:

- The USNRC Project Manager is notified by telephone within 48 hours of leak verification.

- Transferring its contents into an adjacent pond lowers the level of the leaking pond. While lowering the water level in the pond, inspections of the liner are made to determine the cause and location of the leakage. The area of investigation first centers on the pond area specific for the particular standpipe that contains fluid.

- Once the source of the leakage is found, the liner is repaired and water is reintroduced to the pond.

- A written report is submitted to the USNRC within 30 days of leak verification. The report includes analytical data and describes the cause of the leakage, corrective actions taken and the results of those actions.

5.8.9. QUALITY ASSURANCE PROGRAM

A quality assurance program is in place at Crow Butte Uranium Project for all relevant operational monitoring and analytical procedures. The objective of the program is to identify any deficiencies in the sampling techniques and measurement processes so that corrective action can be taken and to obtain a level of confidence in the results of the monitoring programs. The QA program provides assurance to both regulatory agencies and the public that the monitoring results are valid.

The QA program addresses the following:

- Formal delineation of organizational structure and management responsibilities. Responsibility for both review/approval of written procedures and monitoring data/reports is provided.

- Minimum qualifications and training programs for individuals performing radiological monitoring and those individuals associated with the QA program.

- Written procedures for QA activities. These procedures include activities involving sample analysis, calibration of instrumentation, calculation techniques, data evaluation, and data reporting.

- Quality control (QC) in the laboratory. Procedures cover statistical data evaluation, instrument calibration, and duplicate and spike sample programs. Outside laboratory QA/QC programs are included.

- Provisions for periodic management audits to verify that the QA program is effectively implemented, to verify compliance with applicable rules, regulations and license requirements, and to protect employees by maintaining effluent releases and exposures ALARA.

The EMS Program developed by CBR is a critical step to insuring that quality assurance objectives are met. Current procedures exist for a variety of areas, including but not limited to:

1. Environmental monitoring procedures.
2. Testing procedures.
3. Exposure procedures.
4. Equipment operation and maintenance procedures.
5. Employee health and safety procedures.
6. Incident response procedures.
7. Laboratory procedures.

5.8.10. MONITORING PROGRAM SUMMARY

Section 5.8 of this renewal application has reviewed the radiological monitoring data produced at Crow Butte Uranium Project for the years of 1990 through 1994. Each Section has discussed the historical results of the data with an emphasis on regulatory compliance and trend analysis to determine whether CBR's ALARA goals are being met. Where the data indicated that some adjustments in the monitoring program were indicated, CBR has noted those changes in the "Proposed Program" portion of each Section. In order to aid the reviewer in comparing the elements of the current monitoring program with those of the proposed program, Table 5.8-18 provides a tabular summary of both programs as well as the regulatory guidance provided in USNRC Regulatory Guide 8.30, *Health Physics Surveys In Uranium Recovery Facilities*, Revision 1.

Table 5.8-18: Radiological Monitoring Program Summary

Type of Survey	Type of Area	Current Frequency	Proposed Frequency	Reg. Guide 8.30 Recommended Frequency
Airborne Uranium	• Airborne radioactivity areas • Other indoor process areas • Special maintenance involving high airborne concentrations of yellowcake	• Weekly grab samples[1] • Monthly grab samples • Extra breathing zone grab samples	• Weekly grab samples[1] • Monthly grab samples • Extra breathing zone grab samples	• Weekly grab samples • Monthly grab samples • Extra breathing zone grab samples
Radon daughters	• Areas that exceed 0.08WL • Areas that exceed 0.03WL • Areas below 0.03WL	• Weekly radon daughter grab samples • Monthly radon daughter grab samples • Monthly radon daughter grab samples	• Weekly radon daughter grab samples • Monthly radon daughter grab samples • Monthly radon daughter grab samples	• Weekly radon daughter grab samples • Monthly radon daughter grab samples • Quarterly radon daughter grab samples
External radiation: gamma	• Throughout mill • Radiation areas	• Semiannually • Quarterly	• Semiannually • Quarterly	• Semiannually • Quarterly
External radiation: beta	• Where workers are in close contact with yellowcake	• Survey by operation done once plus whenever procedures change	• Survey by operation done once plus whenever procedures change	• Survey by operation done once plus whenever procedures change
Surface contamination	• Yellowcake areas • Eating rooms, change rooms, control rooms, office	• Daily walkthrough • Weekly	• Daily walkthrough • Weekly	• Daily • Weekly
Skin and personal clothing	• Yellowcake workers who shower • Yellowcake workers who do not shower	• Each exit from controlled area[2] • Each exit from controlled area[2]	• Each exit from controlled area[2] • Each exit from controlled area[2]	• Quarterly • Each day before leaving
Equipment to be released	• Equipment to be released that may be contaminated	• Detailed survey before release	• Detailed survey before release	• Once before release

Table 5.8-18: Radiological Monitoring Program Summary

Type of Survey	Type of Area	Current Frequency	Proposed Frequency	Reg. Guide 8.30 Recommended Frequency
Packages containing yellowcake	• Packages	• Detailed survey before release	• Detailed survey before release	• Spot check before release
Ventilation	• All areas with airborne radioactivity	• Daily walkthrough	• Daily walkthrough	• Daily
Respirators	• Respirator face pieces and hoods	• Before reuse	• Before reuse	• Before reuse

Notes: [1] Increased sampling frequency based upon administrative action level of 25% of the MPC or DAC; Sampling is performed in the dryer room during dryer operation.
[2] All employees required to survey upon exit; Quarterly spot checks of >25% process staff also conducted.

mobilized. As the plant is operated in the pH range of 6.5 to 9.0, mobilization of the organics and coloring of the leach solution is avoided.

6.1.3 RESTORATION GOALS

The primary goal of the groundwater restoration program is to return groundwater affected by mining operations to baseline values on a mine unit average. The secondary goal is to return the groundwater to a quality consistent with premining use or uses. The restoration values set by the Nebraska Department of Environmental Quality (NDEQ) in the UIC Permit are these secondary goals. Restoration values for each mine unit have been specified by the NDEQ for groundwater restoration efforts. Prior to mining in each mine unit, baseline groundwater quality is determined. This data is established in each mine unit at the minimum density of one production or injection well per four acres.

The baseline data support establishment of the upper control limits and restoration standards for each mine unit. The upper control limits and restoration standards for each Mine Unit, beginning with Mine Unit 6, are determined by the Safety and Environmental Review Panel (SERP) during the approval process for the new Mine Unit. The NDEQ restoration values are established as the average plus two standard deviations for any parameter that exceeds the applicable drinking water standard. If a drinking water standard exists for a parameter, and baseline is below that standard, the drinking water standard is used to establish the restoration value. If there is no drinking water standard for an element, for example vanadium, the restoration value will be based on best practicable technology. The restoration value for the major cations (Ca, Mg, K, Na) should allow for the concentrations of these cations to vary by as much as one order of magnitude as long as the TDS restoration value is met. The total carbonate restoration criteria should allow for the total carbonate to be less than 50% of the TDS. The TDS restoration value is set at the average plus one standard deviation.

Mine Unit restoration values are contained in Tables 6.1-1 through 6.1-9 as follows:

- Mine unit averages and secondary goals for Mine Units 1 through 5 are given in Tables 6.1-1 through 6.1-5. These restoration values were approved by NRC based on submittals before operation of the Mine Unit.
- The mine unit average and NDEQ restoration values for Mine Unit 6 are given in Table 6.1-6. The CBR SERP determined these restoration values on March 4, 1998.
- The mine unit average and NDEQ restoration values for Mine Unit 7 are given in Table 6.1-7. The CBR SERP determined these restoration values on July 9, 1999.
- The mine unit average and NDEQ restoration values for Mine Unit 8 are given in Table 6.1-8. The CBR SERP determined these restoration values on July 10, 2002.

Before the water can be processed by the reverse osmosis unit, the soluble uranium must be removed by the ion exchange system. The water is then filtered, the pH lowered for decarbonation to prevent calcium carbonate plugging of the membranes, and then pressurized by a pump. The reverse osmosis unit contains membranes which pass about 60 to 75 percent of the water through, leaving 60 to 90 percent of the dissolved salts in the water that will not pass the membrane. Table 6.1-11 shows typical manufacturers specification data for removal of ion constituents. The clean water, called permeate, will be re-injected, sent to storage for use in the mining process, or sent to the waste disposal system. The twenty-five to forty percent of water that is rejected, referred to as the brine, contains the majority of dissolved salts that contaminate the groundwater and is sent for disposal in the wastewater system.

The sulfide reductant that may be added to the injection stream during this stage will reduce the oxidation-reduction potential (Eh) of the aquifer. During mining operations certain trace elements are oxidized. By adding a reductant, the Eh of the aquifer is lowered thereby decreasing the solubility of these elements. A comprehensive safety plan regarding reductant use will be implemented should it be utilized.

The number of pore volumes treated and re-injected during the groundwater treatment stage will depend on the efficiency of the reverse osmosis unit in removing total dissolved solids and the reductant in lowering the uranium and trace element concentrations.

6.1.5 STABILIZATION PHASE

Upon completion of restoration, a groundwater stabilization monitoring program will begin in which the restoration wells and any monitor wells on excursion status during mining operations will be sampled and analyzed for the restoration parameters. Sampling frequency will be one sample per month for a period of 6 months. The stabilization data will be reviewed to determine whether the restoration goals are met and for significant increasing trends in the monitored parameters. The stabilization samples will be collected on the following schedule:

6.1.5.1 INITIAL STABILIZATION SAMPLE

CBR will sample and analyze discrete grab samples from each individual restoration well during the post-restoration (i.e., first round of stabilization) sampling. These samples will be analyzed for the restoration parameters. A physical composite sample will also be prepared from the individual well samples as discussed in Section 6.1.5.2 and included with the discrete grab samples for analysis.

6.1.5.2 SUBSEQUENT STABILIZATION SAMPLES

In subsequent monthly stabilization sampling, each designated restoration well will be sampled. A composite sample of these individual well samples will be prepared in the CBR laboratory and submitted to the contract laboratory for analysis of the restoration parameters. The individual samples from the restoration wells will be properly preserved and retained at the CBR laboratory until analytical results are received from the contract laboratory. If the analytical results indicate increasing trends in any monitored parameter(s), individual well samples may be sent to the contract laboratory to determine whether the changes are due to increases in specific areas of the mine unit.

In addition to the composite sampling, CBR will analyze the discrete grab samples from each individual restoration well approximately three months after the post-restoration (i.e., first round of stabilization) sampling. A physical composite sample of the individual wells will also be included with these discrete grab samples.

6.1.5.3 FINAL STABILIZATION SAMPLE

During the final stabilization sample, CBR will sample and analyze discrete grab samples from each individual restoration well for the restoration parameters. A physical composite sample will also be prepared from the individual well samples as discussed in Section 6.1.5.2 and included with the discrete grab samples for analysis.

6.1.5.4 STABILIZATION DETERMINATION

The data from the stabilization period will be evaluated to confirm that the mine unit has remained stable during the monitoring period. If the stabilization samples show that the restoration standards are met during the stabilization period and that there are no significant increasing trends, restoration shall be deemed complete.

If one or more of the monitored constituents exhibit significant increasing trends after the 6-month stability monitoring period, quarterly grab sample monitoring will continue until no significant increasing trends are observed or until continued restoration is initiated. Individual monitored constituents that exhibit no significant increasing trends after the 6-month stability monitoring period may be removed from the sampling plan upon approval by the regulatory agency.

6.1.6 REPORTING

During the restoration process, Crow Butte Resources will perform daily, weekly, and monthly analysis as needed to track restoration progress. These analyses will be provided to NDEQ in Monthly Restoration Reports and the USNRC in the Semiannual Radiological Effluent and Environmental Monitoring Report. This information will also be included in the final restoration report.

Upon completion of restoration activities and before stabilization, all designated restoration wells in the mine unit will be sampled for the restoration parameters. Analytical results will be reviewed by the CBR SERP. If restoration activities have returned the wellfield average of the restoration parameters to concentrations at or below the standards approved by the NRC in License Condition 10.3, the CBR SERP will recommend initiation of the stabilization phase of restoration. The results of restoration and notification of the initiation of the Stabilization Stage will be submitted to the NDEQ. The NDEQ Director will either accept or deny initiation of stabilization based on the results of restoration. If approved by the NDEQ Director and the CBR SERP, the Stabilization Stage will be initiated. SERP evaluations are summarized in an annual report to the NRC.

During stabilization, all designated restoration wells will be sampled monthly and analyzed according to the schedule in Section 6.1.5. At the end of a six-month stabilization period, CBR will compile all water quality data obtained during restoration and stabilization and submit a final report to the regulatory agencies.

If one or more of the monitored constituents exhibit significant increasing trends after the 6-month stability monitoring period, additional stabilization monitoring will be performed as discussed in Section 6.1.5.4. When all parameters are stable and the restoration criteria is met as discussed in Section 6.1.5, CBR will submit final reports to the regulatory agencies and request that the mine unit be declared restored.

6.2 DECONTAMINATION AND DECOMMISSIONING

The following sections address the final decommissioning of process facilities, evaporation ponds, wellfields and equipment that will be used on the Crow Butte site. It discusses general procedures to be used, both during final decommissioning, as well as the decommissioning of a particular phase or production unit area.

Decommissioning of wellfields and process facilities, once their usefulness has been completed in an area will be scheduled after agency approval of groundwater restoration and stability. It will be accomplished in accordance with an approved decommissioning plan and the most current applicable NDEQ and USNRC rules and regulations, permit and license stipulations and amendments in effect at the time of the decommissioning activity.

The following is a list of general decommissioning activities:

- Plug and abandon all wells as detailed per Section 6.2.3.

- Radiological surveys and sampling of all facilities, process related equipment and materials presently on site to determine their degree of contamination and identify the potential for personnel exposure during decommissioning.

- Removal from the site of all contaminated equipment and materials to an approved licensed facility for disposal or reuse, or relocation to an operational portion of the mining operation.

- Decontamination of items to be released for unrestricted use to levels consistent with the requirements of U.S. Nuclear Regulatory Commission.

- Survey excavated areas for earthen contamination and remove same to a licensed disposal facility.

- Backfill and recontour all disturbed areas.
- Perform final site soil radiation background surveys.
- Establish permanent revegetation on all disturbed areas.

The following sections describe in general terms the planned decommissioning activities and procedures for the Crow Butte facilities. Crow Butte Resources will, prior to final decommissioning of an area, submit to the USNRC and NDEQ a detailed plan for their review and approval.

6.2.1 PROCESS BUILDINGS AND EQUIPMENT

Prior to process plant decommissioning, a preliminary radiological survey will be conducted to identify any potential hazards. The survey will also support the development of procedures for dealing with such hazards prior to commencement of decommissioning activities. The majority of the process equipment in the process building will be reusable, as well as the building itself. Alternatives for the disposition of the building and equipment are discussed below.

6.2.1.1 REMOVAL AND DISPOSAL ALTERNATIVES

All process or potentially contaminated equipment and materials at the process facility including tanks, filters, pumps, piping, etc., will be inventoried, listed and designated for one of the following removal alternatives:

- Removal to a new location within the Crow Butte site for further use or storage.
- Removal to another licensed facility for either use or permanent disposal.
- Decontamination to meet unrestricted use criteria for release, sale or other non-restricted use by the landowners and others.

It is most likely that process buildings will be dismantled and moved to another location or to a permanent licensed disposal facility. Cement foundation pads and footing will be broken up and trucked to disposal site or a licensed facility if contaminated. The landowners, however, could request that a building or other structures be left on site for his use. In this case, the building will be decontaminated to meet unrestricted use criteria.

6.2.1.1.1 DISPOSAL AT A LICENSED FACILITY

If a piece of process equipment is to be moved to another licensed area the following procedures may be used.

- Flush inside of tanks, pumps, pipes, etc., with water or acid to reduce interior contamination as necessary for safe handling.

- The exterior surfaces of process equipment will be surveyed for contamination. If the surfaces are found to be contaminated the equipment will be washed down and decontaminated to permit safe handling.

- The equipment will be disassembled only to the degree necessary for transportation. All openings, pipe fittings, vents, etc., will be plugged or covered prior to moving equipment from the plant building.

- Equipment in the building, such as large tanks, may be transported on flatbed trailers. Smaller items, such as links of pipe and ducting material, may be placed in plastic lined covered dump trucks or drummed in barrels for delivery to the receiving facility.

- Contaminated buried process trunk lines and sump drain lines will be excavated and removed for transportation to a licensed disposal facility.

- All other miscellaneous contaminated material will be transported to a licensed disposal facility.

6.2.1.1.2 DISPOSAL TO UNRESTRICTED USE

If a piece of equipment is to be released for unrestricted use it will be appropriately surveyed before leaving the licensed area. Both interior and exterior surfaces will be surveyed to detect potential contamination. Appropriate decontamination procedures will be used to clean any contaminated areas and the equipment resurveyed and documentation of the final survey retained to show that unrestricted use criteria were met prior to releasing the equipment or materials from the site. Criteria to be used for release to unrestricted use will be USNRCs *"Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Materials"* May 1987 Revision (Annex B) or the most current standards for decontamination at that time.

If a process building is left on site for landowner unrestricted use, the following basic decontamination procedures will be used. Actual corrective procedures will be determined by field requirements as defined by radiological surveys.

- After the building has been emptied, the interior floors, ceiling and walls of the building and exterior surfaces at vent and stack locations will be checked for contamination. Any remaining removable contamination will be removed by washing. Areas where contamination was noted will be resurveyed to ensure removal of all contamination to appropriate levels.

- Process floor sump and drains will be washed out and decontaminated using water and, if necessary, acid solutions. If the appropriate decontamination levels cannot be achieved, it may be necessary to remove portions of the sump and floor to disposal.

- Excavations necessary to remove trunklines or drains will be surveyed for contaminated earthen material. Earthen material that is found to be contaminated will be removed to a licensed disposal facility prior to backfilling the excavated areas.

- The parking and storage areas around the building will be surveyed for surface contamination after all equipment has been removed.

Decontamination of these areas will be conducted as necessary to meet the standards for unrestricted use.

6.2.2 EVAPORATION POND DECOMMISSIONING

6.2.2.1 DISPOSAL OF POND WATER

The volume of water remaining in the lined evaporation ponds after restoration as well as its chemical and radiological characteristics will be considered to determine the most practical disposal program. Disposal options for the pond liquid include evaporation, treatment and disposal or transportation to another licensed facility or disposal site. The pond water from the later stages of groundwater restoration may be treatable to within discharge limits; if this can be accomplished, the water will be treated and discharged under an appropriate NPDES permit. Evaporation of the remaining water may be enhanced by use of sprinkler systems, etc.

6.2.2.2 POND SLUDGE AND SEDIMENTS

Pond sludges and sediments will contain mining process chemicals and radionuclides. Wind blown sand grains and dust blown into the ponds during their active life also add to the bulk of sludges. This material will be contained within the pond bottom and kept in a dampened condition at all times, especially during handling and removal operation to prevent the spread of airborne contamination and potential worker exposure through inhalation. Dust abatement techniques will be used as necessary. The sludge will be removed from the ponds and loaded into dump trucks or drums and transported to a USNRC licensed disposal facility. All equipment and personnel working on sludge and liner removal will be checked prior to leaving the work area to prevent the tracking of sludge into uncontaminated locations.

6.2.2.3 DISPOSAL OF POND LINERS AND LEAK DETECTION SYSTEMS

Pond liners will be kept washed down and intact as much as practical during sludge removal so as to confine sludges and sediments to the pond bottom. Pond liners will be cut into strips and transported to a USNRC licensed disposal facility or will be decontaminated for release to an unrestricted area. After removal of the pond liners, the pond leak detection system piping will be removed. Materials involved in the leak detection system will be surveyed and released for unrestricted use if not contaminated or transported to a USNRC licensed facility for disposal. The earthen material in the pond bottom and leak detection system trenches will be surveyed for soil contamination; any contaminated soil in excess of limits defined in 10 CFR 40, Appendix A, will be removed.

Following the removal of all pond materials and the disposal of any contaminated soils, surface preparation will take place prior to reclamation. Pond surface reclamation will be performed in accordance with the surface reclamation plan, Section 6.3. An additional radiation background survey will be conducted on the recontoured area prior to topsoiling.

6.2.2.4 ON SITE BURIAL

At the present time, on site burial of contaminants is not anticipated. However, depending upon the availability of a USNRC licensed disposal site at the time of decommissioning, on site burial may become a potential alternative. Should this occur, pond locations would be considered initially as the on site disposal locations for contaminated materials. Appropriate licensing with the regulatory agencies would be obtained prior to any on site burial of contaminated wastes.

6.2.3 WELLFIELD DECOMMISSIONING

Wellfield decommissioning will consist of the following steps:

- The first step of the wellfield decommissioning process will involve the removal of surface equipment. Surface equipment primarily consists of the injection and production feed lines, electrical conduit, well boxes, and wellhead equipment. All of the lines are above ground surface lines that will not require excavation for removal. Wellhead equipment such as valves, meters or control fixtures will be salvaged.

- Removal of buried well field piping.

- Wells will be plugged and abandoned according to the procedures described below.

- The well field area may be recontoured, if necessary, and a final background gamma survey conducted over the entire well field area to identify any contaminated earthen materials requiring removal to disposal.

- Final surface reclamation of the well field areas will be conducted according to the surface reclamation plan described in Section 6.3.

- All piping, boxes and wellhead equipment will be surveyed for contamination prior to release in accordance with the USNRC guidelines for decommissioning.

It is estimated that a significant portion of the equipment will meet releasable limits that will allow disposal at an unrestricted area landfill. Other materials which are contaminated will be acid washed or cleansed with other methods until they are releasable. If the equipment still does not meet releasable limits, it will be disposed of at a facility licensed to accept by-product material.

After the Crow Butte aquifer restoration and post-restoration stabilization has been completed and accepted in writing as successful by both the NDEQ and USNRC, the decommissioning of the mine unit wellfields will commence.

Wellfield decommissioning will be an independent ongoing operation throughout the mining sequence at the Crow Butte site. Once a production unit has been mined out and groundwater restoration and stability have been accepted by the regulatory agencies, the wellfield will be scheduled for decommissioning and surface reclamation.

6.2.3.1 WELL PLUGGING AND ABANDONMENT

All wells no longer useful to continued mining or restoration operations will be abandoned. These include all injection and recovery wells, monitor wells and any other wells within the production unit used for the collection of hydrologic or water quality data or incidental monitoring purposes. The only known exception at this time may be a well that could be transferred to the landowner for domestic or livestock use.

The objective of the Crow Butte Resources well abandonment program is to seal and abandon all wells in such a manner as to assure the groundwater supply is protected and to eliminate any potential physical hazard.

The plugging method will be as follows:

- An approved abandonment mud (a mud-polymer mix) will be mixed in a cement unit and pumped down a hose, which is lowered to the bottom of the well casing using a reel.
- When the hose is removed, the casing is topped off and a cement plug placed on top.
- A hole is then dug around the well, and, at a minimum, the top three feet of casing removed.
- The hole is backfilled and the area revegetated.

Records of abandoned wells will be tabulated and reported to the appropriate agencies after decommissioning.

6.2.3.2 BURIED TRUNKLINES, PIPES AND EQUIPMENT

Buried process related piping such as injection and recovery lines will be removed from the production unit undergoing decommissioning. Salvageable lines will be held for use in ongoing mining operations. Lines that are not reusable may either be assumed to be contaminated and disposed of at a licensed disposal site or may be surveyed and, if suitable for release to an unrestricted area, may be sent to a sanitary landfill. If on site burial is an option in the future, lines may be disposed of on site according to conditions of the appropriate licenses/permits.

6.2.4 DECONTAMINATION

After all surface equipment is removed and all wells are properly plugged and abandoned, a gamma survey of the wellfield surfaces will be conducted. Any areas with elevated gamma readings that indicate radium-226 levels in excess of limits in 10 CFR 40, Appendix A, will be resurveyed. Soil samples will be collected from confirmed contaminated locations for the analysis of radium-226 and uranium. Based upon the soil sampling and additional gamma radiation readings, contaminated soil will be removed and transferred to a site licensed to accept by-product materials. Gamma survey results and soil sampling results will be submitted to the USNRC for their review, approval and opportunity to split soil samples. After approval of the soil contamination removal program, revegetation will commence.

The objective of site soil surveys during decommissioning will be to identify and remove to a licensed disposal facility any earthen materials which exceed EPA 40 CFR Part 192.32 standards or other applicable standards at the time of decommissioning. These standards presently require that radium concentrations in surface soils, averaged over areas of 100 square meters, do not exceed background levels by more than 5 pCi/g averaged over the first 15 cm below the surface and 15 pCi/g averaged over any 15 cm thick layer more than 15 cm below the surface.

Three general types of site soil surveys will be conducted on the site during decommissioning:

- Areas of potential surface contamination will be identified using a gross gamma survey on an adequately spaced grid.
- Spot-checks of areas around the site of potentially contaminated areas.
- The final soil background survey on areas which have been prepared for surface reclamation using a grid spacing adequate for confirming clean up to applicable standards.

Contaminated soils that are removed from site surfaces will be transported to a licensed disposal site. The primary areas for potential soil contamination include well field surfaces, evaporation pond bottoms and berms, process building areas, storage yards and transportation routes over which product or contaminants have been moved.

6.2.5 DECOMMISSIONING HEALTH PHYSICS AND RADIATION SAFETY

The health physics and radiation safety program for decommissioning will document decommissioning processes and ensure that occupational radiation exposure levels are kept as low as reasonably achievable during decommissioning. The Radiation Safety Officer, Radiation Safety Technician or designee by way of specialized training, will be on site during any decommissioning activities where a potential radiation exposure hazard exists.

Health physics survey conducted during decommissioning will be guided by applicable sections of 10 CFR 20 and USNRC Regulatory Guide No. 8.30 entitled "*Health Physics Surveys in Uranium Recovery Facilities*", Revision 1 or other applicable standards at the time.

6.2.6 EQUIPMENT AND MATERIAL SURVEYS

Any site equipment to be released for unrestricted use will be surveyed for alpha contamination and beta gamma as necessary to document levels for release, according to USNRC "*Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Materials*", May 1987 Revision (Annex B) or the most current standards for decontamination at that time.

Transportation of all contaminated waste materials and equipment from the site to the approved licensed disposal facility or other licensed sites will be handled in accordance with the Department of Transportation and U.S. Nuclear Regulatory Commission Regulations (49 CFR 173.389)(10 CFR 71).

6.2.7 RECORDS AND REPORTING PROCEDURES

At the conclusion of site decommissioning and surface reclamation, a report containing all applicable documentation will be submitted to the USNRC and NDEQ. Records of all contaminated materials transported to a licensed disposal site will be maintained for a period of five years or as otherwise required by applicable regulations at the time of decommissioning.

6.3 SURFACE RECLAMATION

The following reclamation plan provides procedural techniques for surface reclamation of all disturbances contained in the Crow Butte Resources mine plan. Provided are reclamation procedures for the process plant facilities, evaporation ponds, wellfield production units, access and haul roads. Reclamation techniques and procedures for subsequent satellite facilities, additional ponds and wellfields will follow the same concepts as presented below. Reclamation schedules for wellfield production units will be discussed separately because they are dependent upon the progress of mining and the successful completion of groundwater restoration. Cost estimates for bonding calculations include all activities which are anticipated to complete groundwater restoration, decontamination, decommissioning and surface reclamation of wellfield and satellite plant facilities installed to operate for one year of mining activity.

The principal objective of the surface reclamation plan is to return disturbed lands to production, compatible with the post mining land use, of equal or better quality than its premining condition. The reclaimed lands should therefore be capable of supporting livestock grazing and provided stable habitat for native wildlife species. Soils, vegetation, wildlife and radiological baseline data will be used as guidelines for the design, completion and evaluation of surface reclamation. Final surface reclamation will blend affected areas with adjacent undisturbed lands so as to re-establish original slope and topography and present a natural appearance. Surface reclamation efforts will strive to limit soil erosion by wind and water, sedimentation and re-establish natural through drainage patterns.

6.3.1 WELLFIELD RECLAMATION

Surface reclamation in the wellfield production units will vary in accordance with the development sequence, mining/reclamation timetable. Final surface reclamation of each wellfield production units will be after approval of groundwater restoration stability and the completion of well abandonment and decommissioning activities specified in Section 6.2. Surface preparation will be accomplished as needed so as to blend any disturbed areas into the contour of the surrounding landscape. The seed bed will be prepared and reseeded with assistance from the U.S. Soil Conservation Service.

6.3.2 PROCESS FACILITIES RECLAMATION

Subsoils and stockpiled topsoil will be replaced on the disturbances from which they were removed during construction, within practical limits. Areas to be backfilled will be scarified or ripped prior to backfilling to create an uneven surface for application of backfill. This will provide a more cohesive surface to eliminate slipping and slumping. The less suitable subsoil and unsuitable topsoil, if any, will be backfilled first so as to place them in the deepest part of the excavation to be covered with more suitable reclamation materials. Subsoils will be replaced using paddle wheel scrapers, push-cats or other appropriate equipment to transfer the earth from stockpile locations or areas of use and to spread it evenly on the ripped disturbances. Grader blades may be used to even the spread of backfill materials. Backfill compacting will be accomplished by movement of the equipment over the fill area. Topsoil replacement will commence as soon as practical after a given disturbed surface has been prepared. Topsoil will be picked up from storage locations by paddle wheel scrapers or other appropriate equipment and distributed evenly over the disturbed areas. The final grading of topsoil materials will be done so as to establish adequate drainage and the final prepared surface will be left in a roughened condition. There will be no topsoil used for construction of any kind; topsoil will have been salvaged and stockpiled.

6.3.3 CONTOURING OF AFFECTED AREAS

Due to the relatively minor nature of disturbances created by in-situ mining, there are only a few areas disturbed to the extent to which subsoil and geologic materials are removed causing significant topographic changes that need backfilling and recontouring. Generally speaking, solar evaporation pond construction results in redistribution of sufficient amounts of subsurface materials, which requires replacement and contour blending during reclamation. The existing contours will only be interrupted in small, localized areas; because approximate original contours will be achieved during final surface reclamation, no post mining contour maps have been included in this application.

Changes in the surface configuration caused by construction and installation of operating facilities will be only temporary, during the operating period. These changes will be caused by topsoil removal and storage along with the relocation of subsoil materials used for construction purposes. Restoration of the original land surface, which is consistent with the pre- and post-mining land use, the blending of affected areas with adjacent topography to approximate original contours and re-establishment of drainage patterns will be accomplished by returning the earthen materials moved during construction to their approximate original locations.

Drainage channels which have been modified by the mine plan for operational purposes such as road crossings will be re-established by removing fill materials, culverts and reshaping to as close to pre-operational conditions as practical. Surface drainage of disturbed areas which have been located on terrain with varying degrees of slope will be accomplished by final grading and contouring appropriate to each location so as to allow for controlled surface run off and eliminate depressions where water could accumulate.

6.4 BONDING ASSESSMENT

6.4.1 BOND CALCULATIONS

Cost estimates for the purpose of bond calculations were made for the Crow Butte Project site. The cost assessment includes groundwater restoration, decontamination and decommissioning and surface reclamation costs for all areas to be affected by the installation and operation of the proposed mine plan. The detailed calculation utilized in determining the bonding requirements for the Crow Butte Project is submitted annually to the NDEQ and the NRC and are maintained on file at the project office.

6.4.2 FINAL SURETY ARRANGEMENTS

Crow Butte Resources maintains a NRC-approved financial surety arrangement consistent with 10 CFR 40, Appendix A, Criterion 9 to cover the estimated costs of reclamation activities. Crow Butte maintains an Irrevocable Letter of Credit issued by the Royal Bank of Canada during 2003 in favor of the State of Nebraska in the present amount of $14,909,670.