CROW BUTTE RESOURCES, INC.

86 Crow Butte Road
P.O. Box 169
Crawford, Nebraska 69339-0169

(308) 665-2215
(308) 665-2341 – FAX

January 2, 2004

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. Gillen:

Crow Butte Resources, Inc. (CBR) is providing this annual report that summarizes the changes, tests or experiments made under License Condition 9.4 of SUA-1534. 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 2003, the CBR SERP approved five 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 taken in 2003. 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

2003 SERP Evaluation Index

CROW BUTTE RESOURCES, INC.

Safety and Environmental Review Panel

2003 Evaluation Index

SERP Evaluation Number	Date	Action Taken	Modifications to Previous SERP Actions
SERP 03-01	16 Jan 2003	Approval of change to CRSO Title.	None
SERP 03-02	14 Feb 2003	Wellhouse 36 approval.	None
SERP 03-03	21 Apr 2003	Approval of production processing in Restoration IX System.	None
SERP 03-04	12 Jun 2003	Wellhouse 37 approval.	None
SERP 03-05	22 Oct 2003	Mine Unit 9 and Wellhouse 41 approval.	None

SERP 03-01 Evaluation

Crow Butte Resources, Inc.

Safety and Environmental Review Panel

Evaluation Report – SERP 03-01

Corporate Radiation Safety Officer Title Change

January 16, 2003

The Crow Butte Resources, Inc. (CBR) Safety and Environmental Review Panel (SERP) met in accordance with USNRC Source Materials License SUA-1534 to review a proposed change to the Corporate Radiation Safety Officer's title.

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
Chuck Miller	Plant Manager	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 a proposed change affecting the title of a member of the radiation safety staff. Specifically, it is proposed that the title of the Corporate Radiation Safety Officer (CRSO) be changed to Radiation Safety Officer (RSO). There are no changes proposed to the duties and responsibilities of the RSO as defined in the CBR License Renewal Application (LRA).

The reason for this proposed change is to more clearly reflect that the duties of the CBR RSO are limited to site activities at the Crow Butte Uranium Project and do not involve radiation safety programs or activities at the corporate level. An additional reason for the

proposed change is to maintain consistency with other U.S. operations owned by Cameco Corporation (i.e., the Smith Ranch/Highland Uranium Project). Cameco's U.S. operations are in the process of developing an Environmental Management System (EMS) to meet the certification requirements of ISO 14001. Major portions of this EMS program will apply to all U.S. operations, including management procedures delineating the responsibilities of the site RSO. To maintain consistency, the program will refer to the individual responsible for site radiation protection programs as the RSO. Duties for a CRSO at the corporate level are not delineated in the program, but could be added at a future time if determined necessary by senior management.

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 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. 14 dated November 7, 2002;

- *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

The SERP reviewed the requirements contained in Source Materials License SUA-1534, Amendment 14, dated November 7, 2002. The license refers to the duties of the Radiation Safety Officer in two places and is inconsistent in the use of job titles. License Condition 9.4, which contains the performance-based license condition (PBLC), requires that the SERP membership include "...the Radiation Safety Officer (RSO) or equivalent..." In License Condition 9.6, CBR is required to maintain Standard Operating Procedures (SOPs) for certain activities involving exposure to radioactive materials. This License Condition requires that all written procedures be reviewed and approved in writing by "...the site Corporate Radiation Safety Officer (CRSO)..."

In discussions held on January 13, 2003 with Mr. John Lusher, NRC Project Manager for the Crow Butte Uranium Project, it was determined that License Condition 9.6 is unnecessary since the procedural review and approval requirements are contained in Regulatory Guide 8.31, *Information Relevant to Ensuring that Occupational Radiation exposure at Uranium Recovery Facilities will be As Low As Is Reasonably Achievable (ALARA)*. This Regulatory Guide is incorporated by reference in License Condition 9.12. Mr. Lusher proposed that License Condition 9.6 be deleted as an administrative change at the next license amendment. CBR has agreed to this proposal.

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 EA refers to the CRSO in Section 1.0 and 11.0, both in connection with membership requirements for the SERP. The proposed change in the CRSO's title does not alter the CBR SERP membership requirements.

Financial Surety

The proposed change 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 and addresses the duties of the CRSO in several instances. The SERP evaluated each reference to the CRSO in the SER to determine whether the proposed change would affect the intent of the SER. The following analysis discusses this evaluation:

Section 1.0, Introduction, discusses the membership of the CBR SERP. The RSO or equivalent will continue to be a required member in the CBR SERP. Therefore, there is no change to the intent of Section 1.0 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 3.2, Radiation Safety Staff and Responsibilities, discusses the positions and responsibilities of the CRSO. There are no changes proposed to the responsibilities of the RSO. Therefore, there is no change to the intent of Section 3.2 of the SER.

Section 3.3, Minimum Technical Qualifications for the Radiation Safety Staff, discusses the minimum qualifications and experience requirements for the CRSO. These requirements will not be changed by the proposed change. Therefore, there is no change to the intent of Section 3.3 of the SER.

Section 3.4, Administrative and Operation Procedures, discusses the requirement that SOPs be established, reviewed, and approved by the CRSO. These requirements will not be changed by the proposed change. Therefore, there is no change to the intent of Section 3.4 of the SER.

Section 3.5, Audits and Inspections, discusses the program of inspections and ALARA Audits and the CRSO's responsibilities for the program. These requirements will not be changed by the proposed change. Therefore, there is no change to the intent of Section 3.5 of the SER.

Section 3.6, Radiation Safety Training, discusses the responsibilities of the CRSO for conducting radiation safety training. These requirements will not be changed by the proposed change. Therefore, there is no change to the intent of Section 3.6 of the SER.

Section 4.3, Personnel Monitoring Data, discusses the requirements for the CRSO to review non-routine samples within two working days. This requirement will not be changed by the proposed change. Therefore, there is no change to the intent of Section 4.3 of the SER.

Section 4.5.3, Respiratory Protection Program, requires that the CRSO administer the respiratory protection program. This requirement will not be changed by the proposed change. Therefore, there is no change to the intent of Section 4.5.3 of the SER.

Section 4.7, Contamination Control, requires that employees report contamination incidents to the CRSO and that the CRSO (or qualified individuals) perform surveys of material leaving the restricted area. These requirements will not be changed by the proposed change. Therefore, there is no change to the intent of Section 4.7 of the SER.

Section 11.0, Conclusion Including Safety License Conditions, provides the NRC conclusions concerning the radiation safety program and proposes License Conditions to be included in the renewed license. These requirements will not be changed by the proposed change. Therefore, there is no change to the intent of Section 11.0 of 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 issues related to a change in the CRSO's title.

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 change to the CRSO's title and will not degrade the safety and environmental commitments.

Conclusion

It was the conclusion of the SERP that the proposed change is allowed by License SUA-1534 and should be approved. The revised pages of the license application (pages 5-2 through 5-9, 5-14, 5-28, and 5-38) required in accordance with License Condition 9.4 were reviewed and approved and are attached to this evaluation.

Approved this 16th day of January 2003:

Jim Stokey, Mine Manager
SERP Chairman

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

Rhonda Grantham, Radiation Safety Officer

Chuck Miller, Plant Manager

SERP 03-02 Evaluation

Crow Butte Resources, Inc.

Safety and Environmental Review Panel

Evaluation Report – SERP 03-02

Wellhouse 36 Approval to Operate

February 14, 2003

The Crow Butte Resources, Inc. (CBR) Safety and Environmental Review Panel (SERP) met to review and approve operation of Wellhouse 36 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
Steve Magnuson	Vice President, Engineering and Development	Management
Kirk McDowell	Wellfield Construction Foreman	Operations (Wellfield Construction)
Mike Griffin	Manager of Health, Safety, and Environmental Affairs	Regulatory Affairs/ Environmental
Rhonda Grantham	Radiation Safety Officer	Radiation Safety
Mike Brost	Chief Geologist	Well Construction

Mr. Magnuson 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 36 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. 14 dated November 7, 2002;
- *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 14 to SUA-1534 dated November 7, 2002 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 36.

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 36 are the same as those described in the LRA. All MIT data sheets were contained in the Notice of Intent to Operate Wellhouse 36 that was submitted to the NDEQ. These MIT data sheets were reviewed by the SERP. The records indicate that the MITs performed in Wellhouse 36 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 Well House Start-up Checklist for Wellhouse 36. 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 Wellfield Construction Foreman reviewed these items and stated that all had been completed and the appropriate controls were in place.

A copy of the Well House Start-Up Checklist is attached to this SERP Evaluation. Supporting documentation in the form of pressure tests and ground continuity checks are also attached. The SERP noted that the wellhouse ground resistance sheet was not available for review and should be provided before the operation of the wellhouse is

initiated. This ground resistance check should also be added to the construction checklist and provided for future SERP reviews.

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 36.

Section 3.3.1 discusses leak testing of wellfield piping. The SERP reviewed the completion of pressure testing for piping systems associated with Wellhouse 36 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 14 to SUA-1534 in the amount of $12,816,973.

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 36.

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 36 in Mine Unit 8 will not degrade the safety and environmental commitments.

Based upon this evaluation of the licensing basis, the CBR SERP hereby conditionally approves startup and operation of Wellhouse 36 in Mine Unit 8 upon receipt of the wellhouse ground resistance check sheet.

Approved this 14th day of February 2003.

Steve Magnuson, Vice President, Engineering and Development
SERP Chairman

Kirk McDowell, Wellfield Construction Foreman

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

Rhonda Grantham, Radiation Safety Officer

Mike Brost, Chief Geologist

M. Griffin

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

JAN 13 2003

RECEIVED
JAN 16 2003
POWER RESOURCES, INC.
DENVER

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

Dear Mr. Collings:

On December 13, 2002, 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 36) in the construction of Mine Unit 8.

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 8 have already been submitted and approved. Approval of the additional portion of Mine Unit 8 will not alter those values. The Department hereby approves the Notice of Intent to Operate for the additional portion of Mine Unit 8.

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/notintwh.doc

SERP 03-03 Evaluation

Crow Butte Resources, Inc.

Safety and Environmental Review Panel

Evaluation Report – SERP 03-03

Use of Restoration Pipelines and IX Columns to Recover and Process Production Fluids and Changes in Associated Piping Diagrams in the License Renewal Application

April 21, 2003

The Crow Butte Resources, Inc. (CBR) Safety and Environmental Review Panel (SERP) met in accordance with USNRC Source Materials License SUA-1534 to review a proposed change that would allow production fluids to be commingled with restoration fluids in the restoration piping and ion exchange (IX) columns.

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

Name	Title	Area of Expertise
Steve Magnuson	VP of Operations	Management
Jim Stokey	Mine Manager	Management
Rhonda Grantham	Radiation Safety Officer	Radiation Safety
Chuck Miller	Plant Manager	Operations
John Cash	Safety Director/Wellfield Supervisor	Operations/Safety

Mr. Magnuson is the SERP Chairman. Mr. Cash is the SERP Secretary for this evaluation. Terri Anderson assisted by taking notes during the SERP meeting.

PURPOSE OF SERP EVALUATION

The purpose of the SERP evaluation was to review a proposal that would allow the restoration circuit, inclusive of piping and the IX columns, to be used to recover uranium from production fluids. There are three benefits to using the restoration circuit in this manner.

First, trunklines have a finite flow and pressure capacity. Each time additional pressure is added to the trunkline by turning on a well, every pumping well on that piping circuit sees the pressure and as a result produces less water. For example, when WH 25 produces at a rate of 283 gpm versus being off, the production from WH's 26, 27, 34, 35, and 36 is reduced by approximately 62 gpm. At today's headgrades, this equates to a loss in production of around 54 pounds per day or 20,000 pounds per year. Continuing with this example, the proposal considered by the SERP would allow production flow from WH 25 to be pumped back to the plant via the currently empty restoration trunkline. The production water may be commingled with restoration fluids before being treated by ion exchange and returned to the wellfield via the restoration pipelines. The WH 25 scenario is given as a single example to show what the actual benefit may be. The SERP review focused on the more general process of using the restoration circuit to recover uranium from production fluids.

Second, this proposal could also speed up the restoration process by placing marginal wellhouses into the restoration circuit before the entire mine unit is ready for restoration. One concern raised during the SERP review was, "will the restoration IX columns have the necessary efficiency to remove enough uranium from production waters so as not to contaminate commingled restoration fluids." Due to the efficiency of the IX columns, the vast majority of uranium is removed from production fluid, regardless of the incoming headgrade. The only way higher-grade fluids could make it back to the mine unit in restoration is if the column is not stripped in a timely manner once it becomes loaded. This scenario results in the costly circulation of fluids without uranium removal and is therefore best to be avoided. Grab samples taken at regular intervals from the tails of each IX column system are used to determine when the column is ready to be stripped.

Third, the facility currently has capacity in the restoration trunkline as well as the restoration IX columns that is not being used. Using the restoration circuit to recover production uranium will help utilize this capacity and recoup the capital expended on the system. The NRC license limits production flow to 5,000 gpm with no limit on restoration flow. The UIC permit, however, limits the injection flow of commercial fluids to less than or equal to 4,830 gpm and total injection flow limit, including commercial and restoration fluids, to 5,500 gpm. The flow rate and total flow of every injection well, both commercial and restoration phases, is monitored in the wellhouse for every active well. This data will be used to ensure we do not surpass the NRC license or State UIC permit flow limits.

When production fluids may become mixed with restoration fluids, no mining chemicals will be added since the chemicals may eventually make their way to the mine units in restoration where they would reverse the restoration process. It is conceivable that during a hiatus in restoration, the restoration IX circuit could be used to remove uranium from production fluids. In this case, mining chemicals could be added to the injection stream since there would be no opportunity for them to reach mine units in restoration.

Production fluids processed through the restoration circuit would be considered production fluids until the Nebraska Department of Environmental Quality (NDEQ) approves a restoration plan for that particular mine unit.

The SERP also reviewed and approved the addition of more downflow IX columns in order to increase restoration capacity and to increase the potential number of individual restoration circuits. However, before installing additional tankage, the surety bond would have to be reviewed and possibly updated to account for disposal or tankage clean up.

The MILDOS-Area Model is based on a production flow rate of 5,000 gpm. Since we cannot exceed the licensed flow rate, regardless of the circuit used to recover uranium, the MILDOS-Area Model is valid for the proposed change.

As mentioned above, the sole criteria for determining if a mine unit is in restoration or production, regardless of which piping circuit the water is flowing through, would be whether or not the NDEQ has approved a restoration plan and if NRC has been notified as per the license and restoration plan. Only mine units with an approved restoration plan and being processed without the addition of chemicals will be considered in restoration. The restoration reporting requirements will not change and the necessary data to complete restoration reports will still be available if the proposed change is implemented.

The ability to balance wellfields in order to prevent excursions would not be affected by this change since bleed can be taken from both restoration and commercial production circuits.

Generalized process figures 3.1-6, 3.2-1 and 6.1-1 from the License Renewal Application were reviewed as part of the SERP. The SERP determined that the schematics were too specific regarding the number and labeling of restoration IX columns as well as the source of fluids. The existing and revised figures are attached so side-by-side comparisons can be made.

The SERP does not believe the proposed action would result in the generation of any new safety hazards or changes in existing hazards.

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 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. 15 dated February 12, 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

The SERP reviewed the requirements contained in Source Materials License SUA-1534, Amendment 15, dated February 12, 2003. The license the maximum production flow rate

to 5,000 gpm in condition 10.5. Flow rates from each production well will be totalized to ensure we do not exceed this flow rate.

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. No such impacts were noted.

Financial Surety

The proposed change will have no effect on the level of financial surety maintained by CBR. However, if new tankage is added, the surety will need to be reviewed to ensure sufficient funds are available to dispose of or clean the additional tanks.

Safety Evaluation Report

The Safety Evaluation Report (SER) prepared by NRC in 1998 principally provides the basis for worker safety at Crow Butte. The SERP evaluated the SER and determined that there where no additional issues that would affect the SERP review.

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 address additional issues related to the SERP review.

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 change to the processing system or changes to diagrams.

Conclusion

It was the conclusion of the SERP that the proposed change is allowed by License SUA-1534 and should be approved. The revised pages of the license renewal application (pages 3-14, 3-16, and 6-19) required in accordance with License Condition 9.4 were reviewed and approved and are attached to this evaluation.

Approved this 21st day of April, 2003:

Steve Magnuson, Vice President of Operations
SERP Chairman

Jim Stokey, Mine Manager

Rhonda Grantham, Radiation Safety Officer

Chuck Miller, Plant Manager

John Cash, Safety Director/Wellfield Supervisor

SERP 03-04 Evaluation

Crow Butte Resources, Inc.

Safety and Environmental Review Panel

Evaluation Report – SERP 03-04

Wellhouse 37 Approval to Operate

June 12, 2003

The Crow Butte Resources, Inc. (CBR) Safety and Environmental Review Panel (SERP) met to review and approve operation of Wellhouse 37 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
Steve Magnuson	Vice President, Engineering and Development	Management
Jim Stokey	Mine Manager	Management (Construction)
John Cash	Wellfield Superintendent/ Safety Director	Operations
Rhonda Grantham	Radiation Safety Officer	Radiation Safety

Mr. Magnuson is the SERP Chairman. Mr. Cash 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 37 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. 15 dated February 12, 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 15 to SUA-1534 dated February 12, 2003 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 37.

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 37 are the same as those described in the LRA. All MIT data sheets were contained in the Notice of Intent to Operate Wellhouse 37 that was submitted to the NDEQ. These MIT data sheets were reviewed by the SERP. The records indicate that the MITs performed in Wellhouse 37 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 37. 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 Wellfield Construction Foreman reviewed these items and stated that all had been completed and the appropriate controls were in place with the exception of a small section of the berm at the northwest end of the wellfield.

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 37.

Section 3.3.1 discusses leak testing of wellfield piping. The SERP reviewed the completion of pressure testing for piping systems associated with Wellhouse 37 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 14 to SUA-1534 in the amount of $12,816,973.

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 37.

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 37 in Mine Unit 8 will not degrade the safety and environmental commitments.

Based upon this evaluation of the licensing basis, the CBR SERP hereby conditionally approves startup and operation of Wellhouse 37 in Mine Unit 8 upon completion of the berm at the northwest end of the wellhouse.

Approved this 12th day of June 2003.

Steve Magnuson, Vice President, Engineering and Development
SERP Chairman

Jim Stokey, Mine Manager

John Cash, Wellfield Superintendent/Safety Director
SERP Secretary

Rhonda Grantham, Radiation Safety Officer

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
web site : www.deq.state.ne.us

MAR 0 4 2003

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

Dear Mr. Collings:

On February 24, 2003, 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 37) in the construction of Mine Unit 8.

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 8 have already been submitted and approved. Approval of the additional portion of Mine Unit 8 will not alter those values. The Department hereby approves the Notice of Intent to Operate for the additional portion of Mine Unit 8.

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/notintwh.doc

SERP 03-05 Evaluation

Crow Butte Resources, Inc.

Safety and Environmental Review Panel

Evaluation Report – SERP 03-05

Mine Unit 9 and Wellhouse 41
Approval to Operate

October 23, 2003

The Crow Butte Resources, Inc. (CBR) Safety and Environmental Review Panel (SERP) met to review and approve operation of Mine Unit 9 and Wellhouse 41 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	Regulatory Affairs/ Environmental
Kirk McDowell	Wellfield Construction Foreman	Operations (Wellfield Construction)
John Cash	Wellfield Supervisor/ Safety Director	Wellfield Operations/ Safety
Rhonda Grantham	Radiation Safety Officer	Radiation Safety
Mike Brost	Chief Geologist	Well Construction
Brian Pile	Project Engineer	Engineering

Mr. Stokey is the CBR 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 Mine Unit 9 and Wellhouse 41 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 than 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 Mine Unit 9 Notice of Intent to Operate and preoperational monitoring data and evaluated this information as compared with the requirements of the licensing basis. The SERP also reviewed the Wellhouse 41 startup checklists and supporting documentation. This information was evaluated 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. 15 dated February 12, 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 contained in 10 CFR Parts 20 and 40.

Source Materials License SUA-1534 Requirements

Amendment 15 to SUA-1534 dated February 12, 2003 was reviewed for specific requirements related to approval and operation of new Mine Unit and a wellhouse.

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 41. 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 Wellfield Construction Foreman and Project Engineer 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 for the Wellhouse are also attached. Ground continuity tests for production pumps are performed when the pumps are installed by the Wellfield Operations staff.

License Condition 9.5: This License Condition requires that CBR maintain an NRC-approved financial surety arrangement to cover reclamation of all existing operations and planned expansions for the upcoming year. If such expansion is not covered in the annual update to the existing surety arrangement, an updated surety must be provided to NRC at least 90 days before beginning construction.

The current surety arrangement approved by NRC and NDEQ includes the operation of the two wellhouses in Mine Unit 9 during 2003.

License Condition 9.10: This License Condition requires that CBR conduct operations within the permit area boundaries shown in the License Renewal Application

(LRA), as amended. The SERP confirmed that Mine Unit 9 falls within this permit area boundary.

License Condition 10.2: This License Condition requires that all wells be constructed as described in the LRA and that Mechanical Integrity Tests (MITs) be conducted before the well can be utilized.

The well construction methods in use for Mine Unit 9 are the same as those described in the LRA. The SERP reviewed the MIT information contained in the Notice of Intent to Mine (NOI) submitted to the NDEQ. The package in the NOI included the MITs for required monitoring wells. MITs for future wellhouses in Mine Unit 9 cannot be reviewed since these wells have not been installed. Therefore, the SERP can only review baseline restoration wells and the monitoring wells of Mine Unit 9 and the injection/production wells for Wellhouse 41 for compliance with this License Condition. All MIT data sheets reviewed met the requirements.

License Condition 10.3: This License Conditions contain requirements for establishing pre-operational baseline groundwater quality including well density, sampling frequency and parameters, and determination of groundwater restoration goals.

10.3(A): A total of 21 injection or production wells are identified as baseline restoration wells for Mine Unit 9, which comprises 76 acres. The SERP reviewed the well placement. The wells meet the density requirement of this License Condition (i.e., 1 per every 4 acres) and are evenly spaced in the Mine Unit. Samples were collected at least 14 days apart.

10.3(B): The baseline samples were analyzed for all parameters listed in this portion of the License Condition.

10.3(C): Groundwater restoration goals were proposed for Mine Unit 9 that were based upon the mine unit average of all baseline restoration (BLR) wells. The goals are an arithmetic mean of the averages for the three samples taken for each of the 21 baseline restoration wells.

The SERP determined to insert a restoration goal table for Mine Unit 9 into the approved LRA to include all parameters required by License Condition 10.3(B). A copy of the approved Table is attached to this evaluation.

License Condition 10.4: This License Condition contains requirements for determining Upper Control Limits (UCLs) for upper and perimeter monitor wells including well density, sampling schedule, analytes, and UCL calculational method.

10.4(A): A total of 20 shallow monitors and 20 perimeter monitor wells are identified for Mine Unit 9, which comprises 76 acres. The SERP reviewed the well placement. The wells meet the density requirement of this License Condition (i.e., 1 per every 5 acres for shallow monitor wells) and are evenly spaced in the Mine Unit. Samples were collected at least 14 days apart.

10.4(B): The samples were analyzed for all parameters listed in this portion of the License Condition.

10.4(C): The proposed UCLs for each shallow and perimeter monitor well were calculated as required in this License Condition.

License Condition 10.16: This License Condition specifies the spacing for all perimeter monitor wells drilled after April 1999. Perimeter monitor wells may be spaced no greater than 300 feet from a wellfield unit and no greater than 400 feet between the wells. All of the perimeter monitor wells for Mine Unit 9 meet the spacing requirements of the License.

License Condition 11.3: This License Condition requires that CBR implement the effluent and environmental monitoring program in accordance with the program submitted on March 18, 1999. The approved program requires quarterly sampling of all private wells within 1 km of an active wellfield. Addition of Mine Unit 9 will require quarterly monitoring of one additional private well (Well #13). The SERP directed that this well be added to the sample schedule.

The SERP concluded that all specific license requirements would continue to be met if this change is approved.

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 41.

Section 3.3 of the EA discusses wellfield design and construction. In 3.3.1 (page 20), the EA states that CBR analyzes the monitor wells for 35 parameters. This statement does not match License Condition 10.4(B), which requires that the monitor wells be sampled for the five excursion indicators only. This requirement was amended during license renewal and is discussed in the Technical Evaluation Report section of this evaluation.

Section 3.3.1 discusses leak testing of wellfield piping. The SERP reviewed the completion of pressure testing for piping systems associated with Wellhouse 41 and found that they meet the intent of the EA.

Well construction and testing as described in the EA has been completed for the baseline restoration wells, the shallow and perimeter monitor wells, and the injection/production wells associated with Wellhouse 41. This data was submitted to NDEQ with the NOI. Other wells that will be contained in Mine Unit 9 have not been drilled, constructed and/or tested and therefore cannot be approved by the SERP.

Financial Surety

The proposed change is covered in the NRC-approved financial surety maintained by CBR and approved by Amendment 14 to SUA-1534 in the amount of $12,816,973. The surety estimate was based on the operation of two wellhouses (Wellhouse 41 and 42) in Mine Unit 9 during 2003.

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 Mine Unit 9 or Wellhouse 41.

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. Three TERs relate to approval of a new Mine Unit for operation:

- The TER issued with the License Renewal dated February 24, 1998 accepted a requested change to require baseline sampling of monitor wells for the five excursion parameters rather than the complete list of restoration parameters. This TER was the basis for the License not implementing the program in the EA as discussed in the EA section previously. Mine Unit 9 baseline sampling met the basis of this TER.

- The TER issued to support Amendment 8 dated January 4, 2001 changed the acceptable method for calculating UCLs. Mine Unit 9 UCL calculations met the basis of this TER.

- The TER issued to support Amendment 11 dated May 3, 2001 approved a CBR request to reduce the number of restoration parameters analyzed during baseline

sampling and to recognize the NDEQ restoration standards as an acceptable secondary restoration goal. Preparation of the proposed Mine Unit 9 restoration standards met the basis of this TER.

Based on the SERP review, Mine Unit 9 meets the licensing basis set forth in the three applicable TERs.

None of the TERs prepared since license renewal directly address issues related to approval of a new Wellhouse for operation.

NDEQ UIC Permit

The SERP reviewed the requirements of the NDEQ UIC Permit they relate to startup of Mine Unit 9.

- The NOI was submitted as required on Page 4 of the permit and approved by the NDEQ (see attached letter).

- Part II A 2 of the permit, *Mine Unit Limitations*, allows no more than five mine units in the mining stage, no more than five mine units in restoration (excluding those in stabilization), and no more than three mine units constructed in advance of active mining. The SERP reviewed the current status on Mine Units 1 through 8 and determined the following:

    1. Mine Units Restored: One (Mine Unit 1)
    2. Mine Units in Restoration: Two (Mine Units 2 and 3)
    3. Mine Units in Operation: Five (Mine Units 4 through 8)

    In order to meet the limitations in this section of the permit, Mine Unit 4 must be placed in restoration before mining can begin in Mine Unit 9. The Mine Unit 4 restoration plan was approved by the NDEQ on August 26, 2003. Part II C 3 of the permit contains the restoration procedure, which requires that CBR notify the NDEQ in writing and establish post-mining water quality in coordination with the NDEQ. These steps must be completed before injection may begin in Mine Unit 9.

- Restoration goals were determined for every parameter included in Table 2.6 (Page 10) as required.

- All monitor and restoration wells were installed and baseline monitoring performed as required by permit with the exception of four shallow monitor wells. These wells lie along the south boundary of Mine Unit 7 (which lies directly north of Mine Unit 9). The four wells were located less than 300 feet from an active Mine Unit (i.e.,

Mine Unit 7) when baseline sampling was performed, contrary to UIC Permit Part III D 2 (Page 15). The locations for these shallow monitor wells were chosen to meet the permit requirements in Part III B 2 (Page 14), which requires that shallow monitor wells be equally distributed throughout the Mine Unit. If the four wells were installed at least 300 feet from an active Mine Unit, the spacing would not be equally distributed and there would be gaps in monitoring based on the one well per four acre radius. NDEQ agreed with CBR's approach during their review of the NOI and plans to address this issue during the current permit modification process.

- All monitor wells were shown to be functionally operational as required in Part III B 2 (Page 14).

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 operation of Mine Unit 9 and of Wellhouse 41 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 Mine Unit 9 and Wellhouse 41, contingent on Mine Unit 4 being placed in restoration as discussed in the NDEQ UIC Permit.

Approved this 23rd day of October 2003.

Jim Stokey, Mine Manager
SERP Chairman

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

Kirk McDowell, Wellfield Construction Foreman

CROW BUTTE RESOURCES, INC.

SERP 03-05

John Cash, Wellfield Supervisor/Safety Director

Rhonda Grantham, Radiation Safety Officer

Mike Brost, Chief Geologist

Brian Pile, Project Engineer

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
web site : www.deq.state.ne.us

Mr. Stephen Collings, President
Crow Butte Resources, Inc.
274 Union Boulevard, Suite 310
Lakewood, CO 80228

OCT 2 1 2003

Dear Mr. Collings:

On July 31 and September 15, 2003, the Nebraska Department of Environmental Quality received a copy of a Notice of Intent to Operate for a portion of Mine Unit 9 from Crow Butte Resources, Inc. A correction of the baseline restoration values was submitted to the Department on September 29, 2003.

The Department has reviewed the Notice of Intent to Operate and determined that it meets the regulatory criteria established in Title 122 and UIC permit No. NE0122611. The restoration limits and upper control limits for Mine Unit 9 have been calculated utilizing established procedures in UIC permit No. NE0122611, and are acceptable as submitted.

The Nebraska Department of Environmental Quality hereby grants approval to Crow Butte Resources, Inc. to begin operation in Mine Unit 9. Mine Unit 9 is hereby incorporated into UIC permit No. NE0122611 and is subject to all regulatory conditions and parameters set forth therein.

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.

Sincerely,

Michael J. Linder
Director

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

License Renewal Application

Affected Pages (highlighted version)

2003 SERP Actions

Figure 3.1-6: Process Flow Sheet

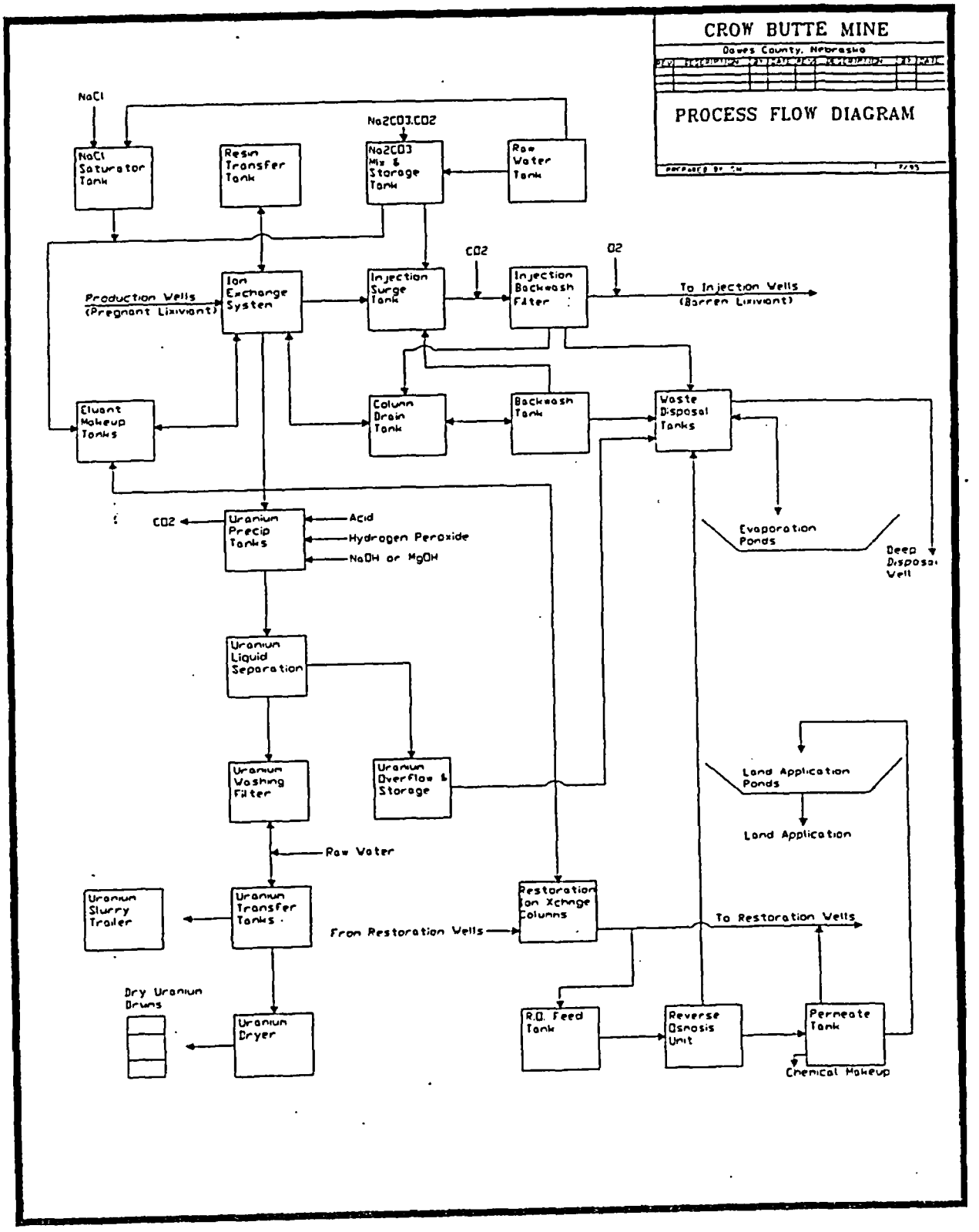


Figure 3.2-1: General Arrangement- Main Processing Facility

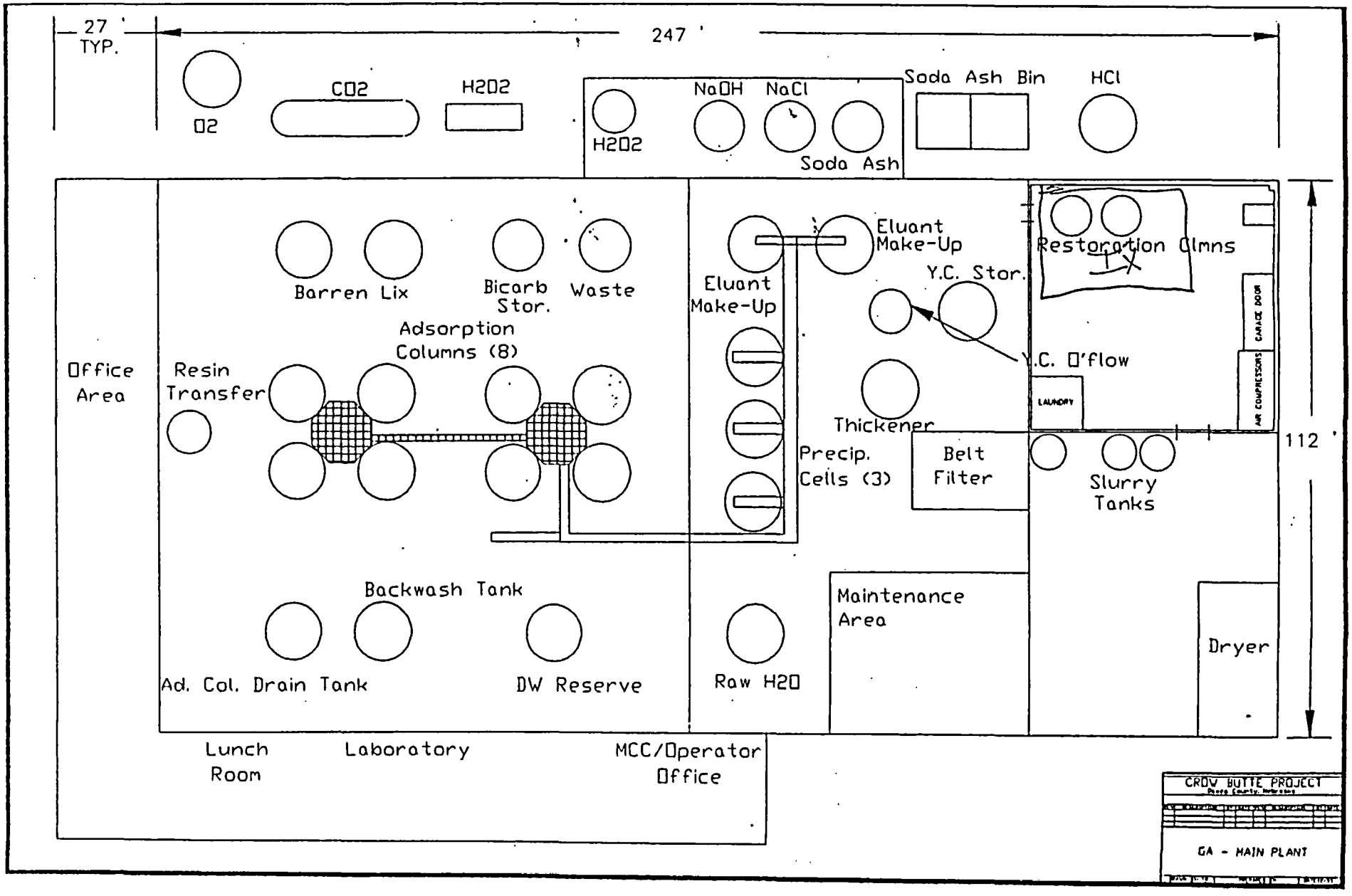
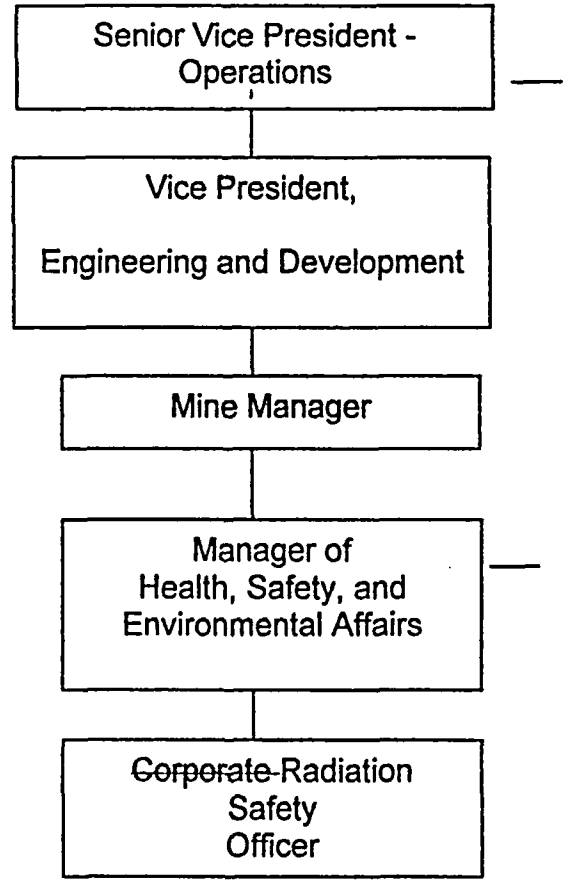


Figure 5.1-1: Crow Butte Resources Organizational Chart



5.1.3. 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.

5.1.4. 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 ~~CRSO~~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.

5.1.5. ~~CORPORATE~~ RADIATION SAFETY OFFICER

The ~~CRSO~~RSO is responsible for the development, administration, and enforcement of all radiation safety programs. The ~~CRSO~~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 ~~CRSO~~RSO is responsible for the implementation of all on-site environmental programs, including emergency procedures. The ~~CRSO~~RSO inspects facilities to verify compliance with all applicable requirements in the areas of radiological health and safety. The ~~CRSO~~RSO works closely with all supervisory personnel to insure that established programs are maintained. The ~~CRSO~~RSO is also responsible for the collection and interpretation of employee exposure related monitoring, including data from radiological safety. The ~~CRSO~~RSO makes recommendations to improve any and all radiological safety related controls.

The ~~CRSO~~RSO has no production-related responsibilities. The ~~CRSO~~RSO will report to the Manager of Health, Safety, and Environmental Affairs

5.1.6. HEALTH PHYSICS TECHNICIAN

The Health Physics Technician (HPT) assists the ~~CRSO~~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 ~~CRSO~~RSO.

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 ~~CRSO~~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 ~~CRSO~~RSO. All written SOPs are reviewed for radiological protection aspects and approved by the ~~CRSO~~RSO prior to implementation. Additionally, the ~~CRSO~~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 ~~CRSO~~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 ~~CRSO~~RSO or designee by way of specialized training issues RWPs.

5.2.2. 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".

5.3. MANAGEMENT AUDIT AND INSPECTION PROGRAM

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

Daily

The ~~CRSO~~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. Results of the Daily Inspections are documented.

Weekly

The ~~CRSO~~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.

Monthly

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

5.4. 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.

The minimum qualifications for the ~~Corporate~~–Radiation Safety Officer (~~CRSO~~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 ~~GRSO~~RSO attends refresher training on uranium mill health physics every two years.

- Specialized Knowledge - The ~~GRSO~~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.

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. 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 ~~CRSO~~RSO. The ~~CRSO~~RSO or a qualified designee conducts training.

5.5.1. TRAINING PROGRAM CONTENT

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.

Contractors

Any contractors having work assignments at the facility are given appropriate training and safety instruction. Contract workers who will be performing work on heavily contaminated equipment receive the same training normally required of permanent workers.

Permanent Employees

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).

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 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." 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 ~~CRSO~~RSO is charged with the responsibility to develop and implement appropriate procedures to handle potential spills. Personnel representing the engineering and operations functions of the Crow Butte Uranium Project facility will assist the ~~CRSO~~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.

Air sampler calibration will be performed in accordance with the instructions contained in Standard Operating Procedure C-6.

5.7.3.3. 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 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 ~~CRSO~~RSO.

5.7.4. 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.

accordance with the guidance contained in USNRC Regulatory Guide 8.22, "Bioassay in Uranium Mills, Revision 1" and with the instructions currently contained in Standard Operating Procedure C-10, "Bioassay Sampling."

5.7.6. 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 ~~CRSO~~RSO, radiation safety staff or properly trained employees. The release limits are set by "Guidelines for Decontamination of Facilities and Equipment Prior to

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 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.

- The mine unit average and NDEQ restoration values for Mine Unit 9 are given in Table 6.1-9. The CBR SERP determined these restoration values on October 23, 2003.

NDEQ Permit Number NE0122611 requires that a Mine Unit be returned to a wellfield average of these restoration values. These concentrations were approved by the NDEQ with the Notice of Intent to Operate submittals. Post mining water quality for Mine Unit 1 can be found in Table 6.1-89.

Crow Butte Resources operated a R&D Pilot Facility starting in July 1986 and initiated restoration activities of its Wellfield No. 2 in February 1987. Wellfield No. 1 was incorporated into Mine Unit 1, thus no restoration took place in that area. The techniques used during that program are the basis for the commercial restoration program outlined in this section. Crow Butte Resources will utilize ion exchange columns, a reverse osmosis unit and reductant addition equipment similar to those used in the R&D restoration during commercial restoration operations.

The commercial groundwater restoration program consists of two stages, the restoration stage and the stabilization stage. The restoration stage consist of four activities:

- Groundwater transfer;
- Groundwater sweep;
- Groundwater treatment; and
- Wellfield recirculation

A reductant may be added at anytime during the restoration stage to lower the oxidation potential of the mining zone. A sulfide or sulfite compound will be added to the injection stream in concentrations sufficient to reduce the mobilized species.

The stabilization stage consists of monitoring the restoration wells for six months following successful completion of the restoration stage. Stabilization will begin once restoration activities have returned the average concentration of restoration parameters to acceptable levels. Following the stabilization phase, Crow Butte Resources will make a request to the appropriate regulatory agencies that the wellfield is restored.

Table 6.1-9: Baseline and Restoration Values for Mine Unit 9

Parameter	Groundwater Standard	MU-9 Baseline	MU-9 Standard Deviation	MU-9 NDEQ Restoration Value
Ammonium (mg/l)	10.0	0.40	0.05	10.0
Arsenic (mg/l)	0.05	0.001	0.000	0.05
Barium (mg/l)	1.0	0.1	0.0	1.0
Cadmium (mg/l)	0.005	0.005	0.000	0.005
Chloride (mg/l)	250	203	13	250
Copper (mg/l)	1.0	0.01	0.00	1.0
Fluoride (mg/l)	4.0	0.8	0.0	4.0
Iron (mg/l)	0.3	0.04	0.01	0.3
Mercury (mg/l)	0.002	0.001	0.000	0.002
Manganese (mg/l)	0.05	0.01	0.00	0.05
Molybdenum (mg/l)	1.0	0.1	0.0	1.0
Nickel (mg/l)	0.15	0.05	0.00	0.15
Nitrate (mg/l)	10.0	0.06	0.01	10.0
Lead (mg/l)	0.05	0.05	0.00	0.05
Radium (pCi/L)	5.0	164	238	640
Selenium (mg/l)	0.05	0.003	0.001	0.05
Sodium (mg/l)	N/A	380	11	3,800
Sulfate (mg/l)	250	320	15	350
Uranium (mg/l)	5.0	0.1	0.24	5.0
Vanadium (mg/l)	0.2	0.1	0.0	0.2
Zinc (mg/l)	5.0	0.01	0.00	5.0
pH (Std. Units)	6.5 - 8.5	8.35	0.30	6.5 – 9.41
Calcium (mg/l)	N/A	13.6	4.6	136
Total Carbonate (mg/l)	N/A	383	14	595
Potassium (mg/l)	N/A	13.9	3.0	139
Magnesium (mg/l)	N/A	3.5	1.2	35.0
TDS (mg/l)	N/A	1,152	38	1,190

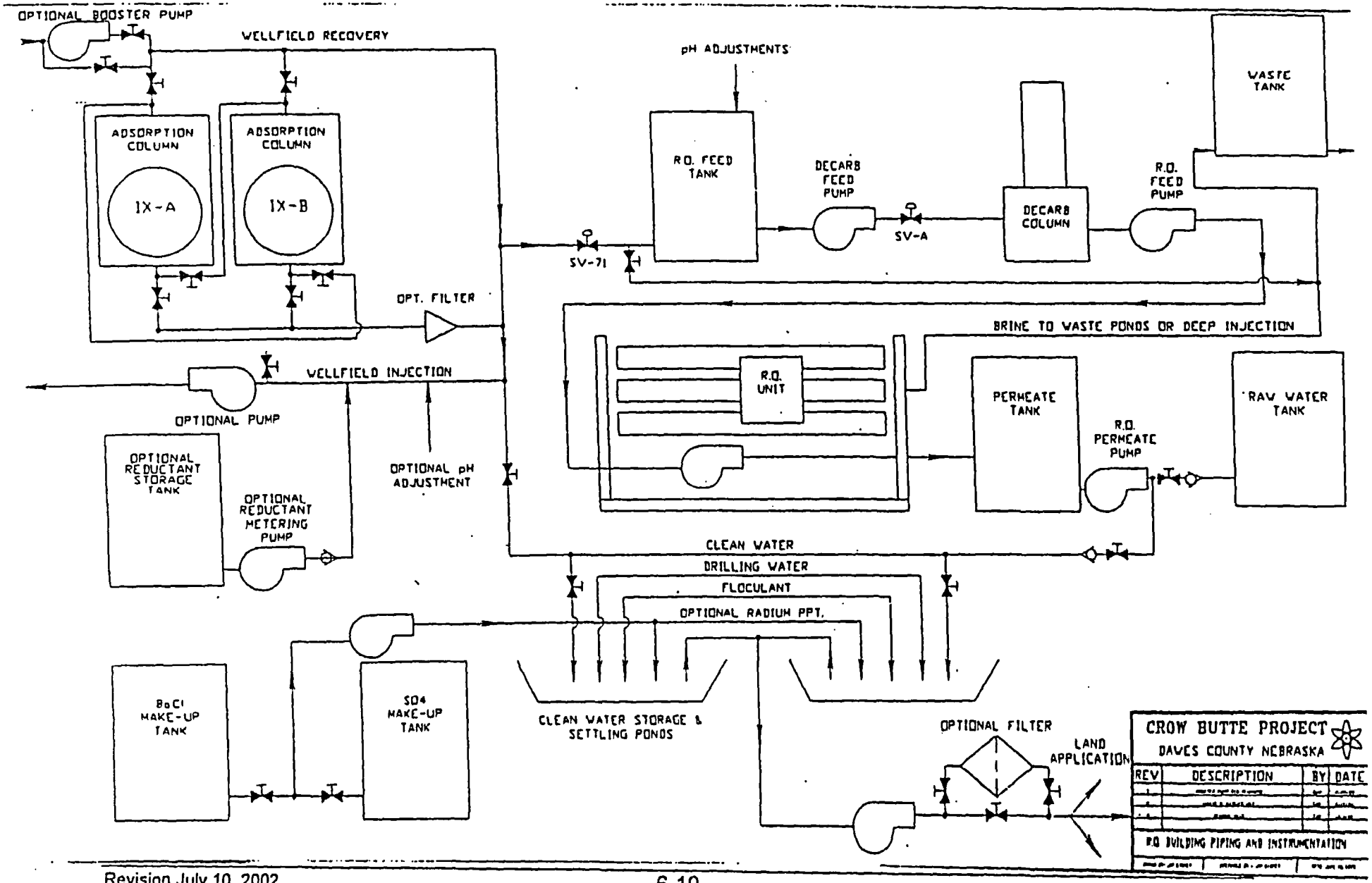
Table 6.1-810: Post Mining Water Quality for Mine Unit 1
Restoration Well Sampling

	PM-1	PM-4	PM-5	PT-5	IJ-6	IJ-13	IJ-25	IJ-28	IJ-45	PR-8	PR-15	PR-19
Ca (mg/l)	87.9	87.1	80.8	87.9	87.6	93.9	89.4	89.6	89.9	85.4	86.7	98.3
Mg (mg/l)	22.6	20.6	22.7	23.8	21.4	23.9	22.5	23.1	24.8	23.2	23.1	23.8
Na (mg/l)	1154	942	1054	1144	1054	1174	1177	1182	1126	1144	1172	1083
K (mg/l)	32.7	26.3	30	30	27.2	31.3	30	31.3	32.7	30	30	28.6
CO_3 (mg/l)	0	0	0	0	0	0	0	0	0	0	0	0
HCO_3 (mg/l)	1099	900	972	981	1057	1086	1111	1207	1104	1170	1170	959
SO_4 (mg/l)	1109	959	1115	1240	1031	1209	1119	1112	1134	1115	1115	1283
Cl (mg/l)	598	455	586	594	544	598	594	619	607	603	603	590
NH_4 (mg/l)	0.33	0.67	0.14	0.33	0.44	0.07	< 0.05	< 0.05	0.33	0.27	0.15	0.49
NO_2 (mg/l)	< 0.01	0.02	0.09	< 0.01	0.11	< 0.01	< 0.01	< 0.01	0.04	0.05	< 0.01	0.05
NO_3 (mg/l)	1.06	< 0.1	0.97	0.99	1.29	0.74	0.86	1.3	1.25	1.46	1.6	0.46
F (mg/l)	0.37	0.26	0.54	0.45	0.45	0.37	0.38	0.45	0.43	0.43	0.4	0.35
SiO_2 (mg/l)	25.7	18.2	35.3	24.7	33.3	34.3	26.4	31.6	28.3	33.2	30	22.2
TDS (mg/l)	3694	3121	3756	3851	3515	3899	3751	3886	3873	3820	3807	3765
Cond (µmho/cm)	5843	4841	5590	5964	5445	6012	5807	6025	5916	5819	5940	5819
$CaCO_3$ (mg/l)	901	738	797	804	866	890	911	989	905	959	959	786
pH (Std. units)	7.65	6.87	6.85	7.28	7.16	7.35	7.65	7.81	7.37	7.46	7.78	6.92
Trace Metals												
Al (mg/l)	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.29
As (mg/l)	0.018	0.007	0.018	0.017	0.031	0.028	0.02	0.028	0.023	0.028	0.024	0.011
Ba (mg/l)	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
B (mg/l)	1.17	1.44	1.09	1.36	1.06	1.26	1.13	1.19	1.15	1.23	1.25	1.17

Table 6.1-810: Post Mining Water Quality for Mine Unit 1 Restoration Well Sampling

	PM-1	PM-4	PM-5	PT-5	IJ-6	IJ-13	IJ-25	IJ-28	IJ-45	PR-8	PR-15	PR-19
Cd (mg/l)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Cr (mg/l)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu (mg/l)	< 0.01	< 0.01	0.05	< 0.01	0.02	< 0.01	< 0.01	< 1	< 0.01	< 0.01	< 0.01	< 0.01
Fe (mg/l)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.38
Pb (mg/l)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Mn (mg/l)	0.02	0.11	0.05	0.04	0.14	0.15	0.08	0.06	0.06	0.02	< 0.01	0.16
Hg (mg/l)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Mo (mg/l)	0.6	0.2	0.42	0.53	0.47	0.5	0.56	0.54	0.53	0.59	0.53	0.37
Ni (mg/l)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.12	0.12	0.12	< 0.05	< 0.05	< 0.05	< 0.05
Se (mg/l)	0.139	0.012	0.129	0.24	0.112	0.122	0.1	0.138	0.149	0.154	0.148	0.041
V (mg/l)	1	0.1	0.38	1.15	1.12	1.18	1.03	1.24	1.29	1.23	1.56	0.28
Zn (mg/l)	< 0.01	0.14	0.11	0.01	0.11	0.01	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Radionuclides												
U (mg/l)	8.63	6.29	54.52	9.3	13.9	9.31	9.9	2.52	14.83	5.24	5.18	6.78
Ra-226 (pCi/l)	370	126	329	1139	1113	1558	1258	1147	681	417	109	1182

Figure 6.1-1: Restoration Process Schematic



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 6.1-911 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 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.

Table 6.1-~~8~~11: Typical Membrane Rejection
Source: Osmonics, Inc.

NAME	SYMBOL	PERCENT REJECTION
Cations		
Aluminum	Al^{+3}	99+
Ammonium	NH_4^{+1}	88-95
Cadmium	Cd^{+2}	96-98
Calcium	Ca^{+2}	96-98
Copper	Cu^{+2}	98-99
Hardness	Ca and Mg	96-98
Iron	Fe^{+2}	98-99
Magnesium	Mg^{+2}	96-98
Manganese	Mn^{+2}	98-99
Mercury	Hg^{+2}	96-98
Nickel	Ni^{+2}	98-99
Potassium	K^{+1}	94-96
Silver	Ag^{+1}	94-96
Sodium	Na^{+}	94-96
Strontium	Sr^{+2}	96-99
Zinc	Zn^{+2}	98-99
Anions		
Bicarbonate	HCO_3^{-1}	95-96
Borate	$B_4O_7^{-2}$	35-70
Bromide	Br^{-1}	94-96
Chloride	Cl^{-1}	94-95
Chromate	CrO_4^{-2}	90-98
Cyanide	CN^{-1}	90-95
Ferrocyanide	$Fe(CN)_6^{-3}$	99+
Fluoride	F^{-1}	94-96
Nitrate	NO_3^{-1}	95
Phosphate	PO_4^{-3}	99+
Silicate	SiO_2^{-1}	80-95
Sulfate	SO_4^{-2}	99+
Sulfite	SO_3^{-2}	98-99
Thiosulfate	$S_7O_3^{-2}$	99+

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 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 6.1-8~~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 6.1-8~~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.

License Renewal Application

Affected Pages (replacement pages)

2003 SERP Actions

Figure 3.1-6: Process Flow Sheet

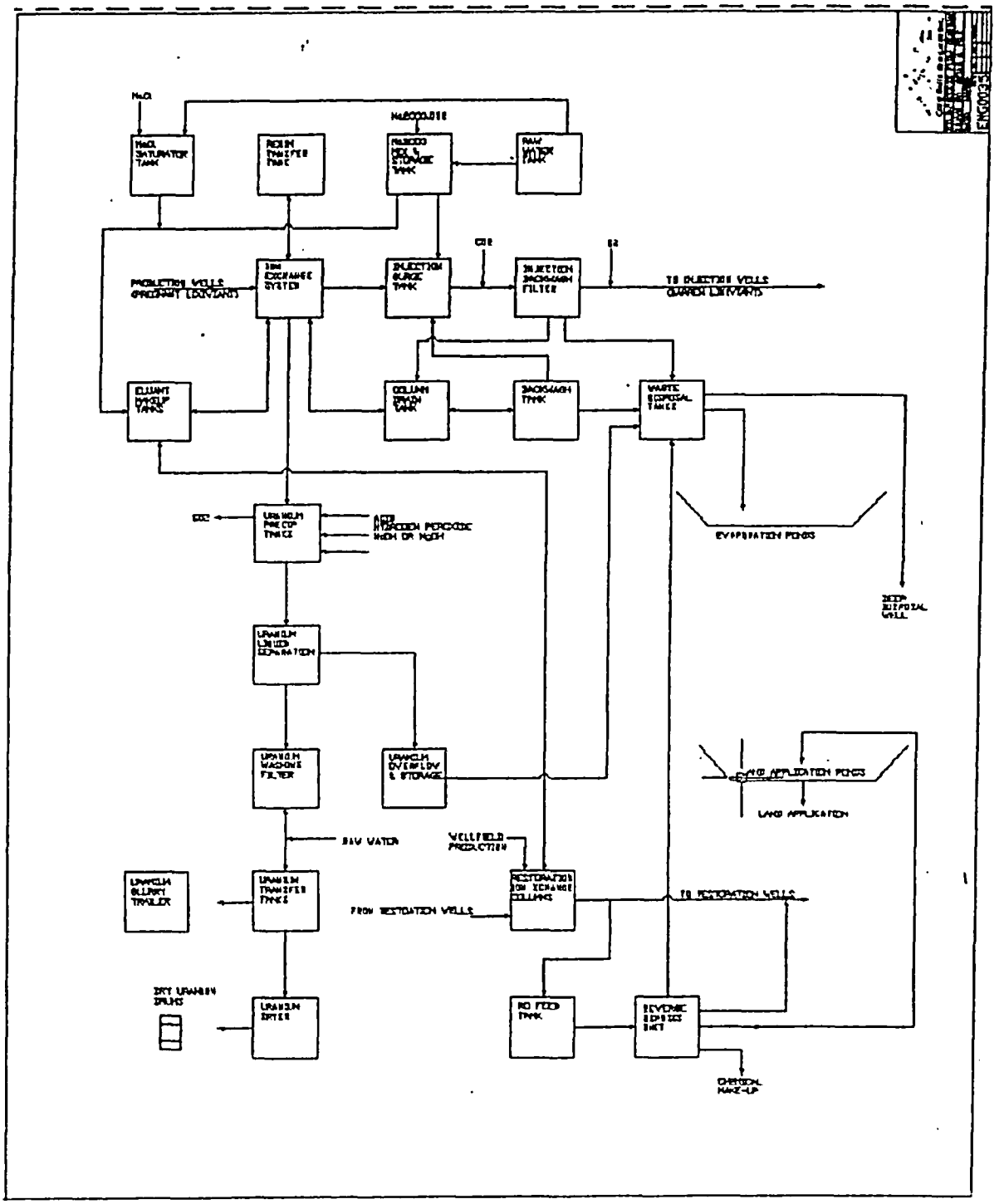


Figure 3.2-1: General Arrangement- Main Processing Facility

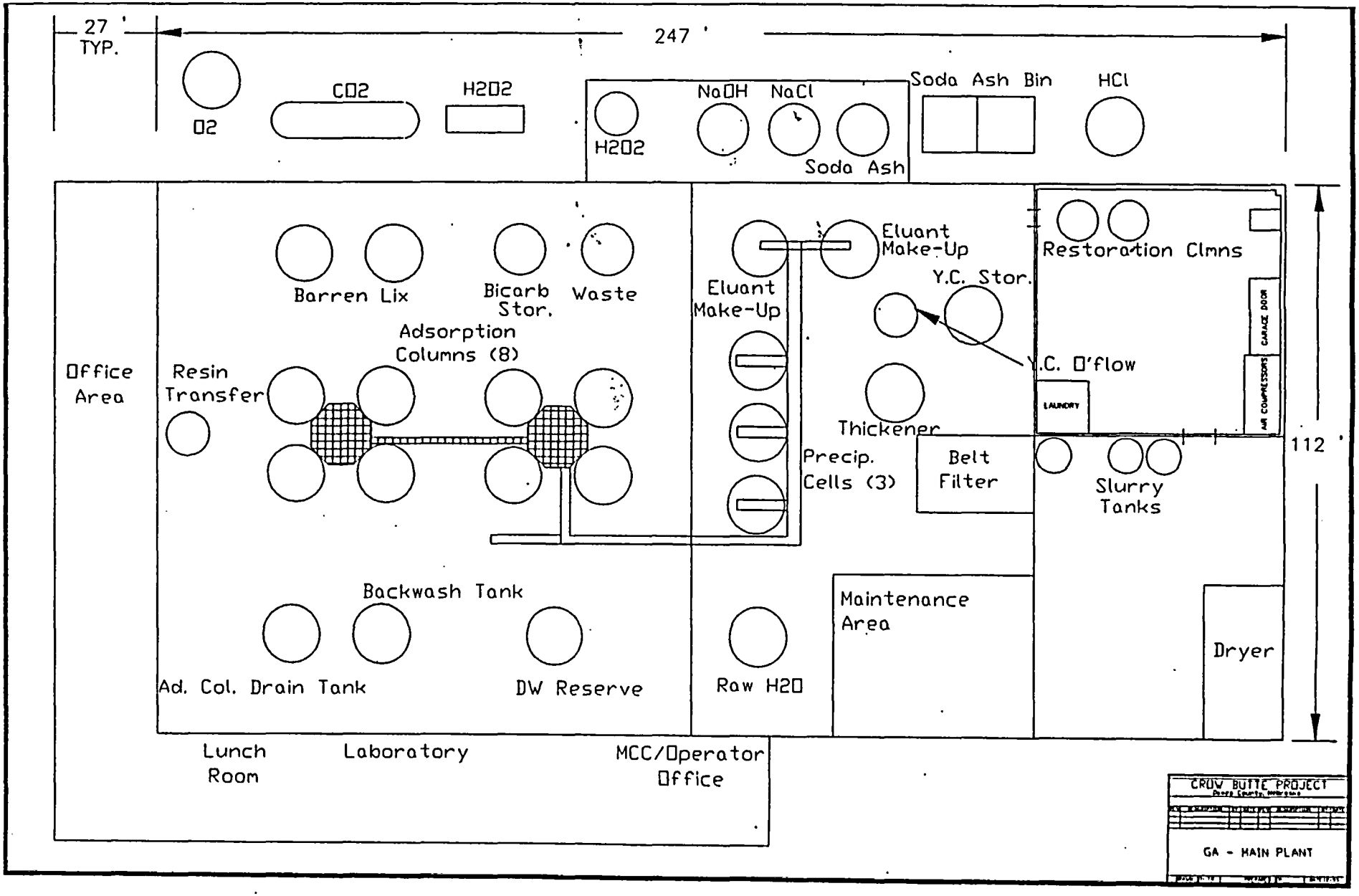
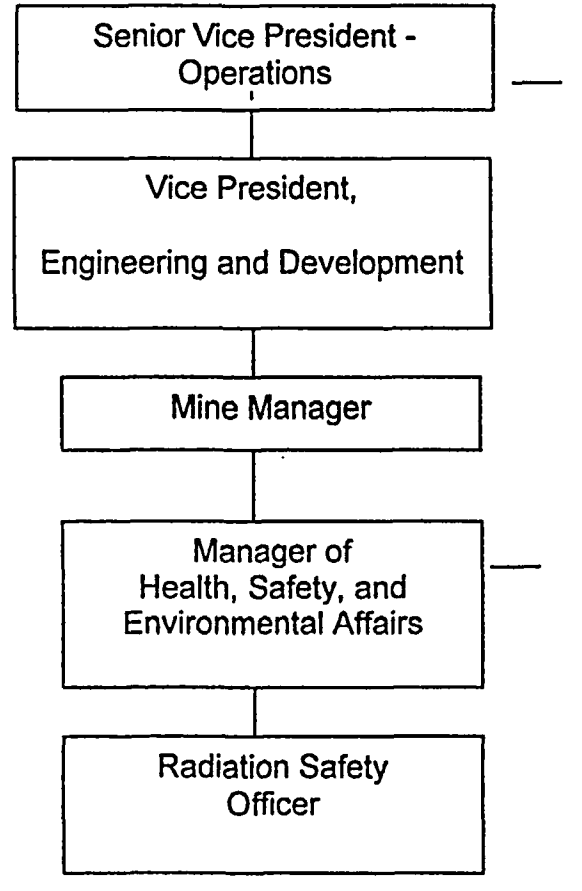


Figure 5.1-1: Crow Butte Resources Organizational Chart



5.1.3. 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.

5.1.4. 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.

5.1.5. 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. 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.

5.1.7. 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. 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".

5.3. MANAGEMENT AUDIT AND INSPECTION PROGRAM

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

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. Results of the Daily Inspections are documented.

Weekly

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.

Monthly

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

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. 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.

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.

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. 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.

5.5.1. TRAINING PROGRAM CONTENT

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.

Contractors

Any contractors having work assignments at the facility are given appropriate training and safety instruction. Contract workers who will be performing work on heavily contaminated equipment receive the same training normally required of permanent workers.

Permanent Employees

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).

(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 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." 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. 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.

Air sampler calibration will be performed in accordance with the instructions contained in Standard Operating Procedure C-6.

5.7.3.3. 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 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.

5.7.4. 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.

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, 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 with HP-270 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 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

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 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.

- The mine unit average and NDEQ restoration values for Mine Unit 9 are given in Table 6.1-9. The CBR SERP determined these restoration values on October 23, 2003.

NDEQ Permit Number NE0122611 requires that a Mine Unit be returned to a wellfield average of these restoration values. These concentrations were approved by the NDEQ with the Notice of Intent to Operate submittals. Post mining water quality for Mine Unit 1 can be found in Table 6.1-10.

Crow Butte Resources operated a R&D Pilot Facility starting in July 1986 and initiated restoration activities of its Wellfield No. 2 in February 1987. Wellfield No. 1 was incorporated into Mine Unit 1, thus no restoration took place in that area. The techniques used during that program are the basis for the commercial restoration program outlined in this section. Crow Butte Resources will utilize ion exchange columns, a reverse osmosis unit and reductant addition equipment similar to those used in the R&D restoration during commercial restoration operations.

The commercial groundwater restoration program consists of two stages, the restoration stage and the stabilization stage. The restoration stage consist of four activities:

- Groundwater transfer;
- Groundwater sweep;
- Groundwater treatment; and
- Wellfield recirculation

A reductant may be added at anytime during the restoration stage to lower the oxidation potential of the mining zone. A sulfide or sulfite compound will be added to the injection stream in concentrations sufficient to reduce the mobilized species.

The stabilization stage consists of monitoring the restoration wells for six months following successful completion of the restoration stage. Stabilization will begin once restoration activities have returned the average concentration of restoration parameters to acceptable levels. Following the stabilization phase, Crow Butte Resources will make a request to the appropriate regulatory agencies that the wellfield is restored.

Table 6.1-1: Baseline and Restoration Values for Mine Unit 1

Parameter	Groundwater Standard	MU-1 Baseline	MU-1 Standard Deviation	MU-1 NDEQ Restoration Value
Ammonium (mg/l)	10.0	<0.372		10.0
Arsenic (mg/l)	0.05	<0.00214		0.05
Barium (mg/l)	1.0	<0.1		1.0
Cadmium (mg/l)	0.01	<0.00644		0.005[1]
Chloride (mg/l)	250.0	203.9	38	250.0
Copper (mg/l)	1.0	<0.017		1.0
Fluoride (mg/l)	4.0	0.686	0.04	4.0
Iron (mg/l)	0.3	<0.0441		0.3
Mercury (mg/l)	0.002	<0.001		0.002
Manganese (mg/l)	0.05	<0.011		0.05
Molybdenum (mg/l)	1.0	<0.0689		1.0
Nickel (mg/l)	0.15	<0.0340		0.15
Nitrate (mg/l)	10.0	<0.050		10.0
Lead (mg/l)	0.05	0.0315		0.05
Radium (pCi/L)	5.0	229.7	177.1	584.0
Selenium (mg/l)	0.01	<0.00323		0.05
Sodium (mg/l)	N/A	412	19.2	4120
Sulfate (mg/l)	250.0	356.2	9.4	375
Uranium (mg/l)	5.0	0.0922	0.089	5.0
Vanadium (mg/l)	0.2	<0.0663		0.2
Zinc (mg/l)	5.0	<0.036		5.0
pH (Std. Units)	6.5 - 8.5	8.46	0.2	6.5 – 8.5
Calcium (mg/l)	N/A	12.5	3.2	125.0
Total Carbonate (mg/l)	N/A	351	31.1	585
Potassium (mg/l)	N/A	12.5	1.5	125.0
Magnesium (mg/l)	N/A	3.2	0.8	32.0
TDS (mg/l)	N/A	1170.2	47.6	1170.2

[1] Standard for Cadmium lowered in modification to UIC permit dated March 9, 2001 following NDEQ approval of Mine Unit 1 restoration.

Table 6.1-2: Baseline and Restoration Values for Mine Unit 2

Parameter	Groundwater Standard	MU-2 Baseline	MU-2 Standard Deviation	MU-2 NDEQ Restoration Value
Ammonium (mg/l)	10.0	0.37	0.07	10.0
Arsenic (mg/l)	0.05	<0.001		0.05
Barium (mg/l)	1.0	<0.1		1.0
Cadmium (mg/l)	0.005	<0.007		0.005
Chloride (mg/l)	250.0	208.6	30.8	250.0
Copper (mg/l)	1.0	<0.013		1.0
Fluoride (mg/l)	4.0	0.67	0.04	4.0
Iron (mg/l)	0.3	<0.045		0.3
Mercury (mg/l)	0.002	<0.001		0.002
Manganese (mg/l)	0.05	<0.01		0.05
Molybdenum (mg/l)	1.0	<0.073		1.0
Nickel (mg/l)	0.15	<0.037		0.15
Nitrate (mg/l)	10.0	<0.039		10.0
Lead (mg/l)	0.05	<0.035		0.05
Radium (pCi/L)	5.0	234.5	411.8	1058.0
Selenium (mg/l)	0.05	<0.001		0.05
Sodium (mg/l)	N/A	410.8	18.2	4108
Sulfate (mg/l)	250.0	348.2	10.3	369.0
Uranium (mg/l)	5.0	0.046	0.037	5.0
Vanadium (mg/l)	0.2	<0.07		0.2
Zinc (mg/l)	5.0	<0.026		5.0
pH (Std. Units)	6.5 - 8.5	8.32	0.2	6.5 – 8.5
Calcium (mg/l)	N/A	13.4	2.4	134.0
Total Carbonate (mg/l)	N/A	366.9	13.3	585.0
Potassium (mg/l)	N/A	12.6	2.5	126.0
Magnesium (mg/l)	N/A	3.5	0.4	35.0
TDS (mg/l)	N/A	1170.4	41	1170.4

Table 6.1-3: Baseline and Restoration Values for Mine Unit 3

Parameter	Groundwater Standard	MU-3 Baseline	MU-3 Standard Deviation	MU-3 NDEQ Restoration Value
Ammonium (mg/l)	10.0	<0.329		10.0
Arsenic (mg/l)	0.05	<0.001		0.05
Barium (mg/l)	1.0	<0.1		1.0
Cadmium (mg/l)	0.005	<0.01		0.005
Chloride (mg/l)	250.0	197.6	16.7	250.0
Copper (mg/l)	1.0	<0.0108		1.0
Fluoride (mg/l)	4.0	0.719	0.05	4.0
Iron (mg/l)	0.3	<0.05		0.3
Mercury (mg/l)	0.002	<0.001		0.002
Manganese (mg/l)	0.05	<0.01		0.05
Molybdenum (mg/l)	1.0	<0.1		1.0
Nickel (mg/l)	0.15	<0.05		0.15
Nitrate (mg/l)	10.0	<0.0728		10.0
Lead (mg/l)	0.05	<0.05		0.05
Radium (pCi/L)	5.0	165	222.5	611.0
Selenium (mg/l)	0.05	<0.00115		0.05
Sodium (mg/l)	N/A	428	27.6	4280
Sulfate (mg/l)	250.0	377.0	13.4	404.0
Uranium (mg/l)	5.0	0.115	0.158	5.0
Vanadium (mg/l)	0.2	<0.1		0.2
Zinc (mg/l)	5.0	<0.0131		5.0
pH (Std. Units)	6.5 - 8.5	8.37	0.3	6.5 – 8.5
Calcium (mg/l)	N/A	13.3	3.1	133.0
Total Carbonate (mg/l)	N/A	358.7	24.8	592.0
Potassium (mg/l)	N/A	13.9	4.0	139.0
Magnesium (mg/l)	N/A	3.5	0.9	35.0
TDS (mg/l)	N/A	1183.0	47.4	1183.0

Table 6.1-4: Baseline and Restoration Values for Mine Unit 4

Parameter	Groundwater Standard	MU-4 Baseline	MU-4 Standard Deviation	MU-4 NDEQ Restoration Value
Ammonium (mg/l)	10.0	0.288	0.08	10.0
Arsenic (mg/l)	0.05	<0.00209		0.05
Barium (mg/l)	1.0	<0.1		1.0
Cadmium (mg/l)	0.005	<0.01		0.005
Chloride (mg/l)	250.0	217.5	34.9	250.0
Copper (mg/l)	1.0	<0.0114		1.0
Fluoride (mg/l)	4.0	0.745	0.05	4.0
Iron (mg/l)	0.3	<0.0504		0.3
Mercury (mg/l)	0.002	<0.001		0.002
Manganese (mg/l)	0.05	<0.01		0.05
Molybdenum (mg/l)	1.0	<0.1		1.0
Nickel (mg/l)	0.15	<0.05		0.15
Nitrate (mg/l)	10.0	<0.114		10.0
Lead (mg/l)	0.05	<0.05		0.05
Radium (pCi/L)	5.0	154.3	171.5	496.0
Selenium (mg/l)	0.05	<0.00244		0.05
Sodium (mg/l)	N/A	416.6	27.8	4166
Sulfate (mg/l)	250.0	337.2	19.3	375.0
Uranium (mg/l)	5.0	<0.122		5.0
Vanadium (mg/l)	0.2	<0.0984		0.2
Zinc (mg/l)	5.0	<0.0143		5.0
pH (Std. Units)	6.5 - 8.5	8.68	0.3	6.5 – 9.28
Calcium (mg/l)	N/A	11.2	2.9	112.0
Total Carbonate (mg/l)	N/A	374.4	28	610.0
Potassium (mg/l)	N/A	16.7	4.7	167.0
Magnesium (mg/l)	N/A	2.8	0.8	28.0
TDS (mg/l)	N/A	1221.1	73.5	1221.1

Table 6.1-5: Baseline and Restoration Values for Mine Unit 5

Parameter	Groundwater Standard	MU-5 Baseline	MU-5 Standard Deviation	MU-5 NDEQ Restoration Value
Ammonium (mg/l)	10.0	0.28	0.05	10.0
Arsenic (mg/l)	0.05	<0.001		0.05
Barium (mg/l)	1.0	<0.10		1.0
Cadmium (mg/l)	0.005	<0.01		0.005
Chloride (mg/l)	250.0	191.9	7.9	250.0
Copper (mg/l)	1.0	<0.01		1.0
Fluoride (mg/l)	4.0	0.64	0.07	4.0
Iron (mg/l)	0.3	<0.05		0.3
Mercury (mg/l)	0.002	<0.001		0.002
Manganese (mg/l)	0.05	<0.01		0.05
Molybdenum (mg/l)	1.0	<0.10		1.0
Nickel (mg/l)	0.15	<0.05		0.15
Nitrate (mg/l)	10.0	<0.1		10.0
Lead (mg/l)	0.05	<0.05		0.05
Radium (pCi/L)	5.0	166.0	184.6	535.0
Selenium (mg/l)	0.05	<0.002		0.05
Sodium (mg/l)	N/A	397.6	14.4	3976
Sulfate (mg/l)	250.0	364.5	10.5	385.0
Uranium (mg/l)	5.0	0.072	0.056	5.0
Vanadium (mg/l)	0.2	<0.10		0.2
Zinc (mg/l)	5.0	<0.02		5.0
pH (Std. Units)	6.5 - 8.5	8.5	0.1	6.5 – 8.5
Calcium (mg/l)	N/A	12.6	1.8	126.0
Total Carbonate (mg/l)	N/A	372	13.0	590.0
Potassium (mg/l)	N/A	11.5	1.2	115.0
Magnesium (mg/l)	N/A	3.4	0.4	34.0
TDS (mg/l)	N/A	1179.5	22.5	1202.0

Table 6.1-6: Baseline and Restoration Values for Mine Unit 6

Parameter	Groundwater Standard	MU-6 Baseline	MU-6 Standard Deviation	MU-6 NDEQ Restoration Value
Ammonium (mg/l)	10.0	0.32	0.05	10.0
Arsenic (mg/l)	0.05	0.002		0.05
Barium (mg/l)	1.0	0.100		1.0
Cadmium (mg/l)	0.005	0.009		0.005
Chloride (mg/l)	250.0	206	15.4	250.0
Copper (mg/l)	1.0	0.012		1.0
Fluoride (mg/l)	4.0	0.65	0.03	4.0
Iron (mg/l)	0.3	0.050		0.3
Mercury (mg/l)	0.002	0.001		0.002
Manganese (mg/l)	0.05	0.010		0.05
Molybdenum (mg/l)	1.0	0.102		1.0
Nickel (mg/l)	0.15	0.050		0.15
Nitrate (mg/l)	10.0	0.1		10.0
Lead (mg/l)	0.05	0.050		0.05
Radium (pCi/L)	5.0	80.6	121.9	325
Selenium (mg/l)	0.05	0.001		0.05
Sodium (mg/l)	N/A	400	12.8	4000
Sulfate (mg/l)	250.0	361	14.6	390
Uranium (mg/l)	5.0	0.133	0.212	5.0
Vanadium (mg/l)	0.2	0.098		0.2
Zinc (mg/l)	5.0	0.011		5.0
pH (Std. Units)	6.5 - 8.5	8.6	0.2	6.5 – 9.0
Calcium (mg/l)	N/A	12.8	2.3	128
Total Carbonate (mg/l)	N/A	367.1	22.9	596
Potassium (mg/l)	N/A	11.9	1.7	119
Magnesium (mg/l)	N/A	3.2	0.7	32
TDS (mg/l)	N/A	1192	28.1	1220

Table 6.1-7: Baseline and Restoration Values for Mine Unit 7

Parameter	Groundwater Standard	MU-7 Baseline	MU-7 Standard Deviation	MU-7 NDEQ Restoration Value
Ammonium (mg/l)	10.0	0.42	0.08	10.0
Arsenic (mg/l)	0.05	0.001		0.05
Barium (mg/l)	1.0	0.10		1.0
Cadmium (mg/l)	0.005	0.007		0.005
Chloride (mg/l)	250.0	198	22.6	250.0
Copper (mg/l)	1.0	0.01		1.0
Fluoride (mg/l)	4.0	0.70	0.05	4.0
Iron (mg/l)	0.30	0.05		0.30
Mercury (mg/l)	0.002	0.001		0.002
Manganese (mg/l)	0.05	0.01		0.05
Molybdenum (mg/l)	1.00	0.10		1.00
Nickel (mg/l)	0.15	0.05		0.15
Nitrate (mg/l)	10.0	0.1		10.0
Lead (mg/l)	0.05	0.05		0.05
Radium (pCi/L)	5.0	142	148.0	438
Selenium (mg/l)	0.05	0.004		0.05
Sodium (mg/l)	N/A	387	21.6	3,870
Sulfate (mg/l)	250.0	346	20.1	386
Uranium (mg/l)	5.0	0.110	0.138	5.0
Vanadium (mg/l)	0.2	0.10		0.2
Zinc (mg/l)	5.0	0.01		5.0
pH (Std. Units)	6.5 - 8.5	8.6	0.3	6.5 – 9.2
Calcium (mg/l)	N/A	12.2	2.6	122
Total Carbonate (mg/l)	N/A	356		588
Potassium (mg/l)	N/A	12.9	3.0	129
Magnesium (mg/l)	N/A	3.2	0.7	32
TDS (mg/l)	N/A	1,176	40.7	1,217

Table 6.1-8: Baseline and Restoration Values for Mine Unit 8

Parameter	Groundwater Standard	MU-8 Baseline	MU-8 Standard Deviation	MU-8 NDEQ Restoration Value
Ammonium (mg/l)	10.0	0.682	0.222	10.0
Arsenic (mg/l)	0.05	0.002	0.001	0.05
Barium (mg/l)	1.0	0.099	0.005	1.0
Cadmium (mg/l)	0.005	0.005		0.005
Chloride (mg/l)	250	196	53.8	250
Copper (mg/l)	1.0	0.01		1.0
Fluoride (mg/l)	4.0	0.638	0.048	4.0
Iron (mg/l)	0.30	0.135	0.086	0.30
Mercury (mg/l)	0.002	0.001		0.002
Manganese (mg/l)	0.05	0.01		0.05
Molybdenum (mg/l)	1.0	0.093	0.023	1.00
Nickel (mg/l)	0.15	0.049	0.003	0.15
Nitrate (mg/l)	10.0	0.2		10.0
Lead (mg/l)	0.05	0.049	0.003	0.05
Radium (pCi/L)	5.0	124.4	151.8	428
Selenium (mg/l)	0.05	0.004		0.05
Sodium (mg/l)	N/A	416.8	41.8	4,168
Sulfate (mg/l)	250	312	33	378
Uranium (mg/l)	5.0	0.188	0.140	5.0
Vanadium (mg/l)	0.2	0.127	0.122	0.2
Zinc (mg/l)	5.0	0.013	0.008	5.0
pH (Std. Units)	6.5 - 8.5	8.67	0.37	6.5 – 9.41
Calcium (mg/l)	N/A	12.3	3.5	123
Total Carbonate (mg/l)	N/A	377	15.6	569
Potassium (mg/l)	N/A	11.8	3.2	117.8
Magnesium (mg/l)	N/A	2.7	0.92	27.1
TDS (mg/l)	N/A	1,137	97.4	1,234

Table 6.1-9: Baseline and Restoration Values for Mine Unit 9

Parameter	Groundwater Standard	MU-9 Baseline	MU-9 Standard Deviation	MU-9 NDEQ Restoration Value
Ammonium (mg/l)	10.0	0.40	0.05	10.0
Arsenic (mg/l)	0.05	0.001	0.000	0.05
Barium (mg/l)	1.0	0.1	0.0	1.0
Cadmium (mg/l)	0.005	0.005	0.000	0.005
Chloride (mg/l)	250	203	13	250
Copper (mg/l)	1.0	0.01	0.00	1.0
Fluoride (mg/l)	4.0	0.8	0.0	4.0
Iron (mg/l)	0.3	0.04	0.01	0.3
Mercury (mg/l)	0.002	0.001	0.000	0.002
Manganese (mg/l)	0.05	0.01	0.00	0.05
Molybdenum (mg/l)	1.0	0.1	0.0	1.0
Nickel (mg/l)	0.15	0.05	0.00	0.15
Nitrate (mg/l)	10.0	0.06	0.01	10.0
Lead (mg/l)	0.05	0.05	0.00	0.05
Radium (pCi/L)	5.0	164	238	640
Selenium (mg/l)	0.05	0.003	0.001	0.05
Sodium (mg/l)	N/A	380	11	3,800
Sulfate (mg/l)	250	320	15	350
Uranium (mg/l)	5.0	0.1	0.24	5.0
Vanadium (mg/l)	0.2	0.1	0.0	0.2
Zinc (mg/l)	5.0	0.01	0.00	5.0
pH (Std. Units)	6.5 - 8.5	8.35	0.30	6.5 – 9.41
Calcium (mg/l)	N/A	13.6	4.6	136
Total Carbonate (mg/l)	N/A	383	14	595
Potassium (mg/l)	N/A	13.9	3.0	139
Magnesium (mg/l)	N/A	3.5	1.2	35.0
TDS (mg/l)	N/A	1,152	38	1,190

Table 6.1-10: Post Mining Water Quality for Mine Unit 1 Restoration Well Sampling

	PM-1	PM-4	PM-5	PT-5	IJ-6	IJ-13	IJ-25	IJ-28	IJ-45	PR-8	PR-15	PR-19
Ca (mg/l)	87.9	87.1	80.8	87.9	87.6	93.9	89.4	89.6	89.9	85.4	86.7	98.3
Mg (mg/l)	22.6	20.6	22.7	23.8	21.4	23.9	22.5	23.1	24.8	23.2	23.1	23.8
Na (mg/l)	1154	942	1054	1144	1054	1174	1177	1182	1126	1144	1172	1083
K (mg/l)	32.7	26.3	30	30	27.2	31.3	30	31.3	32.7	30	30	28.6
CO_3 (mg/l)	0	0	0	0	0	0	0	0	0	0	0	0
HCO_3 (mg/l)	1099	900	972	981	1057	1086	1111	1207	1104	1170	1170	959
SO_4 (mg/l)	1109	959	1115	1240	1031	1209	1119	1112	1134	1115	1115	1283
Cl (mg/l)	598	455	586	594	544	598	594	619	607	603	603	590
NH_4 (mg/l)	0.33	0.67	0.14	0.33	0.44	0.07	< 0.05	< 0.05	0.33	0.27	0.15	0.49
NO_2 (mg/l)	< 0.01	0.02	0.09	< 0.01	0.11	< 0.01	< 0.01	< 0.01	0.04	0.05	< 0.01	0.05
NO_3 (mg/l)	1.06	< 0.1	0.97	0.99	1.29	0.74	0.86	1.3	1.25	1.46	1.6	0.46
F (mg/l)	0.37	0.26	0.54	0.45	0.45	0.37	0.38	0.45	0.43	0.43	0.4	0.35
SiO_2 (mg/l)	25.7	18.2	35.3	24.7	33.3	34.3	26.4	31.6	28.3	33.2	30	22.2
TDS (mg/l)	3694	3121	3756	3851	3515	3899	3751	3886	3873	3820	3807	3765
Cond (µmho/cm)	5843	4841	5590	5964	5445	6012	5807	6025	5916	5819	5940	5819
$CaCO_3$ (mg/l)	901	738	797	804	866	890	911	989	905	959	959	786
pH (Std. units)	7.65	6.87	6.85	7.28	7.16	7.35	7.65	7.81	7.37	7.46	7.78	6.92
Trace Metals												
Al (mg/l)	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.29
As (mg/l)	0.018	0.007	0.018	0.017	0.031	0.028	0.02	0.028	0.023	0.028	0.024	0.011
Ba (mg/l)	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
B (mg/l)	1.17	1.44	1.09	1.36	1.06	1.26	1.13	1.19	1.15	1.23	1.25	1.17

Table 6.1-10: Post Mining Water Quality for Mine Unit 1 Restoration Well Sampling

	PM-1	PM-4	PM-5	PT-5	IJ-6	IJ-13	IJ-25	IJ-28	IJ-45	PR-8	PR-15	PR-19
Cd (mg/l)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Cr (mg/l)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu (mg/l)	< 0.01	< 0.01	0.05	< 0.01	0.02	< 0.01	< 0.01	< 1	< 0.01	< 0.01	< 0.01	< 0.01
Fe (mg/l)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.38
Pb (mg/l)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Mn (mg/l)	0.02	0.11	0.05	0.04	0.14	0.15	0.08	0.06	0.06	0.02	< 0.01	0.16
Hg (mg/l)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Mo (mg/l)	0.6	0.2	0.42	0.53	0.47	0.5	0.56	0.54	0.53	0.59	0.53	0.37
Ni (mg/l)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.12	0.12	0.12	< 0.05	< 0.05	< 0.05	< 0.05
Se (mg/l)	0.139	0.012	0.129	0.24	0.112	0.122	0.1	0.138	0.149	0.154	0.148	0.041
V (mg/l)	1	0.1	0.38	1.15	1.12	1.18	1.03	1.24	1.29	1.23	1.56	0.28
Zn (mg/l)	< 0.01	0.14	0.11	0.01	0.11	0.01	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Radionuclides												
U (mg/l)	8.63	6.29	54.52	9.3	13.9	9.31	9.9	2.52	14.83	5.24	5.18	6.78
Ra-226 (pCi/l)	370	126	329	1139	1113	1558	1258	1147	681	417	109	1182

6.1.4 RESTORATION STAGE

Restoration activities include four steps that are designed to optimize restoration equipment used in treating groundwater and to minimize the number of pore volumes circulated during the restoration stage. Crow Butte Resources will monitor the quality of selected wells during restoration to determine the efficiency of the operations and to determine if additional techniques are necessary.

6.1.4.1 GROUNDWATER TRANSFER

Prior to commencing restoration activities, the regulatory agencies will be notified that mining has ceased in a given mine unit and Crow Butte Resources will proceed to establish post mining water quality data for all of the required parameters listed in Table 6.1-1 through 6.1-8.

During the groundwater transfer step, water may be transferred between the mine unit commencing restoration and a mine unit commencing operations. Baseline quality water from the mine unit starting production may be pumped and injected into the mine unit in restoration. The higher TDS water from the mine unit in restoration may be recovered and injected into the mine unit commencing production. The direct transfer of water will act to lower the TDS in the mine unit being restored by displacing water affected by mining with baseline quality water.

The goal of groundwater transfer is to blend the water in the two mine units until they become similar in conductivity. The recovered water may be passed through ion exchange columns and filtration during this step if suspended solids are sufficient in concentration to present a problem with blocking the injection well screens. For the groundwater transfer to occur, a newly constructed mine unit must be ready to commence mining.

The advantage of using the groundwater transfer technique is that it reduces the amount of water that must be ultimately be sent to the waste disposal system during restoration activities.

6.1.4.2 GROUNDWATER SWEEP

During groundwater sweep, water is pumped without injection from the wellfield causing an influx of baseline quality water from the perimeter of the mining unit that sweeps the affected portion of the aquifer. The cleaner baseline water has lower ion concentrations that act to strip off the cations that have attached to the clays during

mining. The plume of affected water near the edge patterns of the wellfield is also drawn into the boundaries of the mine unit.

The number of pore volumes transferred during groundwater sweep is dependent upon the capacity of the wastewater disposal system and the success of the groundwater transfer step in lowering TDS.

6.1.4.3 GROUNDWATER TREATMENT

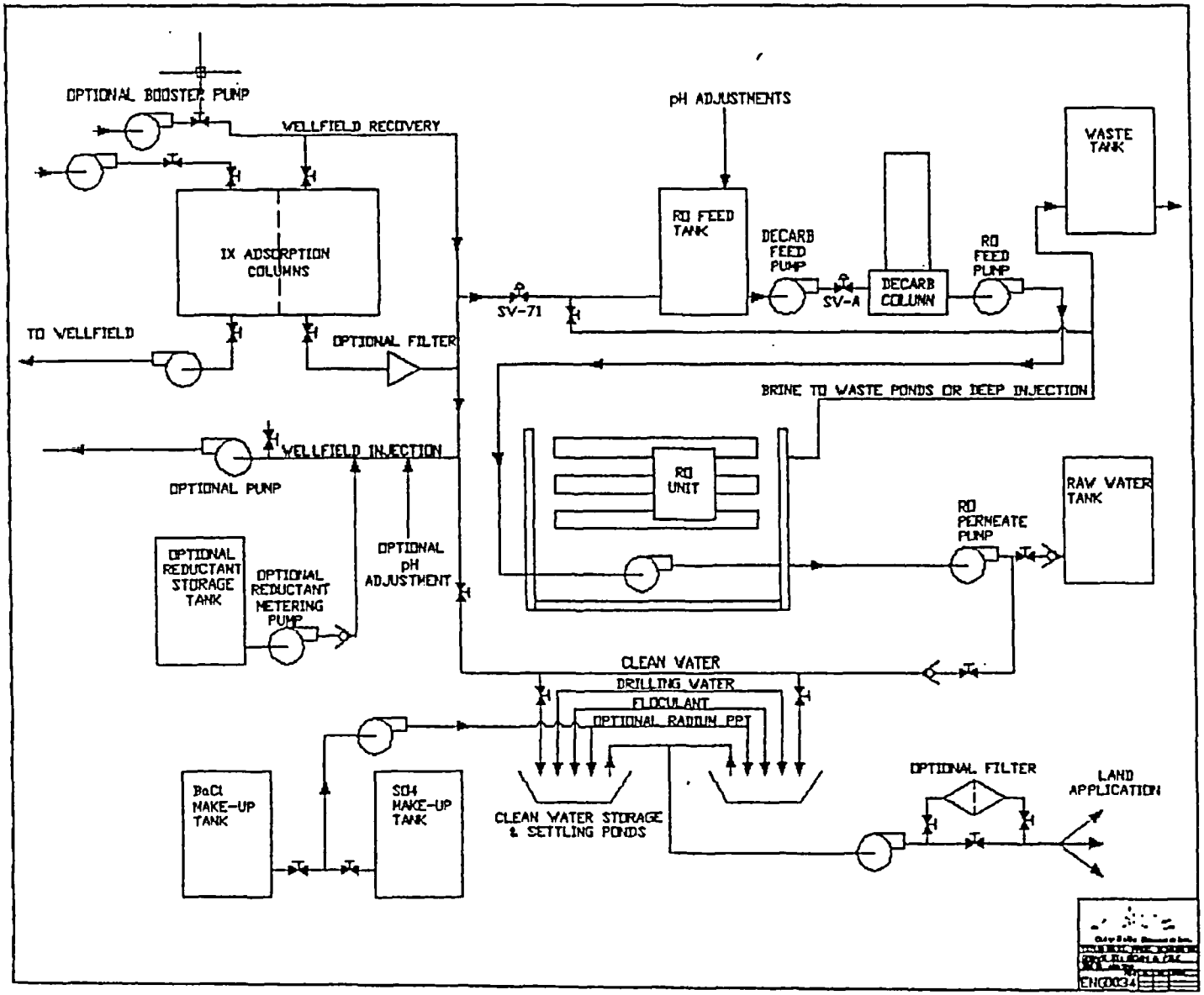
Following the groundwater sweep step water is pumped from production wells to treatment equipment and then reinjected into the wellfield. Ion exchange and reverse osmosis treatment equipment is utilized during this stage as shown in Figure 6.1-1. Depending upon the final configuration of the main plant following the capacity increase to 5,000 gpm, the ion exchange step may utilize the existing fixed bed downflow columns located at the main plant, or may be relocated.

Water recovered from restoration containing a significant amount of uranium is passed through the ion exchange system. The ion exchange columns exchange the majority of the contained soluble uranium for chloride or sulfate. Once the solubilized uranium is removed, a small amount of reductant may be metered into the restoration wellfield injection to reduce any pre-oxidized minerals. The concentration of reductant injected into the formation is determined by the concentration and type of trace elements encountered. The goal of reductant addition is to reduce those minerals that are solubilized by carbonate complexes to prevent build-up of dissolved solids, which would increase the time required to complete restoration.

A portion of the restoration recovery water can be sent to the reverse osmosis unit. The use of a reverse osmosis unit has several effects:

- Reduces the total dissolved solids in the contaminated groundwater;
- Reduces the quantity of water that must be removed from the aquifer to meet restoration limits;
- Concentrates the dissolved contaminates in a smaller volume of brine to facilitate waste disposal; and
- Enhances the exchange of ions from the formation due to the large difference in ion concentration.

Figure 6.1-1: Restoration Process Schematic



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 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.

Table 6.1-11: Typical Membrane Rejection
Source: Osmonics, Inc.

NAME	SYMBOL	PERCENT REJECTION
Cations		
Aluminum	Al^{+3}	99+
Ammonium	NH_4^{+1}	88-95
Cadmium	Cd^{+2}	96-98
Calcium	Ca^{+2}	96-98
Copper	Cu^{+2}	98-99
Hardness	Ca and Mg	96-98
Iron	Fe^{+2}	98-99
Magnesium	Mg^{+2}	96-98
Manganese	Mn^{+2}	98-99
Mercury	Hg^{+2}	96-98
Nickel	Ni^{+2}	98-99
Potassium	K^{+1}	94-96
Silver	Ag^{+1}	94-96
Sodium	Na^{+}	94-96
Strontium	Sr^{+2}	96-99
Zinc	Zn^{+2}	98-99
Anions		
Bicarbonate	HCO_3^{-1}	95-96
Borate	$B_4O_7^{-2}$	35-70
Bromide	Br^{-1}	94-96
Chloride	Cl^{-1}	94-95
Chromate	CrO_4^{-2}	90-98
Cyanide	CN^{-1}	90-95
Ferrocyanide	$Fe(CN)_6^{-3}$	99+
Fluoride	F^{-1}	94-96
Nitrate	NO_3^{-1}	95
Phosphate	PO_4^{-3}	99+
Silicate	SiO_2^{-1}	80-95
Sulfate	SO_4^{-2}	99+
Sulfite	SO_3^{-2}	98-99
Thiosulfate	$S_7O_3^{-2}$	99+

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 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.

6.2 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 No. 0748/S17668 issued by the Royal Bank of Canada during 2002 in favor of the State of Nebraska in the present amount of $12,355,260.