Safety Evaluation Report
License Amendment for the Jane Dough Unit at the Nichols Ranch In Situ Recovery Project in Johnson and Campbell Counties, Wyoming, Revision 1

Materials License No. SUA-1597

Docket No. 040-09067

URANERZ ENERGY CORPORATION

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INTRODUCTION

By letter dated May 8, 2014, Uranerz Energy Corporation (Uranerz, or the licensee) submitted to the U.S. Nuclear Regulatory Commission (NRC) a request to amend Source Material License SUA-1597. The proposed license amendment would allow uranium recovery operations in the Jane Dough Unit at the Nichols Ranch ISR Project site in Johnson and Campbell Counties, WY (Uranerz 2014f). Source material licenses are subject to safety requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, "Standards for Protection Against Radiation," and Part 40, "Domestic Licensing of Source Material."

The licensee's license amendment request consisted of a revision to the Nichols Ranch ISR Project Technical Report (i.e., Jane Dough Technical Report), including several addenda and appendices, and an environmental report. Following a four-month delay because NRC staff resources were not available when Uranerz submitted its request, on September 11, 2014, the NRC notified the licensee that the license amendment request was publicly available and that NRC staff had begun its acceptance review (NRC 2014d). By letter dated October 29, 2014, Uranerz submitted Addendum JD-D11-A, and conforming changes to its Jane Dough Technical Report (Uranerz 2014g). Addendum JD-D11-A was missing from the appendices Uranerz submitted on May 8, 2014. By letter dated November 25, 2014, NRC staff requested that Uranerz revise its license amendment request to address certain deficiencies regarding the description of the mineralized zone and overlying confining units in the Jane Dough Unit (NRC 2014e). Uranerz provided revisions to its license amendment request on April 13, 2015 (Uranerz 2015a) and June 26, 2015 (Uranerz 2015b).

On August 10, 2015, the NRC notified that licensee that it had accepted the Jane Dough license amendment request for detailed technical and environmental review (NRC 2015a). On January 21, 2016, the NRC requested additional information from the licensee (NRC 2016a). The licensee responded to this request by letter dated May 24, 2016, and supplemented its license amendment request with page changes and additional information (Uranerz 2016a). By e-mail dated June 13, 2016 (NRC 2016d), NRC staff informed Uranerz that its May 24, 2016, response was not complete. By letter dated July 19, 2016, (Uranerz 2016b), and e-mails dated August 4, 2016 (Uranerz 2016c), August 17, 2016 (Uranerz 2016d), September 15, 2016 (Uranerz 2016e-g), September 26, 2016 (Uranerz 2016i), September 28, 2016 (Uranerz 2016j), October 31, 2016 (Uranerz 2016k), November 1, 2016, (Uranerz 2016m), and November 7, 2016 (Uranerz 2016n), Uranerz provided additional responses to the NRC staff's January 21, 2016, request for additional information and conforming changes to the Jane Dough Technical Report and its addenda, appendices, and environmental report. Hereafter in this safety evaluation report (SER), the May 8, 2014, license amendment request and its supplements are referred to as the Jane Dough Technical Report (Uranerz 2014f). This SER documents the safety evaluation by the NRC staff of the licensee's Jane Dough Technical Report and supporting addenda and appendices.

The Atomic Energy Act of 1954, as amended by the Uranium Mill Tailings Radiation Control Act of 1978, authorizes the NRC to issue licenses for the possession and use of source material and byproduct material. The NRC must license facilities, including ISR operations, in accordance with NRC regulatory requirements to protect public health and safety from radiological hazards. In accordance with 10 CFR 40.45, the Commission will apply the applicable criteria set forth in 10 CFR 40.32 in considering an application by a licensee to renew or amend his license. In accordance with 10 CFR 40.32, "General Requirements for Issuance of Specific Licenses," the NRC is required to make the following safety findings when amending an ISR license:

- The application is for a purpose authorized by the Atomic Energy Act.

- The licensee is qualified by reason of training and experience to use the source material for the purpose requested in such a manner as to protect health and minimize danger to life or property.

- The licensee's proposed equipment, facilities, and procedures are adequate to protect health and minimize danger to life or property.

- The issuance of the license amendment will not be inimical to the common defense and security or to the health and safety of the public.

This SER documents the safety portion of the staff's safety evaluation of the Jane Dough Technical Report, and includes an analysis to determine Uranerz's compliance with these and other applicable 10 CFR Part 40 requirements, and applicable requirements set forth in 10 CFR Part 40, Appendix A, "Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily for Their Source Material Content." This SER also evaluates Uranerz's compliance with applicable requirements in 10 CFR Part 20, "Standards for Protection against Radiation." Revision 1 of this SER corrects SER Section 5.2.3.1, "Airborne Effluent Monitoring," a subsection titled, Consideration of radon-222 progeny, which includes a description of the licensee's methods for annually demonstrating that public dose limits are met.

The staff performed its safety evaluation of the proposed license amendment request using NUREG-1569, "Standard Review Plan for In Situ Leach Uranium Extraction License Applications" (NRC 2003) (referred to hereafter as the SRP). As described in detail in Appendix A of this SER, the NRC staff concludes that the Nichols Ranch ISR Project has been operated so as to protect health and safety and the environment and has identified no unreviewed safety-related concerns. Therefore, the NRC staff has determined, in accordance with Appendix A, "Guidance for Reviewing Historical Aspects of Site Performance for License Renewals and Amendments," of the SRP, that only those parts of the Jane Dough Technical Report which are revised, updated or changed, from the previously-approved Nichols Ranch ISR Project Technical Report (Uranerz 2007), should be reviewed using the appropriate sections of the standard review plan. The NRC staff has not reexamined those aspects of the Nichols Ranch ISR Project and its operations that have not changed since the last license renewal or amendment.

The review is a comprehensive assessment of the licensee's proposed license amendment request to include operations at the Jane Dough Unit in its Nichols Ranch ISR Project. The regulations at 10 CFR Part 20 and Part 40, and those in Appendix A to 10 CFR Part 40, contain the technical requirements for licensing an ISR project. This SER is presented according to the organization of the SRP, except that sections addressing environmental aspects are not included in the SER because they are addressed in NUREG-1910, "Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities"(referred to here as the GEIS) (NRC 2009), the site's supplemental environmental impact statement (SEIS) (NRC 2011b), and the environmental assessment and finding of no significant impact prepared (EA and FONSI) for the Jane Dough Unit amendment request. The staff prepared the EA and FONSI in parallel with this SER to address the environmental impacts of the proposed action.

The staff's evaluation of the Jane Dough Technical Report identified facility-specific issues that require either new or revised license conditions to ensure that the operation of the facility will be adequately protective of public health and safety. SER Table 1 includes the new or revised license conditions as well as the section of this SER where the need for the new or revised license condition is described. The staff concludes that the findings described in succeeding sections of this SER, including the necessary license conditions, support the issuance of an amended license authorizing licensed activities in the Jane Dough Unit. The staff supports the issuance of an amended license authorizing the construction and operation of the Jane Dough Unit facilities, provided that the new or revised conditions identified below are included in the license.

Table 1. New or Modified License Conditions, Source Material License SUA-1597
(new text in *under-lined italics*; removed text struck out)

License Condition Number	SER Section	License Condition
9.1	1.3	The authorized place of use shall be the licensee's Nichols Ranch in situ recovery (ISR) Project in Johnson and Campbell Counties, Wyoming. The licensee shall conduct operations within the license area boundaries shown in Figures 1-2, *1-2A,* and 1-3 of the approved license application.
9.2	1.3	The licensee shall conduct operations in accordance with the commitments, representations, and statements contained in the license application dated November 30, 2007, as amended by submissions dated August 21, 2008, March 11, 2009, February 24, 2010, September 15, 2010, September 22, 2010, October 3, 2013 (ML13282A301), February 13, 2014 (ML14050A023), February 18, 2014 (ML14063A068), ~~February 19, 2014 (ML14051A113), February 28, 2014 (ML14063A214),~~ March 4, 2014 (ML14064A128), March 5, 2014 (ML14065A018), ~~March 6, 2014 (ML14066A051), March 11, 2014 (ML14071A092),~~ *May 8, 2014 (ML14164A274), October 29, 2014 (ML14309A118), April 13, 2015 (ML15118A122), June 26, 2015 (ML15182A013),* July 30, 2015 (ML15237A149), ~~and~~ August 4, 2015 (ML15218A530), *May 24, 2016 (ML16148A166), July 19, 2016 (ML162070A054), August 17, 2016 (ML16232A096), September 7, 2016 (ML16253A032), September 15, 2016 (ML16263A080, ML16263A167, ML16263A177), September 26, 2016 (ML16271A093), September 28, 2016 (ML16278A624), October 31, 2016 (ML16307A100), November 1, 2016 (ML16307A176), and November 7, 2016 (ML16313A470, ML17019A241)* which are hereby incorporated by reference, except where superseded by specific conditions in this license. The licensee's approved license application must be maintained on site. Whenever the word "will" or "shall" is used in the above referenced documents, it shall denote a requirement.

License Condition Number	SER Section	License Condition
9.7	App. B	The licensee shall follow the guidance set forth in NRC, Regulatory Guides 8.22, “Bioassay at Uranium Mills” (as revised), and 8.30, “Health Physics Surveys in Uranium Recovery Facilities” (as revised), or NRC-approved equivalent. The licensee shall follow the guidance set forth in Regulatory Guide 8.31, “Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Recovery Facilities Will Be as Low as Is Reasonably Achievable” (as revised), or NRC-approved equivalent, with the following exception: The licensee may identify qualified designee(s) to perform daily inspections in the absence of the RSO(s) and radiation safety technician(s) (RSTs). The qualified designee(s) shall have health physics training as specified in the licensee’s training program. The qualified designee(s) shall only perform the inspections on weekends or holidays when the RSO(s) and RST(s) are not present, and in any case no more than three (3) consecutive days per week, except when a holiday falls on a Monday or Thanksgiving (4 days). Reports from qualified designees shall be reviewed by the RSO(s) or RST(s) by the close of business on the first day an RSO or RST returns to work. The RSO or RST review shall be annotated with date ~~and time~~ on the report or other document that can be inspected upon request. If neither an RSO nor an RST can review documents and perform the walk-through for more than three (3) days (e.g., holidays or adverse weather events), an RSO or RST shall call the qualified designee and review previous un-reviewed reports and current operational conditions over the phone. Any proposed exceptions to the guidance are subject to review and written verification by the NRC that the proposed exception does not require a license amendment.

License Condition Number	SER Section	License Condition
10.4	App. B	The licensee shall *maintain* ~~develop and implement~~ written standard operating procedures (SOPs) prior to operation for: (1) all operational activities involving radioactive and nonradioactive materials associated with licensed activities that are handled, processed, stored, or transported by employees; (2) all nonoperational activities involving radioactive materials including in-plant radiation protection and environmental monitoring; and (3) emergency procedures for potential accidents/unusual occurrences including significant equipment or facility damage, pipe breaks and spills, loss or theft of yellowcake or sealed sources, significant fires, and other natural disasters. The SOPs shall include appropriate radiation safety practices to be followed in accordance with 10 CFR Part 20. SOPs for operational activities shall enumerate pertinent radiation safety practices to be followed. A copy of the current written procedures shall be kept in the area(s) of the production facility where they are utilized. ~~The licensee shall also develop and implement SOPs prior to operation for the following:~~ ~~A. Maintenance of surveys and monitoring records in accordance with 10 CFR Part 20, Subpart L, to demonstrate compliance with 10 CFR Part 20 requirements.~~ ~~B. Internal exposure calculation methods and applicable equations for determining the dose(committed effective dose equivalent (CEDE)) from airborne sampling and bioassay data. This methodology will be in accordance with 10 CFR 20.1201, 10 CFR 20.1204, and Regulatory Guides 8.30, (as revised), 8.34, "Monitoring Criteria and Methods To Calculate Occupational Radiation Doses," (as revised), and 8.36, "Radiation Dose to the Embryo/Fetus," (as revised).~~ ~~C. Conduct of its bioassay program and the determination of internal dose (e.g. CEDE) from bioassay data 60 days prior to commencing operations. The licensee will provide a plan or operating procedures to limit the soluble intake to 10 mg per week for uranium.~~ ~~D. Procedures for emergencies identified in Section 7.0 of the licensee's approved application.~~ ~~These SOPs are subject to all inspections, including the preoperational inspection specified in LC 12.3.~~

License Condition Number	SER Section	License Condition
10.7.B	App. B	10.7 Hank Unit Hydrologic Test A. Prior to lixiviant injection at the Hank Unit, the licensee will conduct a hydrologic test. The hydrologic test must be scaled and designed to simulate proposed injection and extraction operational conditions at the Hank Unit to demonstrate that an inward hydraulic gradient can be maintained that prevents excursions beyond the perimeter production zone monitoring well ring. The licensee will report the results of the hydrologic test to the NRC for review and approval prior to lixiviant injection into the production area. B. [*DELETED by Amendment 5]*~~The licensee will update or confirm the restoration schedule for Hank Unit Production Area (PA) #1 and #2 at the completion of the hydrologic test in the Hank Unit as required by this license. The licensee will provide a basis to the NRC for review and approval for any alternate schedule request that meets the requirements of 10 CFR 40.42.~~
10.8	5.3.3.5	Production Area Pump Test Document The licensee *shall submit to NRC* the Production Area Pump Test (PAPT) document for the first production area~~s~~ at the ~~Nichols Ranch and~~ Hank Unit~~s~~ *and shall receive written verification* prior to lixiviant injection into the production area. *The licensee shall submit to NRC the PAPT document for Production Area 1 (the western production area) at the Jane Dough Unit and shall receive written verification prior to lixiviant injection into the production area.* The licensee will provide PAPT documents for each additional *Nichols Ranch ISR project* production area for NRC review. The PAPT document will provide all background ground water data, restoration target values, upper control limits at each monitoring well, as well as the information outlined in Section 5.7.8.4 of the license application.
10.10	App. B	*[DELETED by Amendment 5]* ~~The licensee will update or confirm the restoration schedule for the Nichols Ranch Unit PA #2 and provide a basis to the NRC for review and approval for any alternate schedule request that meets the requirements of 10 CFR 40.42.~~

License Condition Number	SER Section	License Condition
10.11	App. B	All liquid effluents from process buildings and other process waste streams, with the exception of sanitary wastes, shall be returned to the process circuit or disposed of as allowed by NRC regulations. Additionally, the licensee is authorized to dispose of process solutions, injection bleed, and restoration brine using deep well injection, as permitted by WDEQ and described in the approved license application. ~~The licensee will obtain the necessary permits and construct a minimum of two Class I Underground Injection Control (UIC) deep disposal wells prior to the commencement of operations of the Nichols Ranch ISR Project. The licensee shall ensure the deep disposal wells shall have enough capacity to handle the disposal of the total liquid effluent generation as stated in Section 3.2.6 of the license application.~~ The licensee will ensure adequate deep well disposal capacity ~~exists at each unit~~ to dispose of liquids from each unit under normal operating conditions during production, production and restoration, and restoration phases as stated in Section 3.2.6 of the license application. The licensee will notify the NRC within 24 hours if a disposal well is shut down and becomes inoperable, with the exception of routine maintenance or required testing that is completed within 48 hours of shutdown. If necessary, the licensee will use additional deep well capacity, surge tanks or cease injection activities until the disposal well is restored to use as written in Section 3.2.6 of the application. The licensee will notify the NRC when the disposal well is placed back into service and report any repairs or service completed on the well that is not associated with routine maintenance. The licensee shall maintain a record of the volumes of solution disposed in each disposal well and submit this information in the annual monitoring report.

License Condition Number	SER Section	License Condition
10.14	App. B	The licensee shall conduct radiological characterization of airborne samples for natural U, Th-230, Ra-226, Po-210, and Pb-210 for each restricted area air particulate sampling location at a frequency of once every 6 months for the first 2 years, and annually thereafter to ensure compliance with 10 CFR 20.1204(g). The licensee shall also evaluate changes to plant operations to determine if more frequent radionuclide analyses are required for compliance with 10 CFR 20.1204(g). ~~The licensee shall determine if surface contamination limits are warranted for Th-230, Ra-226, Po-210, and Pb-210 identified in airborne sample analyses. Within 1 year of commencement of operations, the licensee shall provide for NRC review and written verification a technical basis for surface contamination limits for the applicable radionuclides of concern.~~

License Condition Number	SER Section	License Condition
11.5	App. B	Excursion Monitoring. Monitoring for excursions shall occur twice monthly and at least 10 days apart for all wells with a UCL. An excursion shall have occurred if, in any monitor well, any two UCL parameters exceed their respective UCLs. A verification sample shall be taken within 48 hours after results of the first analyses are received. If the second sample shows that the excursion criterion is exceeded, an excursion shall be confirmed. If the second sample does not show that the excursion criterion is exceeded, a third sample shall be taken within 48 hours after the second set of sampling data was acquired. If the third sample shows that the excursion criterion is exceeded, an excursion shall be confirmed. If the third sample does not show that the excursion criterion is exceeded, the first sample shall be considered to be an error and the well is removed from excursion status. Upon confirmation of an excursion, the licensee shall notify the NRC, as discussed below, implement corrective action, and increase the sampling frequency for the indicator parameters at the excursion well to once every 7 days. Corrective actions for confirmed excursions may be, but are not limited to, those described in Section 5.7.8.10.3 of the approved license application. An excursion is considered corrected when the concentrations of the indicator parameters are below the concentration levels defining an excursion for three consecutive weekly samples. If an excursion is not corrected within 60 days of confirmation, the licensee shall either: (a) terminate injection of lixiviant within the production area until the excursion is corrected; or (b) increase the surety in an amount to cover the full third-party cost of correcting and cleaning up the excursion. The surety increase shall remain in force until the NRC has verified that the excursion has been corrected and cleaned up. The written 60-day excursion report shall identify which course of action the licensee is taking. Under no circumstances does this condition eliminate the requirement that the licensee must remediate the excursion to meet ground water protection standards as required by LC 10.6 for all constituents established per LC 11.3. The licensee shall notify the NRC Project Manager by telephone or e-mail within 24 hours of confirming a lixiviant excursion, and by letter within *5*~~7~~ days from the time the excursion is confirmed, pursuant to LC 11.6. A written report describing the excursion event, corrective actions taken, and the corrective action results shall be submitted to the NRC within 60 days of the excursion confirmation. For all wells that remain on excursion after 60 days, the licensee shall submit a report as discussed in LC 11.1(A).

License Condition Number	SER Section	License Condition
11.7	5.3.3.6	The licensee shall identify the location, screen depth, and estimated pumping rate of any new ground water wells or new use of an existing well within the license area and within 2 kilometers of any production area. The licensee shall evaluate the impact of ISR operations on potential ground water users and recommend any additional monitoring or other measures to protect ground water users. The evaluation shall be submitted as part of the annual reporting to the NRC for review. After the commencement of uranium recovery operations *in any new production area*, the licensee will sample all domestic and livestock wells that are located within 1 kilometer of the production area monitoring ring wells (MRwells) ~~of the Nichols Ranch and Hank Units~~. Samples shall be collected annually and submitted as part of annual reporting to the NRC until ground water restoration is approved at the production area. Samples shall be analyzed for the UCL parameters in Section 5.7.8.9 of the approved license application and for natural uranium and radium-226.
11.9	App. B	*[DELETED by Amendment 5]*~~Radiological monitoring will be conducted for airborne particulate radioactivity and radon-222 at appropriate environmental monitoring locations in accordance with the criteria in Regulatory Guide 4.14 (as revised) during operations to demonstrate compliance with 10 CFR 20.1301, 10 CFR 20.1501 and 10 CFR Part 40, Appendix A, Criterion 7.~~ ~~Consistent with Regulatory Guide 4.14 (as revised), the licensee shall establish air particulate sampling stations in the three sectors with the highest predicted radioactivity concentrations resultant from operations and co-locate radon air samplers and direct radiation and soil sampling with the air particulate sampling stations.~~
11.10	App. B	*Prior to commencement of operations in any production area, the licensee shall obtain all necessary permits and licenses from the appropriate regulatory authorities. The licensee shall also submit a copy of all permits for its Class I and Class III underground injection wells.*
11.11	App. B	*The licensee shall maintain on-site its documentation of its coordination of emergency response requirements with local authorities, fire department, medical facilities, and other emergency services.*
12.1	App. B	*[DELETED by Amendment 5]* ~~Prior to commencement of operations in any production area, the licensee shall obtain all necessary permits and licenses from the appropriate regulatory authorities. The licensee shall also submit a copy of all permits for its Class I and Class III underground injection wells.~~
12.2	App. B	*[DELETED by Amendment 5]*~~Prior to commencement of operations, the licensee shall coordinate emergency response requirements with local authorities, fire department, medical facilities, and other emergency services. The licensee shall document these coordination activities and maintain such documentation on site.~~

License Condition Number	SER Section	License Condition
12.3	App. B	The licensee shall not commence operations *in the dryer circuit at the Central Processing Plant or in the Hank Unit* until the NRC performs a preoperational inspection to confirm~~, in part,~~ that written operating procedures and approved radiation safety and environmental monitoring programs are in place, and that preoperational testing is complete. The licensee should inform the NRC at least 90 days prior to the expected commencement of operations to allow the NRC sufficient time to plan and perform the preoperational inspection.
12.4	App. B	*[DELETED by Amendment 5]*~~The licensee shall identify the location, screen depth, and estimated pumping rate of any new ground water wells or new use of an existing well within the license area and within 2 kilometers of any proposed production area since the application was submitted to the NRC. The licensee shall evaluate the impact of ISR operations to potential ground water users and recommend any additional monitoring or other measures to protect ground water users. The evaluation shall be submitted to the NRC for review within 6 months of discovery of such well use.~~
12.5	App. B	*[DELETED by Amendment 5]*~~Prior to commencement of operations, the licensee shall submit the qualifications of radiation safety staff members for NRC review.~~
12.6	App. B	*[DELETED by Amendment 5]*~~Prior to commencement of operations, the licensee shall submit a copy of the solid byproduct material disposal agreement to the NRC.~~
12.13	App. B	*[DELETED by Amendment 2]*
12.14	App. B	*[DELETED by Amendment 2]*
12.15	2.6.3.8	*Prior to commencing operations in the Jane Dough Unit, the licensee will submit monitoring results to the NRC that include sampling of domestic and livestock wells that are located within 2 kilometers of the proposed production area monitoring ring wells (MR-wells). Samples shall be collected, at a minimum, once every 6 months for one year. Samples shall be analyzed for the UCL parameters in Section 5.7.8.9 of the approved license application and for natural uranium and radium-226.*

1.0 PROPOSED ACTIVITIES

The NRC staff evaluated the licensee's summary of the proposed activities for which it requested a license amendment for the Nichols Ranch ISR Project. The purpose of the NRC staff's evaluation was to gain a basic understanding of those proposed activities and the likely consequences of any safety or environmental impact. In accordance with SRP Section 1.3, "Acceptance Criteria," (NRC 2003), the staff reviewed the corporate entities involved; the location of the proposed activities; land ownership; ore-body locations and estimated uranium (U_3O_8) content; proposed solution extraction method and recovery processes; operating plans, design throughput and anticipated annual U_3O_8 production; radiation safety protection; estimated schedules for construction, startup, and duration of operations; plans for project waste management and disposal; source and byproduct material transportation plans; plans for ground-water quality restoration, decommissioning, and land reclamation; and surety arrangements covering eventual facility decommissioning, ground-water quality restoration, and site reclamation.

1.1 Regulatory Requirements

The staff determines if the licensee has demonstrated that its summary of the proposed activities at the Jane Dough Unit of the Nichols Ranch ISR Project is in compliance with the applicable requirements in 10 CFR 40.31, "Application for Specific Licenses."

1.2 Regulatory Acceptance Criteria

The staff reviewed the application for compliance with the applicable requirements of 10 CFR 40.31 using the acceptance criteria presented in SRP Section 1.3, "Acceptance Criteria," (NRC 2003).

1.3 Staff Review and Analysis

On May 8, 2014, Uranerz Energy Corporation (Uranerz) submitted to NRC a request to amend its Source Material License SUA-1597 to authorize construction and operation of the Jane Dough Unit at its Nichols Ranch ISR Project (Uranerz 2014f). The application consists of a revised technical report for the Nichols Ranch ISR Project (i.e., Jane Dough Technical Report), an environmental report specific to the Jane Dough Unit amendment, and several addenda and appendices. Uranerz revised its license amendment request on October 29, 2014, April 13, 2015, June 26, 2015, May 24, 2016, July 19, 2016, August 17, 2016, September 7, 2016, September 15, 2016, September 26, 2016, September 28, 2016, October 31, 2016, November 1, 2016, and November 7, 2016 (Uranerz 2014g, 2015a-b, 2016a-b, 2016d-k, 2016m-n). The NRC will revise license condition 9.2 of Source Material License SUA-1597 to include the license amendment request and its supplements. This SER documents the staff's safety review of the Jane Dough Technical Report. An environmental assessment (EA) has been prepared in parallel with this SER to address the environmental impacts of the proposed action (NRC 2016f).

The Nichols Ranch ISR Project is located in the Pumpkin Buttes Uranium Mining District in the Powder River Basin (PRB) in Johnson and Campbell Counties, WY. The existing licensed Nichols Ranch ISR Project is divided into two units, the Nichols Ranch Unit and the Hank Unit. As shown in Figure 1-4, "Commercial, Pilot and Proposed Areas," of the Jane Dough Technical Report, the proposed Jane Dough Unit would be a third unit at the Nichols Ranch ISR Project located adjacent to, and south of, the Nichols Ranch Unit. The NRC staff will revise license

condition 9.1 of Source Materials License SUA-1597 to include Figure 1-2A of the Jane Dough Technical Report among the figures which show the license area boundaries as authorized places of use for licensed material.

The licensee proposes to produce uranium at the Nichols Ranch Unit, Hank Unit, and Jane Dough Unit using the solution extraction process, commonly known as in situ recovery. This process involves dissolving water-soluble uranium compounds from the mineralized host sandstone rock commonly referred to as the ore zone. Uranium in the ore zone is dissolved when the uranium is oxidized from the tetravalent to the hexavalent state with an oxidant such as oxygen or hydrogen peroxide that is pumped into the ore zone through a network of injection wells. A chemical compound, such as a sodium bicarbonate ($NaHCO_3$), is added to complex the uranium in the solution, if needed.

The solution used to dissolve the uranium is called lixiviant, which is native ground water fortified with oxidants and sodium bicarbonate as a complexing agent. Once the lixiviant has circulated through the ore zone and dissolved the uranium into solution, the uranium-laden solution, known as pregnant lixiviant, is withdrawn from the ore zone through a network of production wells and transferred to a central processing plant (CPP). Uranium is removed from the lixiviant at a processing facility using the ion exchange (IX) process, whereby the uranium chemically bonds to the IX resins. Once uranium is removed from the lixiviant, the barren lixiviant solution is then refortified with the oxidant and complexing agent and re-injected to recover more uranium. This process is repeated throughout the uranium production process until it is no longer economical to recover the remaining uranium.

The CPP is located at the Nichols Ranch Unit, and a satellite facility will be located at the Hank Unit. The proposed Jane Dough Unit is located immediately south of the Nichols Ranch Unit and consists of two production areas. No processing facilities will be located in the Jane Dough Unit as all uranium recovered from the Jane Dough Unit will be processed at the existing Nichols Ranch CPP. As of January 2016, the licensee is shipping yellowcake slurry to the White Mesa Uranium Mill in Blanding, Utah, for processing (NRC 2016c). However, the Nichols Ranch ISR Project is licensed to install and operate equipment that will allow it to produce the final product that is commonly known as yellowcake uranium and which contains a combination of uranium oxides and uranyl peroxides.

With the addition of the Jane Dough Unit, land surface ownership within the NRC-licensed Nichols Ranch ISR Project will include approximately 2,739 hectares (ha) (6,770 acres [ac]) of private ownership and approximately 113 ha (280 ac) of U.S. Government ownership administered by the Bureau of Land Management (BLM). The Nichols Ranch Unit encompasses approximately 453 ha (1,120 ac) of land located in Township 43 North Range 76 West, Sections 7, 8, 17, 18, and 20. The Hank Unit encompasses approximately 911 ha (2,250 ac) of land located in Township 44 North Range 75 West, Sections 30 and 31, and Township 43 North Range 75 West, Sections 5, 6, 7, and 8. The Jane Dough Unit contains approximately 1,488 ha (3,680 ac) of privately-owned land located in Township 43N, Range 76, portions of Sections 20, 21, 27, 28, 29, 30, 31, 32, 33, and 34.

The licensee estimates the uranium content for the Jane Dough Unit to be 1,243,182 kilograms (kg) (2,735,000 pounds [lb]). As shown in Figure 3-12, “Production, Restoration, and Reclamation Schedule,” of the Jane Dough Technical Report, production in the Jane Dough Unit is planned to start in 2019, about 3 years before the end of production in the Nichols Ranch production. The licensee also estimated that the Jane Dough Unit will be designed to operate at a flow rate of 3,785 to 13,248 liters per minute (Lpm) (1,000 to 3,500 gallons per minute [gpm])

and an annual production of 230,000 kg (500,000 lb). License condition 10.2 of Source Materials License SUA-1597 limits throughput at the Nichols Ranch CPP to a daily averaged flow rate of 13,248 Lpm (3,500 gpm). In Section 1.1, "Introduction," of the Jane Dough Technical Report, the licensee stated that phased startup of portions of the active production area(s) will continue through the four Nichols Ranch and Jane Dough Unit production areas with offsetting shutdown of depleted wellfield areas to limit the maximum production rate to 13,248 Lpm (3,500 gpm). The licensee estimates it will take 5-10 years to extract uranium from the Nichols Ranch Unit and Jane Dough Unit. The CPP at the Nichols Ranch Unit will have the capacity to produce 909,092 kg (2,000,000 lb) of yellowcake annually.

The Jane Dough Unit ore zone is located in the Eocene Wasatch Formation approximately 11 km (7 mi) west of the South Pumpkin Butte and straddles the Johnson and Campbell County lines. Mineralized sand horizons occur in the lower part of the Wasatch Formation at depths between 122 and 183 meters (m) (400 and 600 feet [ft]).

As shown in Figure 3-12, "Production, Restoration, and Reclamation Schedule," of the Jane Dough Technical Report, the licensee revised its schedule for construction, startup, and duration of operations for the three units. Production at the Nichols Ranch Unit has begun and will continue through mid-2022. Production at the Hank Unit will start in early 2025 and continue until mid-2029. Production at Jane Dough will start in the first half of 2019 and will continue through mid-2027.

Before operations begin, the licensee will install monitoring wells within the production zone and collect four rounds of samples to determine background water quality and calculate restoration standards. To monitor the production zone for hydraulic control of lixiviant solution during operations, the licensee will install monitoring wells adjacent to the production zone and in aquifers immediately above and below the production zone and sample them twice monthly for chemical constituents to ensure that no lixiviant solution is migrating from the production zone. After operations, the licensee will restore the production zone to background water quality or other acceptable alternate standards.

Operation of the Nichols Ranch ISR Project will result in the generation of "byproduct material," as defined in Section 11e.(2) of the Atomic Energy Act of 1954, as amended, and as codified in 10 CFR 40.4, "Definitions." Both liquid and solid forms of byproduct material will be generated during operations. At the Nichols Ranch Unit, the licensee has installed two of four deep disposal wells that it is authorized by the State of Wyoming Department of Environmental Quality (WDEQ) to install and operate at a combined maximum flow rate of up to 568 Lpm (150 gpm) (WDEQ 2013a, 2013b). The licensee is also authorized to install 4 deep disposal wells at the Hank Unit. The deep disposal wells receive liquid byproduct material waste generated during production and restoration. Solid byproduct material (e.g., spent ion exchange resin, pumps, pipes, and building materials used during operations that cannot be decontaminated) will be disposed of at a licensed mill tailings facility or other licensed facility (Uranerz 2013a). NRC staff verified that Uranerz had a valid contract for disposal of solid 11e.(2) byproduct material during pre-operational inspections in November 2013 and January 2014 (NRC 2014b).

To ensure that the operations can be restored and the site returned to its preproduction use, a revised financial surety will be required consistent with the requirements of 10 CFR Part 40, Appendix A, Criterion 9 and license condition 9.5. The surety will include estimated costs for ground water restoration at the Jane Dough Unit. The financial surety arrangement must be in place before startup of operations and will be held by an approved State agency or the NRC.

The licensee maintains an NRC-approved financial surety arrangement consistent with 10 CFR 40, Appendix A, Criterion 9 to cover the estimated costs of reclamation activities. The licensee maintains a surety bond with a face value of $6,235,956 in favor of the WDEQ (NRC 2014c). Because the licensee does not have a standby trust agreement (STA) in place at this time as required by 10 CFR Part 40, Appendix A, Criterion 9, in accordance with 10 CFR 40.14(a), NRC has elected to grant an exemption to the STA requirements in 10 CFR Part 40, Appendix A, Criterion 9, through the 2016 financial assurance cycle (NRC 2014c). The surety amount is revised annually in accordance with the requirements of SUA-1597. The surety amount will be revised to reflect the estimated costs of reclamation activities for the Jane Dough Unit as development activities proceed.

1.4 Evaluation Findings

The staff reviewed the summary of proposed activities at the Nichols Ranch ISR Project involving the proposed Jane Dough Unit in accordance with review procedures in SRP Section 1.2, "Review Procedures," and acceptance criteria outlined in Section 1.3, "Acceptance Criteria." Information contained in the Uranerz Jane Dough Technical Report acceptably described the proposed activities for the Jane Dough Unit at the Nichols Ranch ISR Project, including: (1) the corporate entities involved, (2) the location of the facility, (3) land ownership, (4) ore-body locations, (5) the proposed recovery process, (6) operating plans and design throughput, (7) schedules for construction, startup, and duration of operations, (8) waste management and disposal plans, (9) ground water quality restoration, decommissioning, and land reclamation plans, and (10) financial assurance.

As described above, the NRC staff will revise license condition 9.1 of Source Materials License SUA-1597 to include Figure 1-2A, "Contour Map of the Jane Dough Unit," of the Jane Dough Technical Report, among the figures which show the license area boundaries as authorized places of use for licensed material.

9.1 The authorized place of use shall be the licensee's Nichols Ranch in situ recovery (ISR) Project in Johnson and Campbell Counties, Wyoming. The licensee shall conduct operations within the license area boundaries shown in Figures 1-2, *1-2A,* and 1-3 of the approved license application.

As described above, the NRC staff will revise license condition 9.2 of Source Material License SUA-1597 to include the license amendment request and its supplements. This SER documents the staff's safety review of the Jane Dough Technical Report.

9.2 The licensee shall conduct operations in accordance with the commitments, representations, and statements contained in the license application dated November 30, 2007, as amended by submissions dated August 21, 2008, March 11, 2009, February 24, 2010, September 15, 2010, September 22, 2010, October 3, 2013 (ML13282A301), February 13, 2014 (ML14050A023), February 18, 2014 (ML14063A068), ~~February 19, 2014 (ML14051A113), February 28, 2014 (ML14063A214),~~ March 4, 2014 (ML14064A128), March 5, 2014 (ML14065A018), ~~March 6, 2014 (ML14066A051), March 11, 2014 (ML14071A092),~~ *May 8, 2014 (ML14164A274), October 29, 2014 (ML14309A118), April 13, 2015 (ML15118A122), June 26, 2015 (ML15182A013),* July 30, 2015 (ML15237A149), ~~and~~ August 4, 2015 (ML15218A530), *May 24, 2016 (ML16148A166), July 19, 2016 (ML162070A054), August 17, 2016 (ML16232A096), September 7, 2016 (ML16253A032); September 15,*

2016 (ML16263A080, ML16263A167, ML16263A177); September 26, 2016 (ML16271A093); September 28, 2016 (ML16278A624); October 31, 2016 (ML16307A100); November 1, 2016 (ML16307A176); and November 7, 2016 (ML16313A470, ML17019A241) which are hereby incorporated by reference, except where superseded by specific conditions in this license. The licensee's approved license application must be maintained on site.

Whenever the word "will" or "shall" is used in the above referenced documents, it shall denote a requirement.

Based on the review described above, the NRC staff concludes that the information in the Jane Dough Technical Report meets the applicable acceptance criteria of SRP Section 1.3 and the requirements of 10 CFR 40.31, "Application for specific licenses," which describes the general requirements for the issuance of a specific license.

2.0 SITE CHARACTERIZATION

The NRC staff evaluated the licensee's geographic maps, topographic maps, and drawings that identify the Jane Dough Unit site and its location relative to federal, state, county, and other political subdivisions. These maps show the location and layout of the proposed Jane Dough Unit well fields, and all principal structures such as deep injection wells, recovery plant buildings, exclusion area boundaries and fences, licensee property and leases, and adjacent properties.

The NRC staff also evaluated the regional location and site layout for the proposed in situ leach operations using maps that show the relationship of the site to local water bodies (lakes and streams); geographic features (highlands, forests); geologic features (faults, folds, outcrops); transportation links (roads, rails, airports, waterways); political subdivisions (counties, townships); population centers (cities, towns); historical and archeological features; key species habitat; and non-licensee property (farms, settlements). The staff also evaluated a contour map of the site showing a plan layout of constructions, significant topographic variations of the site environs, and drainage gradients.

2.1 Site Layout and Location

This section describes the NRC staff's evaluation of the licensee's description of the site layout and location of the Jane Dough Unit in the Jane Dough Technical Report (Uranerz 2014f).

2.1.1 Regulatory Requirements

The staff must determine if the licensee has adequately identified the site location in accordance with the requirements of 10 CFR 40.31(g)(2).

2.1.2 Regulatory Acceptance Criteria

Unless specifically stated otherwise, the staff reviewed the Jane Dough Technical Report for compliance with the applicable requirements of 10 CFR Part 40 using the acceptance criteria presented in SRP Section 2.1.3, "Acceptance Criteria" (NRC 2003).

2.1.3 Staff Review and Analysis

Unless otherwise stated, this section describes the NRC staff's evaluation of information, data, and maps submitted by Uranerz in its Jane Dough Technical Report (Uranerz 2014f). The NRC staff's evaluation of the Nichols Ranch Unit and Hank Unit, including the information about the central processing plant located at the Nichols Ranch Unit, is contained in a July 2011 Safety Evaluation Report for the Nichols Ranch ISR Project (NRC 2011a). Therefore, this section focuses on the NRC staff's evaluation of information, data, and maps submitted by Uranerz in support of the license amendment for the Jane Dough Unit. The NRC staff visited the site during this review to confirm information presented in the application (NRC 2016b).

In the Jane Dough Technical Report, the licensee revised Figure 2-1, "Access Roads and Resin Transfer Route," to show the location of the proposed Jane Dough Unit, which is adjacent to and south of the Nichols Ranch Unit in Johnson and Campbell Counties, WY. The licensee also revised Figure 7-3, "Location of Nichols Ranch, Hank Sites and Nearest Residents to Nichols Ranch Central Processing Plant," of the Jane Dough Technical Report to show the Jane Dough permit boundary and wellfields relative to the licensed Nichols Ranch and Hank Units, and

nearby residences and geologic features. Figure 3-11A, “Jane Dough Production Areas,” of the Jane Dough Technical Report provides greater detail of the Jane Dough Unit ore field and production areas, including how the licensee has delineated the Jane Dough Unit into two production areas. The licensee also provided Figure 3-8C, “Jane Dough Unit Proposed Monitor Well Locations,” of the Jane Dough Technical Report to show the proposed monitoring well locations around the Jane Dough Unit wellfields, unit boundaries, and a proposed 0.8 km (0.5 mile) buffer area. Figure 3-9,” Typical 5-Spot Well Pattern,” of the Jane Dough Technical Report shows a typical 5-spot well pattern for production and injection wells. All maps provided by the licensee are legible.

2.1.4 Evaluation Findings

The staff has reviewed the site location and layout of the Nichols Ranch ISR Project in accordance with the review procedures in SRP Section 2.1.2, “Review Procedures,” and the acceptance criteria in SRP Section 2.1.3, “Acceptance Criteria.” The NRC staff finds that the licensee has described the site location and layout with appropriately scaled and labeled maps showing the site layout, principal facilities and structures, boundaries, and topography. Based on the review described above, the NRC staff concludes that the information in the Jane Dough Technical Report meets the applicable acceptance criteria of SRP Section 2.1.3, “Acceptance Criteria” and the requirements of 10 CFR 40.31(g)(2).

2.2 Meteorology

This section describes the NRC staff’s evaluation of the licensee’s description of regional and site meteorology at the Jane Dough Unit. The licensee provided information on the meteorology of the Jane Dough Unit in Sections 2.5.3, “Site Specific Analysis,” of the Jane Dough Technical Report (Uranerz 2014f).

Meteorological data are used for the selection of environmental monitoring locations, assessing the impact of operations on the environment, and determining the radiological dose assessments.

2.2.1 Regulatory Requirements

The staff determines if the licensee has demonstrated that the meteorology program—which is part of the site monitoring programs required by 10 CFR Part 40, Appendix A, Criterion 7—is sufficiently complete to allow for estimating doses to workers and members of the public.

2.2.2 Regulatory Acceptance Criteria

Unless specifically stated otherwise, the staff reviewed the Jane Dough Technical Report for compliance with the applicable requirements of 10 CFR Part 40, Appendix A, Criterion 7, using the acceptance criteria in SRP Section 2.5.3, “Acceptance Criteria” (NRC 2003).

2.2.3 Staff Review and Analysis

In the licensee’s description of its meteorological program contained in the Jane Dough Technical Report, the licensee revised Section 2.5.3, “Site Specific Analysis,” to include:

1. A summary and analysis of mean monthly temperatures based on 2 years of data collected at its on-site meteorological tower within the Nichols Ranch Unit,

2. A summary and analysis of on-site hourly wind speed and direction data, and

3. Revisions to the analysis of the effects of local terrain to include the Jane Dough Unit.

The licensee also provided information in Jane Dough Technical Report, Appendix JD-D4, "Climatology," which includes Addendum JD-D4-A, a February 18, 2014, report prepared by Inter-Mountain Labs (IML) Air Science titled, "Demonstration of Long-term Representativeness of Baseline-Period Meteorological Monitoring at the Nichols Ranch Site." The IML report included as Addendum JD-D4-A was previously evaluated by the staff as part of the NRC's April 2014 safety evaluation in support of removing preoperational license conditions, as described further below in "*Representativeness of On-site Meteorological Data*."

With regard to the mean monthly temperatures, the licensee does not use this information for safety-related facility design or for compliance with any other NRC requirement. Therefore, the NRC staff did not evaluate this information.

Wind Speed and Wind Direction

The NRC staff evaluated wind roses provided by the licensee in Jane Dough Technical Report Figure 2-10b for the first year (June 28, 2011, through July 3, 2012) and second year (July 3, 2012, through July 3, 2013). The wind roses depict wind speed and wind direction. The NRC staff finds that the two wind roses are very similar, and show winds that are predominantly from the east, south-southeast, and north-northwest.

Effect of Nearby Pumpkin Buttes

In Jane Dough Technical Report Section 2.5.3.9, "Effects of Local Terrain," the licensee revised its previous description of the effect on local meteorology of the nearby Pumpkin Buttes. The Pumpkin Buttes are four flat-topped mesas with an elevation above sea level of 1,812 m (5,945 ft), or about 365 m (1,200 ft) above the average elevation of the Jane Dough Unit, located along a line from about 9.6 km (6 mi) east of the Jane Dough Unit to 9.6 km (6 mi) north-northeast (Uranerz 2014f). The licensee's revisions were limited to adding the Jane Dough Unit, in addition to the Nichols Ranch and Hank Units, to the areas potentially affected. Otherwise, the licensee's analysis remains unchanged. Therefore, the staff did not reevaluate this information.

Representativeness of On-site Meteorological Data

The licensee's description of general site conditions, meteorological data acquisition, wind, and atmospheric dispersion for the Nichols Ranch ISR Project did not change in the Jane Dough Technical Report, as compared to the Nichols Ranch Technical Report. The NRC staff's evaluation of the information in the Nichols Ranch Technical Report is contained in a July 2011 Safety Evaluation Report (SER) for the Nichols Ranch ISR Project (NRC 2011a). In its July 2011 SER, the NRC staff found the licensee's description of site and regional meteorology acceptable, with the exception that the licensee had not provided temperature, wind speed, wind direction, and atmospheric stability class data that was representative of on-site conditions. Therefore, in the initial license issued July 19, 2011, license condition 12.7 stated:

> The licensee shall install a meteorological station within the license area and collect meteorological data for a period of 1 year at a data recovery rate of 90 percent prior to commencement of operations. The collection of meteorological data will continue until data are determined to be representative of long term conditions at the Nichols Ranch ISR Project. The data collected shall include, at a minimum, temperature, windspeed, and wind direction. Data submitted shall include an annual wind rose and a summary of the stability classification.

In a April 15, 2014 safety evaluation in support of a license amendment to remove certain pre-operational license conditions, the NRC staff evaluated the licensee's description of the first 2 years of onsite data collected by the licensee in the Nichols Ranch Unit in accordance with license condition 12.7 (NRC 2014). In its April 2014 safety evaluation, the NRC staff found that continued collection of meteorological data is required until the licensee has demonstrated that sufficient data has been collected to represent long-term conditions, which is needed to demonstrate compliance with 10 CFR Part 40, Appendix A, Criterion 7. Therefore, the staff deleted pre-operational license condition 12.7 and added operational license condition 10.15, which states:

> 10.15 The licensee shall continue to collect meteorological data on a continuous basis at a data recovery rate of at least 90 percent until the NRC headquarters staff verifies in writing the data to be representative of long term conditions at the Nichols Ranch ISR Project. The data collected shall include, at a minimum, temperature, wind speed, and wind direction. Data submitted shall include an annual wind rose and a summary of the stability classification. Justification of the similarity or validity of the data shall include an analysis of the statistical data presented to illustrate confidence in the representativeness of the data.
>
> Until the NRC headquarters staff verifies in writing that the meteorological data are representative of long term conditions at the Nichols Ranch ISR Project, the licensee shall continue to evaluate meteorological conditions to ensure that projected doses to members of the public and locations of environmental monitoring stations and radon detectors remain consistent with analyses submitted on February 28, 2014 (ML14063A214) and March 6, 2014 (ML14066A051). The licensee shall submit the results of this evaluation and discuss any proposed changes to its environmental monitoring program in the semi-annual operational effluent and environmental monitoring program report required by License Condition 11.1(D) to NRC headquarters for review.

The licensee continues to collect meteorological data in accordance with license condition 10.15.

Meteorological Tower Siting and Stability Class

In response to a request for additional information (RAI) dated January 21, 2016 (NRC 2016a), the licensee also provided a description of its meteorological monitoring tower with sufficient specificity for the NRC staff to determine that the tower is sited properly and operated with appropriate accuracy and sensitivity (Uranerz 2016a). To make this determination, the NRC staff evaluated: (1) the elevation of base of the tower relative to adjacent facilities; (2) the distance to nearby natural or man-made obstructions (e.g., trees, buildings) that may have influence on measurements; (3) elevation of the instruments on the tower; (4) description of the tower (e.g., open lattice); (5) wind direction and wind speed accuracies and starting thresholds.

In response to a request for additional information (RAI) dated January 21, 2016 (NRC 2016a), the licensee provided information about the methodology used to determine atmospheric stability class and a summary of the on-site stability class data. In its response (Uranerz 2016a), the licensee added information to Jane Dough Technical Report, Addendum JD-D4-A describing the methodology and a summary of the data. The licensee's methodology to determine atmospheric stability is the "sigma-theta" method, where "sigma-theta" refers to the standard deviation of the wind azimuth angle in degrees. Regulatory Position C.1 of Regulatory Guide 3.63, "Onsite Meteorological Measurement Program for Uranium Recovery Facilities – Data Acquisition and Reports," (NRC 1988) states that an indication of atmospheric stability may be obtained by any of five acceptable methods, including the sigma-theta method used by Uranerz. Acceptance criterion 2.5.3 of NUREG-1569 (NRC 2003) states that the meteorological program should be designed in accordance with Regulatory Guide 3.63. Therefore, since the licensee used an acceptable methodology described in Regulatory Guide 3.63, the NRC staff finds the licensee's description meets acceptance criterion 2.5.3, "Acceptance Criteria," of NUREG-1569 (NRC 2003).

2.2.4 Evaluation Findings

NRC has completed its review of the site characterization information concerned with meteorology at the *in situ* leach facility. This review included an evaluation using the review procedures in standard review plan Section 2.5.2, "Review Procedures," and acceptance criteria outlined in standard review plan Section 2.5.3, "Acceptance Criteria."

The licensee has acceptably described the site meteorology by providing data from National Weather Service, military, or other stations recognized as standard installations located within 80 km [50 mi] of the site, including available joint frequency distribution data on (i) wind direction and speed, (ii) stability class, (iii) period of record, (iv) height of data measurement, and (v) average inversion height. The data cover a sufficient time period to constrain long-term trends and support atmospheric dispersion modeling. The licensee has provided acceptable on-site meteorological data, including (i) descriptions of instruments, (ii) locations and heights of instruments, and (iii) joint frequency distributions. The joint-frequency data presented are for a minimum of 1 year, with a joint data recovery of 90 percent or more. Additional data on (i) annual average mixing layer heights, (ii) a description of the regional climate, and (iii) total precipitation and evaporation by month have been provided. The licensee has noted any effect of nearby water bodies or terrain on meteorologic measurements. In accordance with license condition 10.15, the licensee continues to collect on-site meteorological data to establish a meteorological record that is representative of long-term conditions at the site.

Based on the information provided in the Jane Dough Technical Report, and the detailed review conducted of the characterization of meteorology at the *in situ* leach facility, the staff concludes that the information is acceptable to allow evaluation of the spread of airborne contamination at the site and development of conceptual and numerical models. The characterization also meets the requirements of 10 CFR Part 40, Appendix A, Criterion 7, which requires pre-operational and operational monitoring programs.

2.3 Geology and Seismology

This section describes the NRC staff's evaluation of the licensee's description of site geology and seismology at the Jane Dough Unit. The licensee provided information on the site geology

and seismology of the Jane Dough Unit in Sections 2.6, “Geology and Seismology,” 2.7, “Hydrology,” Appendix JD-D5, “Geology,” and Appendix JD-D7, “Soil Assessment,” of the Jane Dough Technical Report (Uranerz 2014f). The licensee provides detailed geologic information to enable the NRC staff to assess the feasibility of conducting ISR operations at the proposed site as well as the likely ability of the geologic formations to isolate production fluids.

2.3.1 Regulatory Requirements

The NRC staff determines if the licensee has demonstrated that the characterization of geology and seismology at the Jane Dough Unit is sufficient to document the licensee’s ability to maintain control over production fluids containing source and byproduct materials, as required in 10 CFR 40.41(c).

2.3.2 Regulatory Acceptance Criteria

Unless specifically stated otherwise, the Jane Dough Technical Report was reviewed using the acceptance criteria presented in SRP Section 2.6.3, “Acceptance Criteria” (NRC 2003).

2.3.3 Staff Review and Analysis

The following sections present the NRC staff’s review and analysis of various aspects of the geology and seismology of the Jane Dough Unit. Aspects reviewed in the following sections include regional geology, site geology, soils, mineralogy, exploration boreholes, and seismology. The information reviewed in this section is from information, data, and maps submitted by Uranerz in the Jane Dough Technical Report (Uranerz 2014f).

2.3.3.1 Regional Geology

The NRC staff has determined that this aspect of the proposed facility and its operations, “Geology and Seismology,” should not be reexamined. Appendix A, “Guidance for Reviewing Historical Aspects of Site Performance for License Renewals and Amendments,” of NUREG-1569 states:

> If, after a review of these historical aspects of site operations, the staff concludes that the site has been operated so as to protect health and safety and the environment and that no unreviewed safety-related concerns have been identified, then only those changes proposed by the license renewal or amendment application should be reviewed using the appropriate sections of this standard review plan. Aspects of the facility and its operations that have not changed since the last license renewal or amendment should not be reexamined.

The regional geology description for the Jane Dough Unit presented in Appendix JD-D5, “Geology,” is a replication of the regional geology description presented in Section 2.6.1, “Regional Geology,” for the Nichols Ranch and Hank Units in the Nichols Ranch ISR Project Technical Report (Uranerz 2007). The licensee did not propose changes to Section 2.6.1, “Regional Geology,” of the Jane Dough Technical Report, as compared to the same section of the Nichols Ranch ISR Project Technical Report. The NRC staff previously reviewed Section 2.6.1, “Regional Geology,” of the Nichols Ranch ISR Project Technical Report (Uranerz 2007) and found acceptable the licensee’s description of regional geology at its Nichol’s Ranch ISR Project (NRC 2011a).

The NRC staff observes that the Jane Dough Unit is located within the Powder River Basin which was previously described by the licensee for the currently licensed Nichols Ranch ISR Project (Uranerz 2007). The NRC staff finds nothing to invalidate its previous findings and previous staff conclusions remain valid. In addition, the NRC staff has not identified any unreviewed safety-related concerns pertaining to the licensee's description of the regional geology.

2.3.3.2 Site Geology

The licensee described the geology of the Jane Dough Unit in detail in Appendix JD-D5, "Geology," of the Jane Dough Technical Report (Uranerz 2014f). The licensee stated that the Jane Dough Unit lies within the Powder River Basin. SER Figure 1 presents the general stratigraphy of the Powder River Basin. The licensee notes that the White River Formation shown in SER Figure 1 is eroded locally except at the top to the Pumpkin Buttes which are northeast of the Jane Dough Unit leaving the Wasatch Formation as the surficial unit in the rest of the area.

The licensee provided geological cross sections that display the stratigraphy and isopach maps that show the thickness of each relevant layer in the Jane Dough Unit. These maps were developed using well logs from historical and recent exploratory borings. SER Figure 1 shows a generalized local and regional stratigraphic section that describes the sequence of sands and aquitards for the Jane Dough Unit area.

The licensee described the local geology of the Jane Dough Unit using fifteen different cross sections (A-A' through O-O') and eleven isopachs presented as Exhibits JD-D5-16 through JD-D5-26 of the Jane Dough Technical Report (Uranerz 2014f). Cross section A-A' transects north to south along the length of the western ore zones. Cross section B-B' transects north to south along the length of the eastern ore zones. The other nine cross sections (C-C', through O-O') transect west to east at approximately equal intervals across the site area from north to south, respectively.

The licensee identified eight fluvial sandstone horizons. The licensee referred to these horizons from shallowest to deepest as, the H, G, F, C, B, A and 1 Sands (see SER Figure 1) and further indicated that the notable sand units (i.e. the thicker and more aerially extensive units) are the G, F, B, A and 1 Sands. The licensee indicated that the Jane Dough Unit sands are stratigraphically the same as those at the currently licensed Nichols Ranch Unit.

Separating the sand horizons are less permeable horizons composed of siltstones, mudstones, carbonaceous shales and poorly developed thin coals. The naming convention for these aquitard units is presented in SER Table 2 "Jane Dough Unit Geological Sections".

The licensee reports that the uranium mineralization at the Jane Dough Unit is a continuation of the mineralization found within the Nichols Ranch Unit and is located within the A Sand at an approximate depth of 168 m (550 ft). The A Sand is mostly continuous across the site and typically ranges between 15 m to 34 m (50 to 110 ft) thick (Exhibit JD-D5-18, "Jane Dough Unit A Sand Isopach," of the Jane Dough Technical Report). The A Sand is the production zone.

The 1A mudstone serves as the underlying confining unit to the A Sand and is continuous throughout the Jane Dough Unit with an approximate thickness ranging from 8.8 m to 37 m (29 to 120 ft) (Exhibit JD-D5-19, "Jane Dough Unit 1A Mudstone Isopach," of the Jane Dough Technical Report).

The licensee designated the 1 Sand as the underlying aquifer relative to the A Sand production zone. The 1 Sand is not present in the central portion of the Jane Dough Unit. The 1 Sand is confined to incised valleys cut into the 1A mudstone with thicknesses ranging from 0 to 23 m (0 to 75 feet) (Exhibit JD-D5-20, "Jane Dough Unit 1 Sand Isopach," of the Jane Dough Technical Report).

The AB mudstone serves as the overlying confining unit to the A Sand. During the NRC staff's review of the geologic cross sections and the isopach of the AB mudstone (Exhibit JD-D5-17, "Jane Dough Unit AB Mudstone Isopach," of the Jane Dough Technical Report), the NRC staff determined that while the AB mudstone thickness can locally exceed 46 m (150 feet) in the southwestern portion of the proposed Jane Dough Unit, it thins toward the east and is not present in the east and northwest portions of the Jane Dough Unit. The licensee stated in Section 2.7.2.2.3, "Aquifer Description," of the Jane Dough Technical Report that where the AB mudstone is present, the B Sand, which overlies the AB mudstone, will be designated as the overlying aquifer relative to the A Sand production zone.

Where the AB mudstone is absent, the B Sand sits directly upon the A sand and therefore the A and B sands effectively combine into a single aquifer unit. The license stated that where this is the case, the aquifer above the B Sand is designated as the overlying aquifer relative to the production zone. Because the sands that overlie the B Sand are not continuous across the site, the designated overlying aquifer in areas where the A and B Sands coalesce may be the C, F or G Sand, depending upon the location.

The NRC staff evaluated the geology of the license area using the geologic descriptions, cross sections and isopachs provided by the licensee as summarized in Table 2 of this SER. The alternating sand, silt, siltstone, clay layercake geology and lack of faulting and underground mine works is consistent with the NRC staff's historical knowledge of the geology of the Powder River Basin associated with historical and current ISR projects.

The NRC staff finds the licensee's description of the site geology is generally consistent with that provided for the Nichols Ranch Unit which NRC staff previously found acceptable (NRC 2011a). Moreover, the NRC staff finds that the licensee's characterization of the site geology is consistent with the acceptance criteria in SRP Section 2.6.3, "Acceptance Criteria" (NRC 2003).

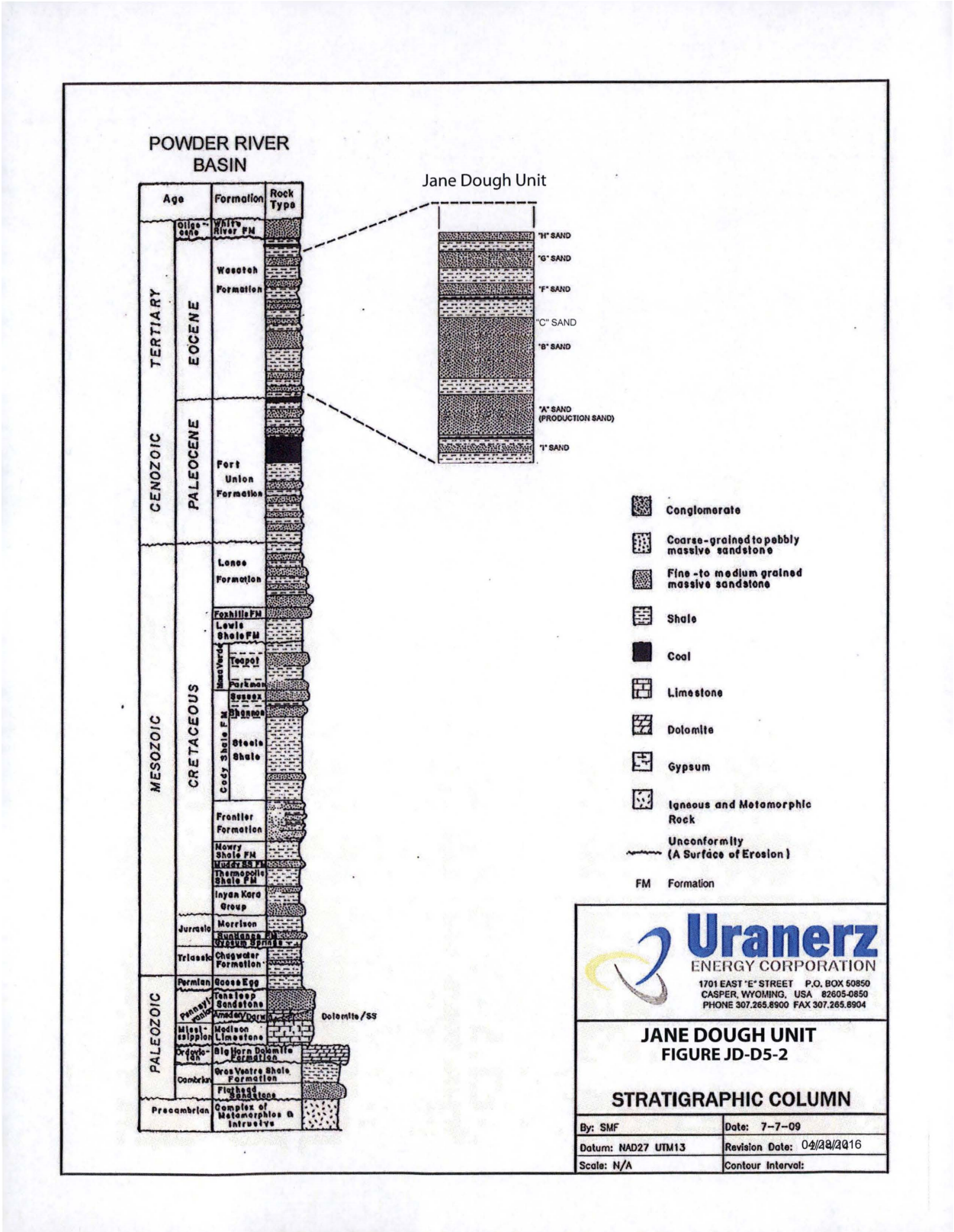

Figure 1. Stratigraphic Column in Jane Dough Unit
(adopted from Figure JD-D5-2, "Stratigraphic Column," of Uranerz 2014f)

Table 2. Jane Dough Unit Geological Sections

Geological Section	Description
G Sand	Medium and fine grained sand. Relatively continuous over the Jane Dough Unit with thickness over 60 feet in some areas (Jane Dough Technical Report Exhibit JD-D5-21).
GB mudstone	Consists of mudstones, thin carbonaceous shales, poorly developed lignitic coal beds and thin discontinuous siltstones. It is continuous over the Jane Dough Unit with approximate thickness ranging from 140 to 300 feet (Jane Dough Technical Report Exhibit JD-D5-22).
F sand	Medium and fine grained sand. Discontinuous, occurs predominantly over the western portion of the Jane Dough Unit with thickness up to 70 feet (Jane Dough Technical Report Exhibit JD-D5-23).
FB Mudstone	Consists of mudstones and thin discontinuous siltstones. It is continuous over the Jane Dough Unit with approximate thickness ranging from 70 to 180 feet (Jane Dough Technical Report Exhibit JD-D5-24).
C Sand	Consists of silt to medium grained sand. Discontinuous, occurs sporadically over the Jane Dough Unit with thickness up to 55 feet (Jane Dough Technical Report Exhibit JD-D5-25).
CB Mudstone	Consists of mudstones and thin discontinuous siltstones. It is continuous over the Jane Dough Unit with approximate thickness ranging from 40 to 140 feet (Jane Dough Technical Report Exhibit JD-D5-26).
B Sand	Fine to coarse-grained sand occasionally split by lenses of mudstone, siltstone, and carbonaceous shale that may extend horizontally for thousands of feet. The sand thickness ranges from 0 to 234 feet. Continuous over the majority of Jane Dough Unit with thickness typically exceeding 80 feet (Jane Dough Technical Report Exhibit JD-D5-16). Sits directly upon A Sand when AB Mudstone is not present.
AB Mudstone	Consists of mudstones and thin discontinuous siltstones. Thickness ranges from 0 to 160 feet. Thins from west to east. Not present over most of the eastern portion of the Jane Dough Unit (Jane Dough Technical Report Exhibit JD-D5-17).
A Sand	This sand is the production zone. Fine to coarse-grained sand with occasional lenses of mudstone and siltstone. The sand thickness ranges from 0 to 115 feet. Continuous over the majority of Jane Dough Unit with thicknesses ranging from 50 to 110 feet. (Jane Dough Technical Report Exhibit JD-D5-18).
1A Mudstone	Consists of mudstones and carbonaceous shale. It is continuous over the Jane Dough Unit with approximate thickness ranging from 29 to 120 feet. (Jane Dough Technical Report Exhibit JD-D5-19).
1 Sand	Very fine to coarse-grained sand. It is missing over the majority of the Jane Dough Unit. Thickness ranges from 0 to 75 feet (Jane Dough Technical Report Exhibit JD-D5-20).

Based on information provided in Jane Dough Technical Report, Appendix JD-D5 (Uranerz 2014f)
To convert units from feet to meters multiply the value in feet by 0.3048.

2.3.3.3 Mineralogy

The NRC staff has determined that portions of this aspect of the proposed facility and its operations, "Geology and Seismology," should not be reexamined. Appendix A, "Guidance for Reviewing Historical Aspects of Site Performance for License Renewals and Amendments," of NUREG-1569 states:

> If, after a review of these historical aspects of site operations, the staff concludes that the site has been operated so as to protect health and safety and the environment and that no unreviewed safety-related concerns have been identified, then only those changes proposed by the license renewal or amendment application should be reviewed using the appropriate sections of this standard review plan. Aspects of the facility and its operations that have not changed since the last license renewal or amendment should not be reexamined.

The licensee stated in Appendix JD–D5, "Geology," of the Jane Dough Technical Report (Uranerz 2014f) that the ore body located in the A sand in the Jane Dough Unit is a continuation of the Nichols Ranch Unit uranium deposit and is a typical Powder River Basin type roll front deposit.

The licensee stated in Appendix JD–D5, "Geology," that the uranium ore bearing sandstone on the eastside of the Jane Dough Unit is composed of at least two vertically stacked roll fronts. The lateral distances between the stacked roll fronts are highly variable and range from 0 to 60 m (0 to 200 ft) (Uranerz 2014f). The licensee stated that the mineralization on the west side appears to be principally one roll front which occasionally splits into three sub-rolls.

The description of the mineralogy of the ore body at the Jane Dough Unit presented in Appendix JD-D5, "Geology," of the Jane Dough Technical Report is a replication of the mineralogy description presented in Section 2.6.1, "Regional Geology," of the Nichols Ranch ISR Project Technical Report. The NRC staff previously reviewed Section 2.6.1, "Regional Geology," of the Nichols Ranch ISR Project Technical Report (Uranerz 2007) and found acceptable the licensee's description of the ore body minerology at its Nichol's Ranch ISR Project (NRC 2011a). The NRC staff finds nothing to invalidate its previous findings and previous staff conclusions remain valid. In addition, the NRC staff has not identified any unreviewed safety-related concerns pertaining to the licensee's description of the ore body mineralogy.

2.3.3.4 Exploration Boreholes

The licensee stated in Section 2.7.5.2, "Jane Dough Unit," of the Jane Dough Technical Report that a total of 2,165 abandoned exploration drill holes were located within the Nichols Ranch ISR Project boundaries. The licensee stated that holes drilled from 2006 through year 2013 have been plugged in accordance with current State of Wyoming regulations. Additionally, the licensee stated that, to the best of its knowledge, boreholes drilled before 1997 were plugged in accordance with regulations in effect at that time.

The licensee provided the locations of all known abandoned drill holes in two tables in Volume IX, Addendum JD-D6I, "Exploration Drill Holes," of the Jane Dough Technical Report. Exhibit JD-D6-4, "Jane Dough Unit Exploration Drill Holes," presents the location of exploration drill holes located within the Jane Dough Unit.

The licensee committed in Section 7.5.7, "Aquifer Communication Through Old Exploration Holes," of the Jane Dough Technical Report to reenter, plug, and abandon any improperly plugged boreholes it discovers by pumping tests or other methods. The NRC staff finds the assessment of the location and plugging of exploratory boreholes and the commitment to take corrective action if any improperly plugged holes are located meets the applicable acceptance criteria in Section 2.6.3, "Acceptance Criteria," of NUREG-1569.

2.3.3.5 Seismology

The NRC staff has determined that this aspect of the proposed facility and its operations, "Geology and Seismology," should not be reexamined. Appendix A, "Guidance for Reviewing Historical Aspects of Site Performance for License Renewals and Amendments," of NUREG-1569 states:

> If, after a review of these historical aspects of site operations, the staff concludes that the site has been operated so as to protect health and safety and the environment and that no unreviewed safety-related concerns have been identified, then only those changes proposed by the license renewal or amendment application should be reviewed using the appropriate sections of this standard review plan. Aspects of the facility and its operations that have not changed since the last license renewal or amendment should not be reexamined.

The licensee had previously described the seismology of the Nichols Ranch and Hank Units in Section 2.6.3.1, "Nichols Ranch and Hank Units," of the Nichols Ranch ISR Project Technical Report (Uranerz 2007) To address the seismology of the Jane Dough Unit, the licensee added a new sub-Section 2.6.3.2, "Jane Dough Unit," to the Jane Dough Technical Report which provided the same information already provided in Section 2.6.3.1, except that Section 2.6.3.2 references Figure JD-D5-4, "Seismic Zone Map of Wyoming," rather than Figure 2-14, "Seismic Zone Map of Wyoming." Both figures are presented in the Jane Dough Technical Report and provide the same information.

The NRC staff previously reviewed Section 2.6.3, "Seismology," of the Nichols Ranch ISR Project Technical Report (Uranerz 2007) and found acceptable the licensee's assessment of seismology at its Nichol's Ranch ISR Project (NRC 2011a).

The Jane Dough Unit is located in close proximity to the Nichols Ranch and Hank Units and NRC staff finds nothing to invalidate its previous findings and previous staff conclusions remain valid. In addition, the NRC staff has not identified any unreviewed safety-related concerns pertaining to the licensee's assessment of seismology.

2.3.3.6 Soils

The licensee described soils occurring in the Jane Dough Unit as typical for the semi-arid grass land of the western United States. The licensee described the soil textures as generally loamy or fine-loamy (Uranerz 2014f).

In Appendix JD-D7, "Soil Assessment," of the Jane Dough Technical Report, the licensee presented a soils map of the Jane Dough Unit area developed from field mapping of the proposed project area. Detailed soil unit descriptions are presented in Addendum JD-D7-A, "Soil Mapping Unit Descriptions." Appendix JD-D7 of the Jane Dough Technical Report also

includes references to Natural Resources Conservation Service (NRCS) farmland surveys of the area.

The NRC staff finds the licensee's description of soils acceptable because it is consistent with the acceptance criteria in Section 2.6.3, "Acceptance Criteria," of NUREG-1569 and is supported by published information produced by NRCS.

2.3.4 Evaluation Findings

The NRC staff evaluated the licensee's site characterization information addressing geology and seismology at the Jane Dough Unit in accordance with SRP Section 2.6.3, "Acceptance Criteria." The licensee adequately described the geology and seismology by providing: (1) a description of the local and regional stratigraphy, (2) geologic, topographic, and isopach maps at acceptable scales showing surface and subsurface features and locations of all wells and site explorations used in defining stratigraphy, (3) a geologic and geochemical description of the mineralized zone and the geologic units adjacent to the mineralized zone, (4) a description of the local and regional geologic structure, (5) a discussion of the seismicity and seismic history of the region, (6) a generalized stratigraphic column that includes the thickness of rock units, a representation of lithologies, and a definition of mineralized horizon, and (7) a description and map of the soils. As noted in the sections above, several aspects the proposed facility and its operations, were not reexamined as the information was previously reviewed and approved by NRC staff (NRC 2011a). Based on the review conducted by the staff as described above, the information provided in the Jane Dough Technical Report meets the applicable acceptance criteria of SRP Section 2.6.3 and 10 CFR 40.41(c).

2.4 Hydrology

This section describes the NRC staff's evaluation of the licensee's description of site hydrology at the Jane Dough Unit. The licensee provided information on the hydrology of the Jane Dough Unit in Appendix JD-D6, "Hydrology," of the Jane Dough Technical Report (Uranerz 2014f). This information is need to establish the potential effects of in situ recovery operations on the adjacent surface water and groundwater resources and the potential effects of surface water flooding on the in situ recovery facility. The following sections present the NRC staff's review and analysis of various aspects of the surface water and groundwater hydrology for the Jane Dough Unit. Unless otherwise stated, the information reviewed in this section is from information, data and maps submitted by Uranerz in its Jane Dough Technical Report (Uranerz 2014f).

2.4.1 Regulatory Requirements

The NRC staff determines if the licensee has demonstrated that the characterization of surface and ground water hydrology at the Jane Dough Unit is sufficient to document the licensee's ability to maintain control over production fluids containing source and byproduct materials, as required by 10 CFR 40.41(c).

2.4.2 Regulatory Acceptance Criteria

Unless stated otherwise, the Jane Dough Technical Report was reviewed for consistency with the applicable requirements of 10 CFR Part 40, using the acceptance criteria presented in SRP Section 2.7.3, "Acceptance Criteria" (NRC 2003).

2.4.3 Staff Review and Analysis

The following sections present the NRC staff's review and analysis of various aspects of the surface water and groundwater hydrology for the Jane Dough Unit.

2.4.3.1 Surface Water

The licensee described the surface water hydrology for the proposed Jane Dough Unit in Appendix JD-D6, "Hydrology," of the Jane Dough Technical Report. The majority of the Jane Dough Unit is located within the Cottonwood Creek and Seventeen Mile Creek drainages as shown in Figure JD-D6-1, "Surface Drainage Areas," of Jane Dough Technical Report (Uranerz 2014f). Figure JD-D6-1 also presents the site surface topography. The entire Cottonwood Creek drainage area is presented in Figure D6-1 of the Nichols Ranch ISR Project Technical Report (Uranerz 2007). The Cottonwood Creek and Seventeen Mile drainages encompass 208 and 29.8 km^2 (80.2 and 11.5 mi^2), respectively.

Cottonwood Creek and Seventeen Mile Creek are tributaries of the Dry Fork of the Powder River. The confluence of Seventeen Mile Creek is approximately 5 km (3 mi) upstream from the confluence of Cottonwood Creek and the Dry Fork of the Powder River. Powder River is a tributary of the Yellowstone River, which is part of the Missouri River drainage basin (Uranerz, 2014e).

To quantify the local flows within the Jane Dough Unit, the licensee defined six smaller drainage subbasins labeled JDA1 through JDA6 as shown in Figure JD-D6-2, "Jane Dough Unit Inundated Areas for 25-year Flood," of the Jane Dough Technical Report. Subbasin JDA1 drains into Seventeen Mile Creek. Subbasin JDA2 drains into the Dry Fork of the Powder River and Subbasins JDA3 through JDA6 drain into Cottonwood Creek. The NRC staff's review of Figure JD-D6-2 of the Jane Dough Technical Report indicates all six of these subbasins cross at least a small portion of the planned wellfields.

The NRC staff does not agree with the delineation of Subbasin JDA1, which is within the Seventeen Mile Creek basin. The NRC staff's review of the site topographic map indicates that additional drainage area upstream of Subbasin JDA1 will contribute flow at the outlet of Subbasin JDA1. Not accounting for this additional area will underestimate the predicted flood flows at this location and, therefore, the predicted flood flows shown in Jane Dough Technical Report Table JD-D6-1, "Surface Draining Properties, Estimated Peak Flows, and Velocities," should be disregarded. The licensee did, however, appropriately include this drainage area in the computed flood flows for the Seventeen Mile Creek basin as shown in Jane Dough Technical Report Table JD-D6-1 and therefore the licensee's delineation of Subbasin JDA1 does not pose a safety concern.

The licensee reported that the Cottonwood and Seventeen Mile Creeks are ephemeral and only flow in response to heavy snow melt and large rainstorms. The licensee estimated peak flood flows for recurrence intervals of 2, 5, 10, 25, 50, and 100 years for the Cottonwood Creek and Seventeen Mile Creek using the methods of Lowham (1976), which were developed for and are suited to drainages of this size. Peak flows were also estimated for the smaller subbasins (JDA1 through JDA6) using the methods of Craig and Rankl (1978). The Lowham and Craig-Rankl methods were developed for estimated flood flows for drainage basins located in Wyoming and are, therefore, acceptable. These methods were also used to estimate flood flows

at the currently licensed Nichols Ranch Unit (Uranerz 2007) which the NRC staff previously reviewed and found acceptable (NRC 2011a). SER Table 3 shows the licensee-calculated peak flow rates for the Jane Dough Unit.

The licensee used the Manning equation to compute flow velocities in the drainages based on the 25-year peak flow rate. The licensee assumed a trapezoidal channel configuration and a Manning's roughness coefficient of 0.03. Based the NRC staff's observations during a site visit, the NRC staff finds these assumptions acceptable (NRC 2016b). In Table JD-D6-1 of the Jane Dough Technical Report the licensee reported flow velocities ranging from 3.17 to 3.96 meters per second (10.4 to 13.0 ft per second [fps]) for drainage basins JDA2 through JDA6.

In Figure JD-D6-2 of the Jane Dough Technical Report, the licensee provided a map of the areas anticipated to be flooded in the Jane Dough Unit license area for a 25-year event. The licensee predicted that flow in the smaller tributaries will be confined to the channels, which are incised. Confining flood flows to incised channels prevents wellfield areas from being inundated. NRC staff notes that although it disagrees with the delineation of JDA1, the wellfield within JDA1 is not at risk of inundation as the wellfield is located at a basin divide, rather than near a basin outlet where flow converges.

The licensee recognized that large runoff events may present an erosion risk to the site and damage well field infrastructure. The licensee committed in Jane Dough Technical Report Section 2.7.1.1.2 to minimizing damage from erosion and to well field infrastructure from runoff events by avoiding well installation in the ephemeral drainages. If such wells must be installed, appropriate erosion protection controls will be applied to minimize damage to the drainage. Controls include grading and contouring, culvert installation, low-water crossing constructed of stone, water contour bars, and designated traffic routes. If wells are to be placed near a stream, appropriate well and wellhead protection will be used. The protective measures will include barriers surrounding the well, such as cement blocks, protective steel casings, and other measures.

Additionally, in the event that a drainage has to be crossed, the licensee committed to the use of best management practices such as riprap and rock, in accordance with of WDEQ, Land Quality Division (LQD), Chapter 3 Rules and Regulations (2006). Staff finds the application of erosion control best management practices using WDEQ regulations by the licensee provides reasonable assurance that the potential for damage to site infrastructure which could result in loss of control of production fluids in minimal.

NRC staff notes that processing of the Jane Dough Unit production fluids will be conducted at the central processing plant which is located in the Nichols Ranch Unit licensed area. The surface water hydrology related to this facility (Uranerz 2007) has been previously evaluated and found acceptable by NRC (NRC 2011a). Additionally, neither the Nichols Ranch nor Jane Dough Units contain ISR-related surface water impoundments.

Table 3. Peak Flood Discharge Estimates for Jane Dough Unit Drainages (adopted from Jane Dough Technical Report, Table JD-D6-1)

Drainage Basin	Area (km^2) (mi^2)	Peak Flow Rate (m^3/s) (ft^3/s)					
		2-year	5-year	10-year	25-year	50-year	100-year
Cottonwood Creek	207.7 (80.2)	12.9 (454)	34.0 (1220)	60.9 (2150)	106.5 (3760)	153.5 (5420)	212.4 (7500)
Seventeen Mile Creek	29.8 (11.5)	6.4 (226)	17.2 (607)	29.7 (1049)	51.9 (1832)	74.8 (2641)	103.5 (3654)
JDA2	3.6 (1.4)	3.3 (117)	6.9 (244)	10.2 (361)	15.5 (548)	20.4 (720)	26.1 (920)
JDA3	1.0 (0.4)	1.7 (60)	3.4 (121)	4.9 (174)	7.3 (257)	9.3 (330)	11.7 (412)
JDA4	3.4 (1.3)	3.1 (110)	6.5 (230)	9.6 (339)	14.6 (514)	19.1 (673)	24.3 (859)
JDA5	1.3 (0.5)	1.7 (60)	3.5 (122)	5.0 (177)	7.4 (260)	9.5 (335)	11.8 (418)
JDA6	4.4 (1.7)	3.7 (132)	7.9 (278)	11.7 (413)	17.9 (631)	23.6 (832)	30.2 (1068)

Coal Bed Methane (CBM)

The licensee stated in Section 2.2.5.2, "Coal Bed Methane," of the Jane Dough Technical Report that there are 47 CBM production wells located within the Jane Dough Unit. Jane Dough Technical Report Exhibit JD-D6-2, "Jane Dough Coal Bed Methane Wells – 3 Mile Radius," presents the locations of CBM wells within 5 km (3 mi) of the Jane Dough Unit. In Exhibit 2-4, "WYPDES Outfalls Jane Dough Unit," and Table 2-12e, "Outfalls Inside and Within a One-Mile Radius of the Jane Dough Unit License Boundary," of the Jane Dough Technical Report, the licensee provided the location of permitted CBM outfalls and impoundments within 1.6 km (1 mi) of the Jane Dough Unit license area.

Table 2-12f, "WYPES Effluent Limitations for Permits Within a One Mile of the Jane Dough Unit Project," of the Jane Dough Technical Report provides effluent water quality limits for each of these permitted outfall locations. The limits depict the end-of-pipe maximum concentrations of specific chemical constituents. The NRC staff notes that CBM-produced water may contain chemical constituents similar to those found in uranium production processes.

The licensee stated in Section 2.7.1.2.4.3, "CBM/CBNG Effect on Surface Water/Surficial Aquifer," of the Jane Dough Technical Report that with the exception of WY0051161 and WY0094536, the WYPDES permits within 1.6 km (1 mi) of the site provide total containment. The NRC staff notes that based on review of Jane Dough Technical Report Exhibit 2-4, the WY0051161 outfall location is outside of the Jane Dough Unit and in separate hydrologic drainage basin. The NRC staff therefore concludes that the WY0051161 outfall is unlikely to have any significant effect on the surface water quality at the site.

In Section 2.7.1.2.4.3, "CBM/CBNG Effect on Surface Water/Surficial Aquifer," of the Jane Dough Technical Report, the licensee stated that water discharged from WY0094563 outfall will flow through the Jane Dough License Boundary after a stream reach length of approximately 3.2 km (2 mi). Given that effluent water will meet discharge quality limits and will likely infiltrate

into dry ephemeral streambeds before it reaches any downstream wellfield, the NRC staff determined that outfall WY0094563 is unlikely to impact surface water quality at the site.

The licensee stated that for the remainder of the permits, discharge can only occur to non-discharging impoundments. These impoundments are designed to allow the effluent to infiltrate to the groundwater. Discharge from the impoundment is permitted only during significant runoff events, where the CBM-produced water will be diluted by natural runoff. The licensee noted that production and use of the water in these impoundments is at the discretion of the CBM operators, and Uranerz has no control over CBM operations (Uranerz 2016a).

The licensee stated that the WDEQ permit and freeboard requirements for the impoundments should prevent any impacts on surface water quality in the license area. The NRC staff agrees with the licensee's statement about impacts on surface water quality in the license area because the surface water discharges from the CBM outfalls are regulated by the WDEQ and must meet the State's regulatory requirements.

2.4.3.2 Ground Water

As described in Jane Dough Technical Report Appendix JD-D6, "Hydrology," the licensee conducted a site investigation to develop an understanding of the hydrogeology at the Jane Dough Unit. The investigation included drilling of exploration borings, installation of monitoring wells, and measurement of hydrogeologic properties within the different aquifers. The results of the site investigation formed the basis of the licensee's understanding of the hydrogeology at the Jane Dough Unit.

Regional Hydrogeology

The Jane Dough Unit is located in the south-central Powder River Basin, to the southwest of the Middle Pumpkin Butte. The general stratigraphy of the area is shown in SER Figure 1. The regional geologic structure is relatively flat with a gentle dip to the southwest toward the basin axis. The uppermost regional aquifers are found in the Wasatch Formation, which is also the host formation for the uranium deposits. Groundwater in the Wasatch aquifers generally flows to the north and northwest. Underlying the Wasatch are aquifers in the sandstones and coal seams of the Fort Union Formation, and flow in these aquifers is also expected to be generally to the north and northwest. Underlying the Fort Union is the Lance Formation, which is composed of very fine to fine-grained sandstone, shale, and coal beds. Ground water flow direction in the Lance Formation is expected to be to the north. The Fox Hills sandstone is located below the Lance and is composed of fine- to medium-grained sandstone.

Jane Dough Unit Hydrogeology

The licensee reported that the Jane Dough Unit is located in the outcrop of the Wasatch Formation which consists of alternating layers of sand and shale. The layering and naming convention of these units at the Jane Dough Unit is presented in SER Table 2. The licensee indicated that the Jane Dough Unit geologic units are stratigraphically the same as those at the currently licensed Nichols Ranch Unit.

The licensee reported in Appendix JD-D5, "Geology," of the Jane Dough Technical Report (Uranerz 2014f) that the uppermost relatively continuous aquifer in the Jane Dough Unit is the G Sand. Where present, the depth to the top of the G Sand ranges from 0 to approximately

39.6 m (130 ft) below ground surface. The G Sand thickness exceeds 18.3 m (60 ft) thick in some areas. The licensee completed two wells in the G Sand. NRC staff review of water level data presented in Table JD-D6D.1-1, “Water-Level Data for Jane Dough Wells,” indicates that water levels in these wells were relatively steady over the late 2010 to late 2013 time period.

The licensee reported that the next aquifer encountered in the license area is the F Sand. The F Sand is discontinuous and occurs predominately over the western portion of the site with thicknesses up to 21.3 m (70 ft). The licensee completed three wells in the F Sand. NRC staff review of water level data presented in Table JD-D6D.1-1 indicates that water levels in these wells were relatively steady over the late 2010 to late 2013 time period.

Below the F Sand, the C Sand occurs sporadically over the Jane Dough Unit. The licensee installed one well in the C Sand. NRC staff review of water level data presented in Table JD-D6D.1-1 indicates that water levels in this wells were relatively steady over the late 2010 to late 2013 time period.

Below the C sand, the next aquifer is the B Sand. The B Sand is continuous across the majority of the Jane Dough Unit with thicknesses typically exceeding 24.4 m (80 ft). The licensee completed four wells in the B Sand. NRC staff review of water level data presented in Table JD-D6D.1-1 indicates that water levels in these wells were relatively steady over the late 2010 to late 2013 time period. Jane Dough Technical Report Figure JD-D6-7, “Jane Dough Unit Water-Level Elevations for the B Sand Aquifer, 2013,” presents a potentiometric map surface map for the B Sand. The potentiometric surface represents the level to which water rises in a well. Figure JD-D6-7 indicates that the groundwater flow direction in the B Sand is to the northwest. The B Sand overlies, and on the western portion of the site is separated from, the A Sand by the AB mudstone. The A Sand is the ore production zone. As shown in Jane Dough Technical Report Exhibit JD-D5-17, “Jane Dough Unit AB Mudstone Isopach,” the AB mudstone is absent on the eastern portion of the site and the B Sand sits directly upon the A Sand. The A and B sands, therefore, effectively combine into a single aquifer unit in areas where the AB mudstone is absent. SER Section 5.3, “Groundwater and Surface Water Monitoring Programs,” discusses the impacts of the presence or absence of the AB mudstone on the operational groundwater monitoring program.

The A Sand is the ore production zone and is continuous over the majority of the Jane Dough Unit with thicknesses ranging from 15.2 to 30.5 m (50 -110 ft). The licensee used 8 wells, as shown in SER Figure 2, to measure water levels in the A Sand. Water level measurement in the A Sand demonstrate that the aquifer is confined, with a potentiometric surface rising approximately 61 – 91.4 m (200 - 300 ft) above the top of the sand unit.

NRC staff review of water level data presented in Table JD-D6D.1-1 indicates that water levels in the A Sand wells were relatively steady over the late 2010 to late 2013 time period. The water level data for well URZJA-19 showed an unexplained dip in late 2012 and subsequent rebound. NRC staff review of this data suggests the dip in the data is likely the result of measurement error because no other nearby well completed in the A Sand exhibited a similar water level drop during the same time period.

Based on the potentiometric contours, the licensee reported the groundwater flow direction is to the northwest with a gradient of 0.0064 m/m (0.0064 ft/ft). Using this gradient, an effective

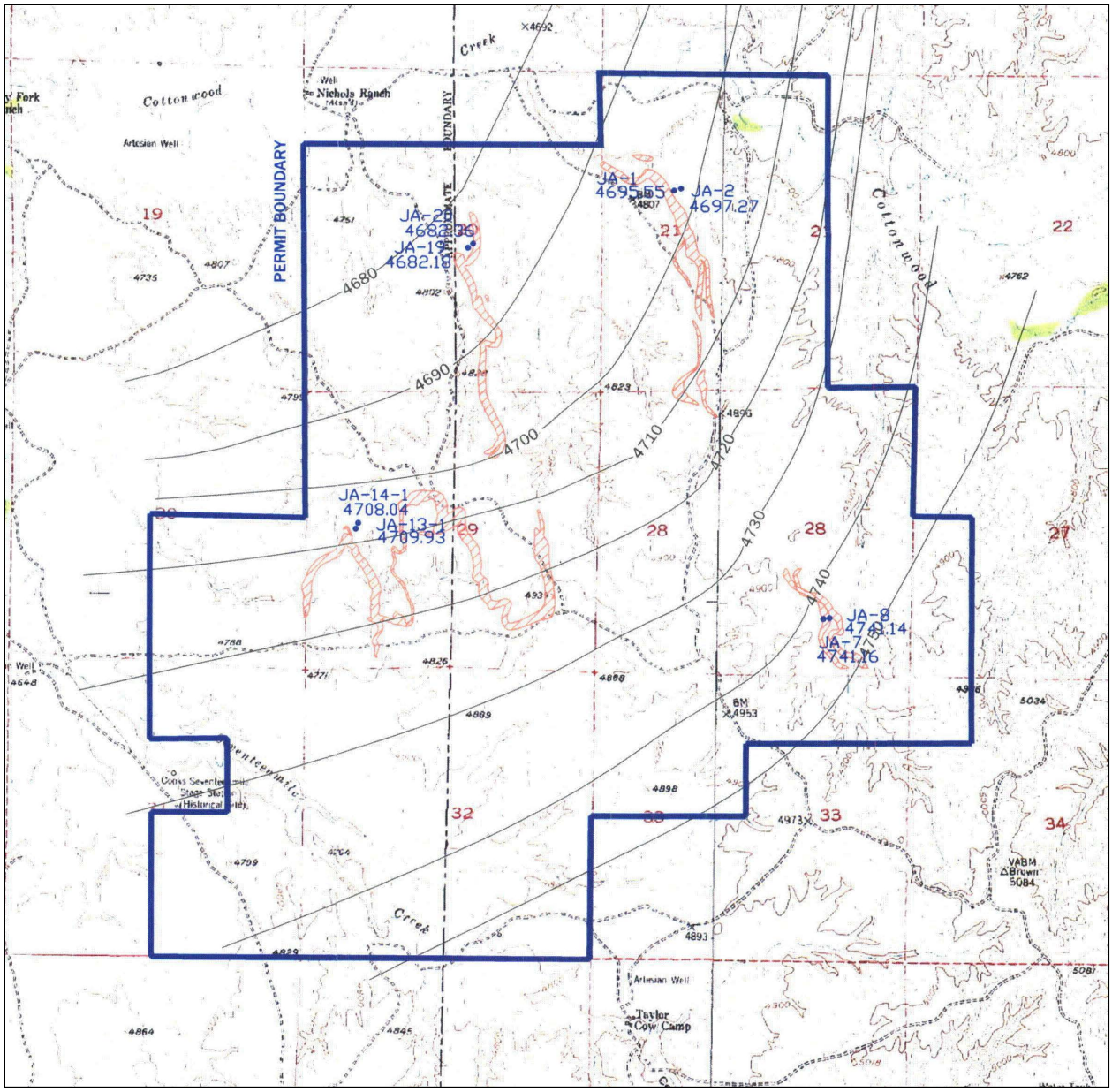

Figure 2. Potentiometric Surface of the Jane Dough Unit A Sand Aquifer in 2013 (elevation in feet, modified from Jane Dough Technical Report Figure JD-D6-5)

porosity of 0.05 and an average hydraulic conductivity of 0.08 m/day (0.25 ft/day), the licensee calculated an average A Sand groundwater flow velocity of 3.7 m/yr (12 ft/yr).

The A1 mudstone serves as the underlying confining unit to the A Sand and is continuous throughout the Jane Dough Unit. The A1 mudstone thickness ranges from approximately 8.8 to 36.6 m (29 to 120 ft). The aquifer that underlies the A Sand is the 1 Sand. The licensee described the 1 Sand as discontinuous, being confined to incised valleys cut into the A1 mudstone and having an approximate thickness ranging from 0 to 22.9 m (0 to 75 ft) as shown in Jane Dough Technical Report Exhibit JD-D5-20, "Jane Dough Unit 1 Sand Isopach." SER Section 5.3, "Groundwater and Surface Water Monitoring Programs," discusses the impacts of the presence or absence of the 1 Sand on the operational groundwater monitoring program. The licensee completed three wells in the 1 Sand. The licensee described the water levels in the URZJ1-6 and J1-23-1 wells as variable over the late 2010 to late 2013 time period. This description is consistent with the acceptance criteria in SRP Section 2.7.3 to assess historical variation.

The NRC staff notes that given the thickness of the A1 mudstone, monitoring of the 1 Sand may not be required throughout much of the Jane Dough Unit. As discussed in SER 5.3.3.1 "Mine Unit Operational Groundwater Monitoring Locations" the licensee does not plan to install monitoring wells in the underlying aquifer (i.e., the 1 Sand) when the thickness of the confining unit that separates the 1 Sand from the production zone is greater than 15.2 m (50 ft) thick. This practice was approved by NRC (2013) for the Nichols Ranch Unit and is consistent with SRP acceptance criterion 5.7.8.3(3).

The licensee stated that the geologic section presented in Exhibit D6-5 of the Nichols Ranch ISR Project Technical Report (Uranerz 2007) is representative of the geologic section for the Jane Dough Unit. This exhibit shows that the next aquifer below the 1 Sand would be located in the Fort Union sands. Based on a review of this exhibit, the NRC staff concludes that the Fort Union Sands appear to be separated from the 1 Sand by a thick shale layer.

Water Use

The licensee reported in Jane Dough Technical Report Appendix JD-D6, "Hydrology," that the limited use of surface water in the Jane Dough Unit is for livestock rather than domestic purposes. Contrary to that stated in Appendix JD-D6, an adjudicated surface water right does exist within 0.8 km (0.5 miles), of the Jane Dough Unit. This water right is located approximately 0.4 km (0.25 miles) west of the southwest corner of the Jane Unit boundary as shown in Jane Dough Technical Report Figure JD-D6-14. A dam is constructed at this location within the Short Draw ephemeral stream to create a reservoir. NRC staff review of the Wyoming e-permit website indicates that the reservoir water is used for stock and irrigation purposes.

This location (Johnson 23-31-4376 Reservoir) has been sampled and as discussed in Jane Dough Technical Report Section 5.7.8.11, "Operational Surface Water Monitoring Program," the licensee has committed to continue to sample this location. Although the licensee omitted this water right from Jane Dough Technical Report Appendix JD-D6, the licensee has accounted for this location within their surface water sampling program and therefore its omission in Appendix JD-D6 is not a safety concern.

In Table JD-D6G.1-1, "Jane Dough Unit Water Wells and Adjacent," of the Jane Dough Technical Report, the licensee provided a list of water wells within 0.8 km (0.5 mi) of the Jane Dough Unit. The majority of the wells listed in Table JD-D6G.1-1 are described as stock wells

or monitoring wells. The licensee reported that there are four domestic wells located within 5 km (3 mi) of the Jane Dough Unit. These wells are Garden Well, Doughstick #3, Dry Fork #1 and URZN2-12 (Uranerz 2014f, Uranerz 2013b). Contrary to that described in Appendix JD-D6, "Hydrology," of the Jane Dough Technical Report, one domestic well is located within 0.8 km (0.5 mi) of the Jane Dough Unit. The permitting for this well, URZN2-12, changed from industrial to domestic uses in 2013.

SER Figure 3 presents the locations of stock wells and domestic wells located within 0.8 km (0.5 mi) and 5 km (3 mi), respectively, of the Jane Dough Unit. Note that wells P1, 01 and T-CHAIR 12-22 are in close proximity and appear as a single symbol on SER Figure 3. Similarly, wells Doughstick #3 and Garden Well appear as a single symbol on SER Figure 3.

The licensee reported that of the wells completed within the Jane Dough Unit, only Pats Well #1 is potentially completed in the A Sand (the ore sand) based on its depth. The licensee reported that it is unclear whether Pats Well #1 is completed in the A or B Sand.

The licensee reported that domestic wells Doughstick #3 and Garden Well are thought to be completed in the A Sand, URZN2-12 is completed below the 1 Sand in the Fort Union Formation and the completion interval for Dry Fork #1 is unknown.

Based on NRC staff review of the Wyoming e-permit database, the average appropriation for the wells presented in SER Figure 3 is less than 38 Lpm (10 gpm).

Pre-operational and operational sampling of stock and domestic wells near the Jane Dough Unit is required by license conditions 12.15 and 11.7 as discussed in SER Sections 2.6.3.8 "Ground Water Sampling" and 5.3.3.6 "Other Sampling", respectively.

Section 7.2.3.1, "Analytical Modeling," of the Jane Dough Technical Report states that surface use agreements are in place between the licensee and nearby landowners to address mitigation measures in the event that drawdown from the operation of the Nichols Ranch ISR Project, which includes the Jane Dough Unit, impacts the use of a landowner's well (Uranerz 2014f).

Single Well Pumping Tests

The licensee conducted single-well pumping tests at eight locations and multi-well pumping tests at five locations across the Jane Dough Unit to determine the hydraulic characteristics of the site aquifers. The licensee conducted the single well tests in several different aquifers while they conducted the multi-well tests all within the A or AB Sands.

Single well tests are conducted to define the local transmissivity (T) and hydraulic conductivity (K) of aquifers. Because single well tests tests do not use observation wells, it is not possible to use the results of single well tests to assess aquifer storativity (S) and the integrity of confining units. The NRC staff's evaluation of the licensee's multi-well pumping tests, where these parameters can be assessed, is described in the next SER section, "Multi-Well Pumping Tests."

The licensee conducted the single well tests at constant pumping rates ranging from 1.1 to 30.3 Lpm (0.3 to 8 gpm) for durations ranging from 2 to 24 hours. SER Table 4 presents the results from the single-well tests. Most tests included collecting test recovery data unless operational problems occurred. NRC staff review of the data for the URZJC-22 test indicates that the measured drawdown in the well is larger at the beginning of the test rather than at the end of the test which is counter to the fundamental concepts of aquifer pumping tests.

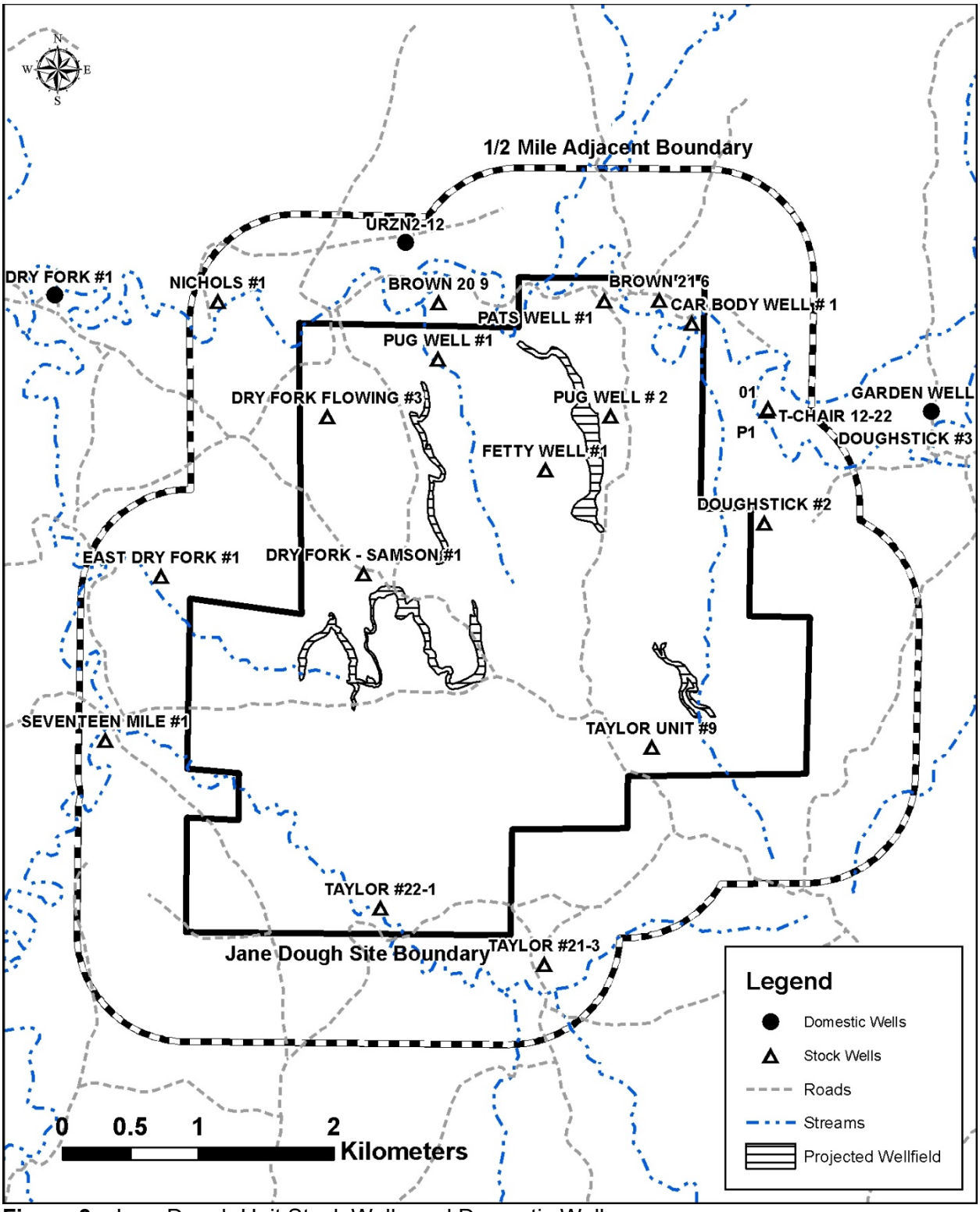

Figure 3. Jane Dough Unit Stock Wells and Domestic Wells

Table 4. Jane Dough Unit Single-Well Pumping Tests

Well	Aquifer Unit	Flow (Lpm) (gpm)	Test Duration (hours)	T (m^2/day) (gal/day/ft)	K (m/day) (ft/day)
URZJF-5	F Sand	3.8 (1)	2	0.38 (31)	0.05 (0.17)
URZJF-5 (2nd test)	F Sand	1.9 (0.5)	4	0.26 (21.3)	0.03 (0.11)
URZJC-22	F Sand	3.8 (1)	5	*	*
URZJC-10	C Sand	1.1 (0.3)	24	0.03 (2.1)	0.003 (0.01)
URZJB-3	AB Sand	30.3 (8)	5	4.5 (361)	0.04 (0.15)
URZJB-9	AB Sand	7.6 (2)	6	0.77 (62)	0.02 (0.05)
URZJB-15	B Sand	12.5 (3.3)	6	0.72 (58)	0.02 (0.05)
URZJB-21	B Sand	3.8 (1)	24	1.43 (115)	0.03 (0.09)
URZJB-12	1 Sand	1.9 (0.5)	24	0.79 (63.8)	0.04 (0.13)
URZJB-12 (2nd test)	1 Sand	3.8 (1)	24	0.24 (19.4)	0.05 (0.16)

Modified from Jane Dough Technical Report Table JD-D6-3
*Results are not reliable

Therefore, the licensee-calculated transmissivity and hydraulic conductivity values at this location should be disregarded.

Multi-Well Pumping Tests

The licensee pumped well URZJA-1 for 2 days at a constant rate of 38 Lpm (10 gpm). The licensee completed the pumping well and two observation wells in the AB sand. Additionally, the licensee monitored one observation well in the overlying F Sand and one observation well in the underlying 1 Sand throughout the test. The overlying and underlying wells showed negligible response to pumping indicating limited communication between the AB sand and the overlying and underlying aquifers. The results of the URZJA-1 test are presented in SER Table 5.

The licensee pumped well URZJA-7 for 1 day at a constant rate of 20.8 Lpm (5.5 gpm). The licensee completed the pumping well and two observation wells in the AB sand. Additionally, the licensee monitored one observation well in the overlying C Sand and one observation well in the underlying 1 Sand throughout the test. The overlying and underlying wells showed negligible response to pumping indicating limited communication between the AB sand and the overlying and underlying aquifers. The results of the URZJA-7 test are presented in SER Table 6.

The licensee pumped well URZJA-8 for 2 days at a constant rate of 16.3 Lpm (4.3 gpm). The licensee completed the pumping well and two observation wells in the AB sand.

Additionally, the licensee monitored one observation well in the overlying C Sand, one observation well in the overlying G Sand and one observation well in the underlying 1 Sand throughout the test. The overlying and underlying wells showed minimal response (less than 0.3 m (1 ft)) response to pumping. The licensee stated that the response in these wells was due to changes in barometric pressure rather that a response to pumping but did not attempt to correct the observation well data for barometric pressure changes. The NRC staff finds the licensee's explanation reasonable, indicating limited communication between the AB sand and

the overlying and underlying aquifers. The results of the URZJA-8 test are presented in SER Table 7.

Table 5. Jane Dough Unit Multi-Well Pumping Test at URZJA-1

Well	Well Type	Distance to pumping well (m) (ft)	Aquifer Unit	T (m^2/day) (gal/day/ft)	K (m/day) (ft/day)	S
URZJA-1	Pumping	0	AB Sand	8.4 (678)	0.08 (0.28)	NA
URJZA-2	Observation	38.7 (127)	AB Sand	8.2 (663)	0.08 (0.27)	2.6E-4
URJZB-3	Observation	25 (82)	AB Sand	11.2 (901)	0.11 (0.37)	8.5E-5

Table 6. Jane Dough Unit Multi-Well Pumping Test at URZJA-7

Well	Well Type	Distance to pumping well (m) (ft)	Aquifer Unit	T (m^2/day) (gal/day/ft)	K (m/day) (ft/day)	S
URZJA-7	Pumping	0	AB Sand	3.3 (267)	0.06 (0.20)	NA
URZJA-8	Observation	34.4 (113)	AB Sand	3.4 (274)	0.06 (0.20)	4.5E-5
URZJB-9	Observation	36.9 (121)	AB Sand	3.2 (259)	0.06 (0.19)	6.3E-4

Table 7. Jane Dough Unit Multi-Well Pumping Test at URZJA-8

Well	Well Type	Distance to pumping well (m) (ft)	Aquifer Unit	T (m^2/day) (gal/day/ft)	K (m/day) (ft/day)	S
URZJA-8	Pumping	0	AB Sand	3.8 (305)	0.07 (0.23)	NA
URZJA-7	Observation	34.4 (113)	AB Sand	3.7 (299)	0.07 (0.22)	4.5E-5
URZJB-9	Observation	25 (82)	AB Sand	3.6 (290)	0.07 (0.22)	2.9E-3

The licensee pumped well URZJA-13-1 for 2 days at a constant rate of 14.4 Lpm (3.8 gpm). The licensee completed the pumping well and one observation well in the A sand. Additionally, the licensee monitored one observation well in the overlying B Sand and one observation well in the overlying F Sand throughout the test. The overlying wells showed negligible response to pumping indicating limited communication between the A sand and the overlying aquifers. The licensee did not address the approximate 0.1 m (0.3 ft) data shift observed in the overlying wells after termination of pumping. The NRC staff observes this data shift is likely an equipment issue rather than a response to pumping cessation. The results of the URZJA-13-1 test are presented in SER Table 8.

The licensee pumped well URZJA-14-1 for 2 days at a constant rate of 15.2 Lpm (4.0 gpm). The licensee completed the pumping well and one observation well in the A sand. Additionally, the license monitored one observation well in the overlying B Sand and one observation well in

the overlying F Sand throughout the test. The overlying wells showed negligible response to pumping indicating limited communication between the A sand and the overlying aquifers. The results of the URZJA-14-1 test are presented in SER Table 9.

Table 8. Jane Dough Unit Multi-Well Pumping Test at URZJA-13-1

Well	Well Type	Distance to pumping well (m) (ft)	Aquifer Unit	T (m^2/day) (gal/day/ft)	K (m/day) (ft/day)	S
URZJA-13-1	Pumping	0	A Sand	0.63 (50.6)	0.05 (0.16)	NA
URZJA-14-1	Observation	34.4 (113)	A Sand	0.48 (38.4)	0.03 (0.10)	1.5E-5

Table 9. Jane Dough Unit Multi-Well Pumping Test at URZJA-14-1

Well	Well Type	Distance to pumping well (m) (ft)	Aquifer Unit	T (m^2/day) (gal/day/ft)	K (m/day) (ft/day)	S
URZJA-14-1	Pumping	0	A Sand	0.67 (53.8)	0.04 (0.14)	NA
URZJA-13-1	Observation	34.4 (113)	A Sand	0.51 (40.9)	0.04 (0.13)	7.8E-6

NRC staff observes that the licensee used established and widely accepted methods to analyze pumping test data and that the results of these tests indicate similar, although slightly lower, hydraulic conductivity values as compared to those measured at the currently licensed Nichols Ranch Unit.

Based on these initial pumping test results, NRC staff concludes that sufficient communication exists across the A and AB Sands (the production zone) and that minimal communication exists between the production zone and the underlying or overlying aquifers in the Jane Dough Unit.

NRC staff notes that the licensee committed to conduct additional pumping tests at proposed wellfield locations as described in Jane Dough Technical Report Section 5.7.8.3, “Production Area Pump Test.” The results of these additional tests will be reviewed by NRC staff as described in revised license condition 10.8 of Source Material License SUA-1597 and SER Section 5.3.3.5, “Wellfield Testing.”

In addition to pumping tests, the licensee evaluated the potential for communication between the ore zone and overlying and underlying aquifers in the Jane Dough Unit using site water level data and also presented measurements of aquitard permeability from nearby sites.

In Jane Dough Technical Report Appendix JD-D6, “Hydrology,” the licensee reported an upward gradient from the A to the B Sand of 0.15 m/m (0.15 ft/ft) at well URZJA-20. At this same location, the licensee reported an upward gradient of 0.24 m/m (0.24 ft/ft) from the 1 Sand to the A Sand.

In Jane Dough Technical Report Table JD-D6-4, “Summary of Aquitard Properties at North Butte, Ruth and Ruby,” the licensee reported that measured and estimated vertical permeabilities of the aquitards near the license area ranged from 1.0E-7 to 1.5E-9 cm/s (3.3E-9 to 4.9E-11 ft/s), which are sufficient to minimize vertical movement of water.

The NRC staff concludes that the presence of the vertical gradient across the overlying and underlying aquitards, the low vertical permeabilities, and lack of response in the overlying and underlying aquifers during pumping tests demonstrate confinement of the ore zone by the overlying and underlying aquitards in the Jane Dough Unit.

Coal Bed Methane

The licensee reported that coal bed methane (CBM) production has been underway in the Power River Basin for more than 15 years and occurs in the Jane Dough Unit. CBM production involves pumping water from coal seams which could potentially effect water levels in the overlying ore sands. The top of the CBM production zone in the Jane Dough Unit is located approximately 204 m (670 ft) below the base of the "A sand" ore zone. The licensee reported that CBM wells typically produce approximately114 Lpm (30 gpm) initially, then production rates significantly decrease with time.

Based on the licensee's comprehensive analysis of BLM-measured drawdowns in sands that overlie the CBM zone near the license area and the development of a highly generalized groundwater flow model of the site using 13 layers stressed with CBM production over 20 years, the licensee provides reasonable assurance that the drawdown in the CBM zone will not impact water levels in the overlying ore zone unless there are artificial hydraulic connections, that may allow water to move from one unit to another. The licensee used the same modeling approach to demonstrate that CBM production would not impact ore sands in the Nichols Ranch Unit which NRC staff previously reviewed and found acceptable (NRC 2011a).

The licensee investigated the potential for the presence of artificial hydraulic connections, such as old improperly abandoned wells, between coal seams and overlying ore sands. It identified several exploratory borings and permitted wells that exceed depths of 244 m (800 ft) in and around the Jane Dough Unit as shown on Jane Dough Technical Report Figure JD-D6-11, "Deep Wells & Drill Holes Near Nichols Ranch Permit." The licensee reported that in Jane Dough Technical Report Section JD-D6.2.3, "Coal Bed Production Effects on Water Levels," that the only exploration boring or well to extend to the first major coal seam is drill hole CC-4-6. The licensee stated that this drill hole is located within the Hank Unit, over 6.4 km (4 mi) from the Jane Dough Unit license boundary, and because of its location should not be a concern relative to ISR operations conducted at the Jane Dough Unit.

The licensee reported that they did not identify any open historic drill holes from visual inspections conducted during drilling operations in the Jane Dough Ranch Unit. Additionally, the licensee stated that there has not been any evidence of a hydraulic connection between aquifers during pumping tests or in reviews of historic versus current water levels. The licensee noted that historic drill holes were abandoned and released by the WDEQ, so it can be assumed that they were properly abandoned according to the rules and regulations in place at the time. NRC staff agrees with the licensee's assessment.

As discussed earlier in this section the measured water level data indicates that there is an upward gradient between the 1 Sand and A Sand. This data indicates that current CBM operations, which occur below the production zone, have not induced downward vertical gradients that could result in vertical excursions.

In addition, as described in WDEQ's Guideline No. 4, "In Situ Mining Noncoal," the licensee is required to provide an annual report that includes updated potentiometric surface maps for all

aquifers that are or may be affected by the mining operation (WDEQ 2013c). These updated potentiometric surface maps would alert the licensee and State regulators of changes in vertical gradients such that corrective actions could be taken.

2.4.4 Evaluation Findings

The NRC staff has completed its review of the hydrologic site characterization information for the proposed Jane Dough Unit. During the review, the staff determined that the applicant has acceptably described the surface water hydrology by providing the following:

- the location of the drainages in and around the license area
- peak flood estimates for appropriate recurrence intervals for all drainages
- a description of historical and current CBM-produced water discharges in and around the license area
- acceptable erosion protection against the effects of flooding from all drainages in and around the license area

The applicant has acceptably described the ground water hydrology by providing the following:

- a description of the regional hydrogeology
- a description of the overlying aquifer, extraction zone, and underlying aquifer hydrogeology using potentiometric surfaces maps with acceptable contour intervals based on an appropriate number of monitoring wells
- vertical gradients and pumping test data to evaluate the integrity of the confining layers and initially assess hydraulic parameters
- water level data to evaluate the seasonal variability
- locations of groundwater stock and domestic wells in vicinity of the license area

Based on its review of the information provided by the licensee, as supplemented by information to be collected in accordance with revised license condition 10.8 (described in SER Section 5.3.3.5), the staff concludes that the information meets the applicable acceptance criteria of SRP Section 2.7.3 and the requirements of 10 CFR 40.41(c).

2.5 Background Surface Water and Ground Water Quality

This section describes the NRC staff's evaluation of the licensee's description of the background surface water and ground water quality at the Jane Dough Unit. The licensee provided information on the background surface water and ground water quality of the Jane Dough Unit in Appendix JD-D6, "Hydrology," and Addendum JD-D6E, "Ground-Water Quality," of the Jane Dough Technical Report (Uranerz 2014f). This information is needed to provide a basis for evaluating potential effects of ISR operations on the quality of local groundwater and surface water resources.

2.5.1 Regulatory Requirements

The staff determines if the licensee has demonstrated that the characterization of surface and ground water quality at the Jane Dough Unit has been performed to meet the requirements of 10 CFR Part 40, Appendix A, Criterion 7.

2.5.2 Regulatory Acceptance Criteria

The Jane Dough Technical Report was reviewed for compliance with the applicable requirements of 10 CFR Part 40, Appendix A, Criterion 7, using the acceptance criteria outlined in SRP Section 2.7.3, “Acceptance Criteria” (NRC 2003).

2.5.3 Staff Review and Analysis

The following sections include the NRC staff’s evaluation of the background surface water and ground water quality within the proposed Jane Dough Unit.

2.5.3.1 Surface Water

The licensee reported water quality data for 3 streams and 13 surface water impoundments within and near the Jane Dough Unit. The licensee reported that the steams in the Jane Dough Unit project area were ephemeral and therefore only limited data could be collected. The stream sampling points include two locations on Cottonwood Creek and one location within Seventeen Mile Creek. The Cottonwood Creek sampling locations are in the northern portion and west of the Jane Dough Unit while the Seventeen Mile Creek sampling point is in the southwestern portion of the Jane Dough Unit as shown in Figure JD-D6-1, “Surface Drainage Areas,” of the Jane Dough Technical Report (Uranerz 2014f). The data provided for the Cottonwood Creek locations were collected in 2008. Seventeen Mile Creek was sampled three times from 2011 to 2013. SER Table 10 presents the stream sampling results. Seventeen Mile Creek was sampled via a passive self-sampler designed to collect ephemeral stream flow. The licensee reported an additional self-sampler is located within Cottonwood Creek, however no sample has been collected at that location.

The sampled surface water impoundments were constructed to hold groundwater removed from approximately 244 meters (800 ft) below ground surface by coal bed methane (CBM) operations.

CBM discharge is regulated by the Wyoming Department of Environmental Quality. CBM discharge effluent limits are presented in Table 2-12f, “WYPDES Effluent Limitations for Permits within One Mile of the Jane Dough Unit Project,” of the Jane Dough Technical Report (Uranerz 2014f).

Review of Figure JD-D6-1, “Surface Drainage Areas,” and Figure 3-8C, “Proposed Monitor Well Locations,” of the Jane Dough Technical Report (Uranerz 2014f) indicates that of the 13 impoundments sampled, only JD RES 29-2 is located within a planned wellfield area. JD RES 29-2 was sampled five times from 2010 to 2012. SER Table 10 presents the sampling results for the 3 streams and impoundment JD RES 29-2. Addendum JD-D6, “Hydrology,” of the Jane Dough Technical Report (Uranerz 2014f) presents all available surface water quality data for the Jane Dough Unit.

Most samples were analyzed for the analytes listed in SRP Table 2.7.3-1, “Typical Baseline Water Quality Indicators to be Determined During Pre-operational Data Collection,” except for silver, alkalinity, gross alpha and gross beta. Section 2.7.3, “Acceptance Criteria,” of NUREG-1569 (NRC, 2003a) states that a reasonably comprehensive suite of chemical and radiochemical analyses of pre-operational water quality be obtained. NRC staff finds the analyte list for surface water samples sufficient and consistent with the acceptance criteria presented in Section 2.7.3, “Acceptance Criteria,” of NUREG-1569 (NRC, 2003a).

SER Table 10 presents the measured surface water quality parameters for the four locations discussed above. An analysis by the NRC staff indicated the following:

- Surface water quality measured at the Cottonwood Creek Downstream (Cottonwood Creek D) location in 2008 exceeded the Wyoming Class I (domestic use) and U.S. Environmental Protection Agency (EPA) secondary drinking water standard for iron.

- The Cottonwood Creek Upstream (Cottonwood Creek U) location exceeded Wyoming Class I and EPA primary and secondary drinking water standards for total dissolved solids (TDS), sulfate, uranium, Ammonia as Nitrogen and manganese in 2008.

- The Seventeen Mile Creek location exceeded Wyoming Class I and EPA primary and secondary drinking water standards for pH, Ammonia as Nitrogen, iron and manganese.

- JD RES 29-2 exceeded Wyoming Class I and EPA primary and secondary drinking water standards for pH and TDS.

In the NRC staff's analysis above, the description of exceedances of surface water quality indicators and drinking water standards are used only as points of reference and are meant to establish a pre-operational baseline for comparison with future sample results obtained from the operational environmental monitoring program. Other authorities, such as the Wyoming Department of Environmental Quality, regulate surface water quality. The licensee has committed in Section 5.7.8.11, "Operational Surface Water Monitoring Program," of the Jane Dough Technical Report (Uranerz 2014f) to continue the sampling of these locations after operations begin if water is present. SER Section 5.3, "Ground Water and Surface Water Monitoring Programs," further discusses operational data collection.

2.5.3.2 Groundwater

This section describes the preoperational ground water quality monitoring that was conducted as part of the initial site characterization of the license area. SER Section 5.3, "Ground Water and Surface Water Monitoring Programs," discusses an evaluation of the programs for baseline ground water monitoring, which takes place as part of well field development and operational ground water monitoring. SER Section 6.1, "Plans and Schedules for Ground Water Quality Restoration," addresses restoration monitoring, which is conducted during ground water restoration.

In Addendum JD-D6E, "Ground-Water Quality," of the Jane Dough Technical Report (Uranerz 2014f) the license reported preoperational groundwater quality data for overlying, underlying and ore zone aquifers as part of the initial site characterization of the Jane Dough Unit.

Jane Dough Technical Report Table JD-D6-2, "Basic Well Data for Jane Dough Unit," presents well coordinate and completion information (including, for example, the zone the well is completed in; e.g. "A Sand") for the sampled groundwater wells. Exhibit JD-D6-1, "Jane Dough Unit Water Wells – 3 Mile Radius," of the Jane Dough Technical Report (Uranerz 2014f) presents the locations of the sampled wells.

Table 10. Jane Dough Unit Surface Water Quality Parameters

Water Quality Parameter	Sample Location			
	Cottonwood Creek U Nichols	Cottonwood Creek D Nichols	Seventeen Mile Creek	Reservoir JD 29-2
Bicarbonates as HCO3 (mg/L)	245	148	103	1300
Carbonates as CO3(mg/L)	<1	<1	<5	78
Alkalinity (mg/L)	NR	NR	93	NR
Chloride (mg/L)	18	<1	2.3	7
Conductivity (umhos/cm)	NR	NR	233	2219
Fluoride (mg/L)	0.2	<0.1	0.1	1.2
pH	NR	NR	**6.3**	**8.6**
Total Dissolved Solids (mg/L)	**1880**	197	183	**1336**
Total Suspended Solids (mg/L)	NR	NR	NR	NR
Sulfate (mg/L)	**1030**	12	39	62
Radium-226 (pCi/L)	0	-0.1	0.25	0.35
Nitrogen, Ammonia as N (mg/L)	**0.7**	<0.1	**0.52**	0.18
Nitrogen, Nitrate+Nitrite as N (mg/L)	0.1	<0.05	<0.1	1.2
Aluminum (mg/L)	<0.1	0.2	<0.1	<0.1
Arsenic (mg/L)	0.003	0.004	0.003	0.002
Barium (mg/L)	<0.1	<0.1	<0.1	0.7
Boron (mg/L)	0.1	<0.1	<0.1	0.2
Cadmium (mg/L)	<0.005	<0.005	<0.005	<0.005
Calcium (mg/L)	141	22	32	25
Chromium (mg/L)	<0.05	<0.05	<0.05	<0.05
Copper (mg/L)	<0.01	<0.01	<0.01	<0.01
Iron (mg/L)	0.19	**0.57**	**0.41**	0.07
Lead (mg/L)	<0.001	0.001	<0.001	0.001
Magnesium (mg/L)	77	5	6	32
Manganese (mg/L)	**0.36**	0.05	**0.1**	0.01
Mercury (mg/L)	<0.001	<0.001	<0.001	<0.001
Molybdenum (mg/L)	<0.1	<0.1	<0.1	0.1
Nickel (mg/L)	<0.05	<0.05	<0.05	<0.05
Potassium (mg/L)	27	13	9	31
Selenium (mg/L)	0.001	0.002	0.001	<0.001
Sodium (mg/L)	288	18	6.3	472
Uranium (mg/L)	**0.137**	0.0009	0.0013	0.0005
Vanadium (mg/L)	<0.1	<0.1	<0.1	<0.1
Zinc (mg/L)	0.01	<0.01	0.013	0.012

Bold indicates an exceedance of Wyoming Class I or EPA primary of secondary standards
The values in the above table represent averages if multiple samples were taken.

The licensee conducted a range of chemical and radiochemical analyses of the groundwater samples including those listed in SRP Table 2.7.3-1, "Typical Baseline Water Quality Indicators to be Determined During Pre-operational Data Collection," except for silver and alkalinity. Generally, four sampling events were conducted over a period of 1 to 2 years at each well. Section 2.7.3, "Acceptance Criteria," of NUREG-1569 (NRC, 2003a) states that a reasonably comprehensive suite of chemical and radiochemical analyses of pre-operational water quality be obtained. NRC staff finds the analyte list for the groundwater samples sufficient and consistent with the acceptance criteria presented in Section 2.7.3, "Acceptance Criteria," of NUREG-1569 (NRC, 2003a).

SER Table 11 presents the measured groundwater quality parameters for the four aquifer zones of principal interest to the Jane Dough Unit. An analysis of the submitted data by the NRC staff indicated the following:

- The average A Sand concentrations of radium-226 and gross alpha exceed the EPA primary drinking water standards and Wyoming Class I standards. The average pH values exceed the EPA secondary drinking water standard and Wyoming Class I standard. The major A Sand ions include: sodium, sulfate and bicarbonate.

- The average B Sand concentration for Uranium exceeds the EPA primary drinking water standard. The average gross alpha concentration exceeds the EPA primary drinking water standard and Wyoming Class I standard. The major B Sand ions include: sodium, sulfate and bicarbonate.

- The average F Sand concentration for uranium exceeds the EPA primary drinking water standard. The average radium-226 and gross alpha concentrations exceed the EPA primary drinking water standards and Wyoming Class I standards. The average TDS, Sulfate and Manganese concentrations exceed the EPA secondary drinking water standards and Wyoming Class I standards. The major F Sand ions include: sodium, calcium, sulfate and bicarbonate.

- The average 1 Sand concentration exceeds the EPA secondary standard and Wyoming Class I standard for pH. The major 1 Sand ions include: sodium and bicarbonate.

- With regard to gross beta concentrations in groundwater, the maximum contaminant level (MCL) for beta particle and photon radioactivity applies to the average annual concentration of beta particle and photon radioactivity from man-made radionuclides in drinking water (40 CFR 141.66(d)). Specifically, the average annual concentration of beta particle and photon radioactivity from man-made radionuclides must not produce an annual dose equivalent to the total body or any internal organ greater than 4 millirem per year. The NRC staff evaluated the licensee's measurements of gross beta concentrations in groundwater and determined the gross beta concentrations can be accounted for by concentrations in groundwater of naturally-occurring radionuclides such as potassium-40 and radium-226, rather than man-made radionuclides. Therefore, the 4 millirem per year MCL for beta particle and photon radioactivity is not exceeded.

Table 11. Jane Dough Unit Ground Water Quality Parameters

Water Quality Parameter	Sample Location			
	"F Sand" Overlying Aquifer	"B Sand" Overlying Aquifer	"A Sand" Ore Zone Aquifer	"1 Sand" Underlying Aquifer
Bicarbonates as HCO3 (mg/L)	149	146	147	234
Carbonates as CO3(mg/L)	7	6	9	16
Chloride (mg/L)	7	6	9	4
Conductivity (umhos/cm)	1773	559	555	429
Fluoride (mg/L)	0.2	0.2	0.3	0.6
pH (s.u.)	8.1	8.5	**8.8**	**9.1**
Total Dissolved Solids (mg/L)	**1381**	350	350	253
Sulfate (mg/L)	**832**	131	114	2
Radium-226 (pCi/L)	**53.6**	0.1	**25.5**	0.1
Nitrogen, Ammonia as N (mg/L)	0.08	0.05	0.05	0.06
Nitrogen, Nitrate+Nitrite as N (mg/L)	0.7	0.1	0.1	0.1
Aluminum (mg/L)	0.1	0.1	0.1	0.1
Arsenic (mg/L)	0.001	0.003	0.002	0.001
Barium (mg/L)	0.1	0.1	0.1	0.1
Boron (mg/L)	0.11	0.1	0.1	0.1
Cadmium (mg/L)	0.005	0.005	0.005	0.005
Calcium (mg/L)	163	11	10	5
Chromium (mg/L)	0.05	0.048	0.049	0.05
Copper (mg/L)	0.01	0.01	0.01	0.01
Iron (mg/L)	0.2	0.03	0.03	0.16
Lead (mg/L)	0.001	0.001	0.001	0.001
Magnesium (mg/L)	30	1	1	1
Manganese (mg/L)	**0.097**	0.01	0.011	0.01
Mercury (mg/L)	0.001	0.001	0.001	0.001
Molybdenum (mg/L)	0.1	0.096	0.097	0.1
Nickel (mg/L)	0.05	0.048	0.049	0.05
Potassium (mg/L)	14	4	5	3
Selenium (mg/L)	0.011	0.001	0.001	0.002
Sodium (mg/L)	209	108	108	96
Uranium (mg/L)	**0.073**	**0.04**	0.024	0.0
Vanadium (mg/L)	0.1	0.1	0.1	0.1
Zinc (mg/L)	0.02	0.01	0.01	0.01
Gross Alpha (pCi/L)	**290.9**	**45.6**	**153.2**	-1.2
Gross Beta (pCi/L)	79.7	11.8	75.7	1.9

Bold indicates an exceedance of Wyoming Class I or EPA primary of secondary standards.
The information in this table was obtained from Jane Dough Technical Report, Table JD-D6-6 (Uranerz 2014f).

2.5.4 Evaluation Findings

The licensee described the background surface water and groundwater quality at the Jane Dough Unit by providing appropriate chemical and radiochemical analyses of water samples taken from surface drainages and aquifers within and away from mineralized zones.

The NRC staff finds the licensee's approach to water quality characterization at the Jane Dough Unit consistent with that NRC staff previously reviewed and approved for the Nichols Ranch Unit (NRC 2011a). Additionally, the NRC staff finds that the analytical results presented for the Jane Dough Unit are consistent with the applicable results presented for the Nichols Ranch Unit (e.g., the "A Sand" at both units).

Based on the review described above, the NRC staff concludes that the information provided in the Jane Dough Technical Report, meets the applicable acceptance criteria of SRP Section 2.7.3, "Acceptance Criteria," and the requirements of 10 CFR Part 40, Appendix A, Criterion 7.

2.6 Background Radiological Characteristics

This section describes the NRC staff's evaluation of the licensee's description of the background radiological characteristics at the Jane Dough Unit. The licensee provided information on the background radiological characteristics of the Jane Dough Unit in Section 2.9, "Background Radiological Characteristics," and Appendix JD-D11, "Radiology," of the Jane Dough Technical Report (Uranerz 2014f). Background radiological characteristics are used to evaluate the potential radiological impact of operations on human health and the environment. Such impacts could result from spills, routine discharges from operations, and other potential releases to the environment. In addition, the data collected are used to identify a radiological baseline for decommissioning, restoration, and reclamation.

2.6.1 Regulatory Requirements

The staff determines if the licensee has demonstrated that the background radiological characteristics or the preoperational environmental monitoring program is in compliance with 10 CFR Part 40, Appendix A, Criterion 7.

2.6.2 Regulatory Acceptance Criteria

The Jane Dough Technical Report was reviewed for compliance with the applicable requirements of 10 CFR Part 40, Appendix A, Criterion 7, and using the acceptance criteria presented in SRP Section 2.9.3, "Acceptance Criteria" (NRC 2003). Also, as discussed in Regulatory Guide 4.14, "Radiological Effluent and Environmental Monitoring at Uranium Mills" (NRC 1980), the preoperational monitoring program should include at least 12 consecutive months of data, in accordance with 10 CFR Part 40, Appendix A, Criterion 7, including the submittal of complete soil sampling, direct radiation, and radon flux data, prior to any major site construction.

2.6.3 Staff Review and Analysis

The licensee provided background radiological characteristics for the Jane Dough Unit in Section 2.9, "Background Radiological Characteristics," and Appendix JD-D11, "Radiology," of the Jane Dough Technical Report. The licensee measured radionuclide concentrations in the

following environmental media: air, flora and fauna, surface soil, subsurface soil, and sediment. The licensee's measurements of radionuclides in air included both particulate matter radionuclides and gaseous radon-222. The licensee also assessed gamma radiation levels in the Jane Dough Unit environment by taking instantaneous measurements of radiation exposure rates in air and quarterly measurements of total exposure.

2.6.3.1 Air Sampling (Particulate and Radon-222)

As part of its pre-operational monitoring program, the licensee sampled particulate matter radionuclides (uranium, thorium-230, radium-226 and lead-210) and radon-222 at seven locations on a quarterly frequency from July 2010 through September 2011 (i.e., five quarters). Five pre-operational air sampling locations were inside the Jane Dough Unit. A sixth pre-operational air sampling location was outside the Jane Dough Unit near a residence at Dry Fork Ranch. A seventh location was upwind outside the eastern boundary of the Jane Dough Unit. The air sampler locations are shown in Exhibit JD-D11-2, "Radiological Sample Location," of the Jane Dough Technical Report. The sampling method (e.g., description of air sampling equipment) and background results for the Nichols Ranch and Hank Units (Uranerz 2007) were previously reviewed and found acceptable by the NRC staff (NRC 2011a).

The number of air samplers and numbers of samples from the pre-operational air sampling locations is acceptable because Regulatory Position C.1.1.1, "Air Samples," of Regulatory Guide 4.14, "Radiological Effluent and Environmental Monitoring at Uranium Mills" (NRC 1980), states the minimum pre-operational samples should be four quarters at three locations at or near the site boundary, one location near a residence or occupiable structure, and another at a remote location that represents background (e.g., upwind).

As shown in Exhibit JD-D11-2, "Radiological Sample Location," of Appendix JD-D11, the licensee's pre-operational air samplers in the Jane Dough Units were located as follows:

JD-01: Outside the licensed area, 1.6 km (1 mi) east of the nearest ore body
JD-02: Inside the Jane Dough licensed area, southeast corner
JD-03: Inside the Jane Dough licensed area, northeast corner
JD-04: Inside the Jane Dough licensed area, southwest corner
JD-05: Inside the Jane Dough licensed area, central
JD-06: Inside the Nichols Ranch licensed area, near boundary with Jane Dough
JD-07: Dry Fork Ranch, nearest resident near northwest corner of Jane Dough

To evaluate the locations of the air samplers, NRC staff examined the wind roses presented in Figure 2-10b, "Wind Rose Comparison, Baseline (Year 1) and Year 2 for the Jane Dough Unit." of the Jane Dough Technical Report and the joint frequency distribution provided in Appendix JD-D11-A, "MILDOS Report." The Figure 2-10b wind roses are based on on-site meteorological data collected after the pre-operational air samples were collected. The wind roses and joint frequency distribution indicate a prevailing light wind from the east (i.e., 15.1% of the time, as compared to <10.2% from all other directions), which is often very stable (i.e., 7.7% of the east winds are atmospheric stability Class E or Class F). These stable east winds would result in the highest downwind concentrations of radionuclides in areas west of the Jane Dough well fields. Since none of the pre-operational air sampling locations were located west of the Jane Dough well fields, NRC sent RAI 2.9-2 requesting that the licensee revise Section 2.9 of its Jane Dough Technical Report to address changes in the operational monitoring program required as a result of new information about on-site prevailing wind directions (NRC 2016a). In its response, the licensee provided a modified Exhibit JD-D11-2, "Radiological Sample

Location," showing the revised locations of operational air sampling stations (Uranerz 2016a). In the operational air sampling program, air sampler location JD-04 will be re-located to the site boundary location west of the ore bodies in the southern ends of Production Areas 1 and 2. Air sampler location JD-05 will be re-located to the site boundary location west of the ore bodies in the northern ends of Production Areas 1 and 2. Finally, air sampler location JD-06 will be re-located north and north-north-west of Production Areas 1 and 2. All three of these samplers will be located downwind at the site boundary. The NRC staff finds these new locations acceptable because they meet the criteria in Regulatory Position C.2.1.2, "Air Samples," of Regulatory Guide 4.14, for a minimum of three locations at or near the site boundary; one location near an residence, and; a remote location representing background conditions. These are not the same locations used for pre-operational air samples, but since pre-operational air samples are not actually used in the operational environmental monitoring program to compare to operational air samples, or for any other purpose, the NRC staff finds acceptable the licensee's commitment in Section 2.9.3.2, "Survey Methodology," of the Jane Dough Technical Report for two additional quarters of data at the new locations (Uranerz 2014f).

The NRC staff evaluated the pre-operational sample results by plotting the results on charts and examining the data for unusual or unexpected temporal or spatial trends. These trend charts are presented in SER Figures 4 through 8 below. Radon-222 concentrations show no discernable spatial trend and vary from lows around 0.3 pCi/L in the winter (1st Q 2011) to highs around 0.6 pCi/L to 1.2 pCi/L in the fall (3rd Q 2011). This is normal, because frozen soil and snow attenuates radon-222 emanation in the winter and low precipitation, dry soil, and elevated temperatures in the summer and early fall cause radon-222 diffusion and emanation rates to increase. As expected, lead-210, a long-lived progeny of radon-222, is detectable at low and variable concentrations consistent with changes in regional radon-222 concentrations. Radium-226, thorium-230 and uranium are generally associated with mill tailings, which are not present either at the Nichols Ranch ISR Project or any nearby facility.

Based on the review described above, the NRC staff concludes that the information provided in the Jane Dough Technical Report meets the applicable acceptance criteria of SRP Section 2.9.3, and the requirements of 10 CFR Part 40, Appendix A, Criterion 7.

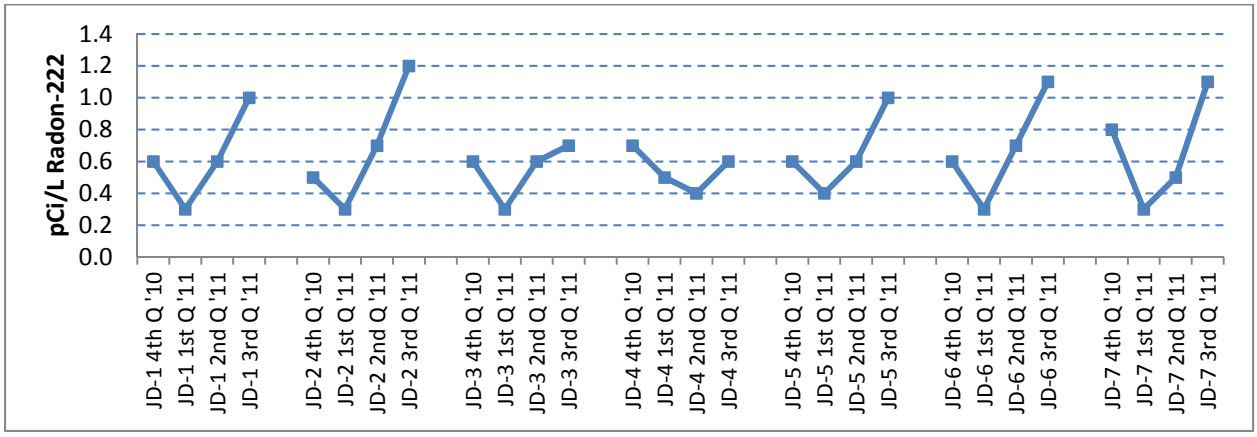

Figure 4. Jane Dough Unit preoperational Radon-222 concentrations in air

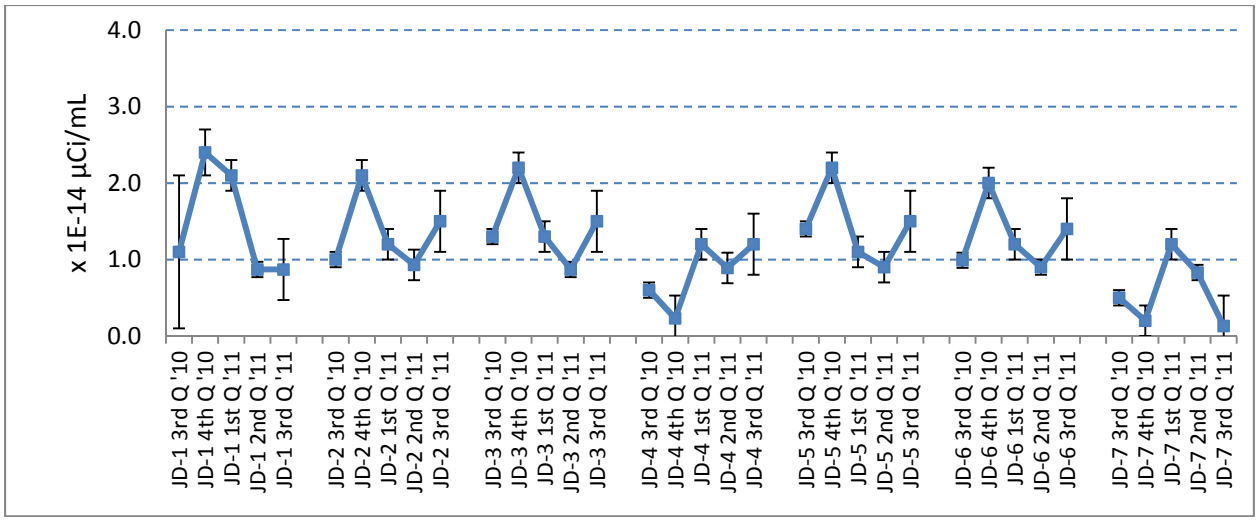

Figure 5. Jane Dough Unit preoperational Lead-210 concentrations in air

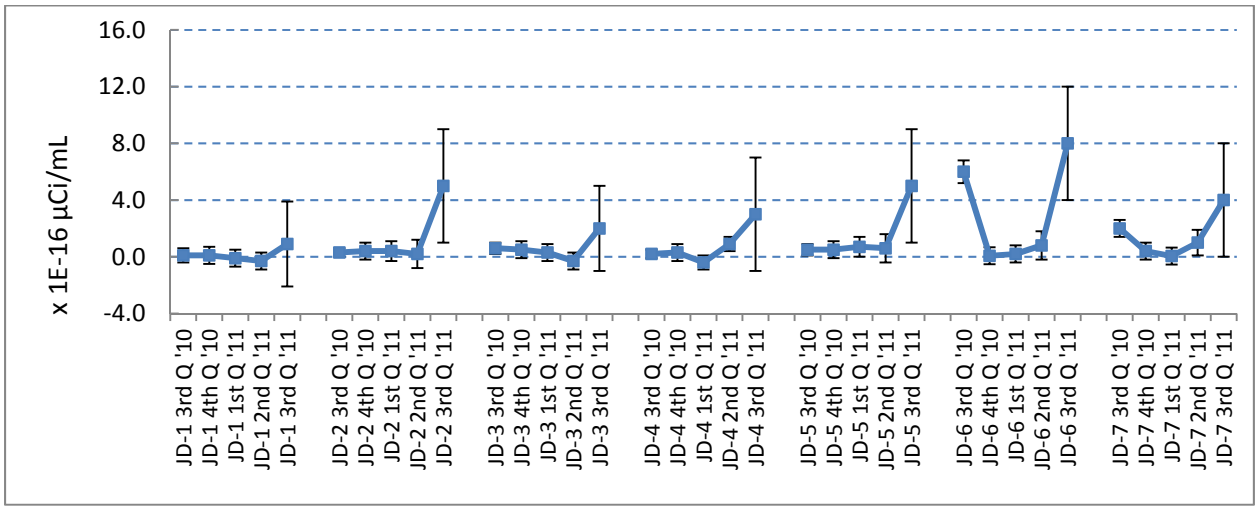

Figure 6. Jane Dough Unit preoperational Radium-226 concentrations in air

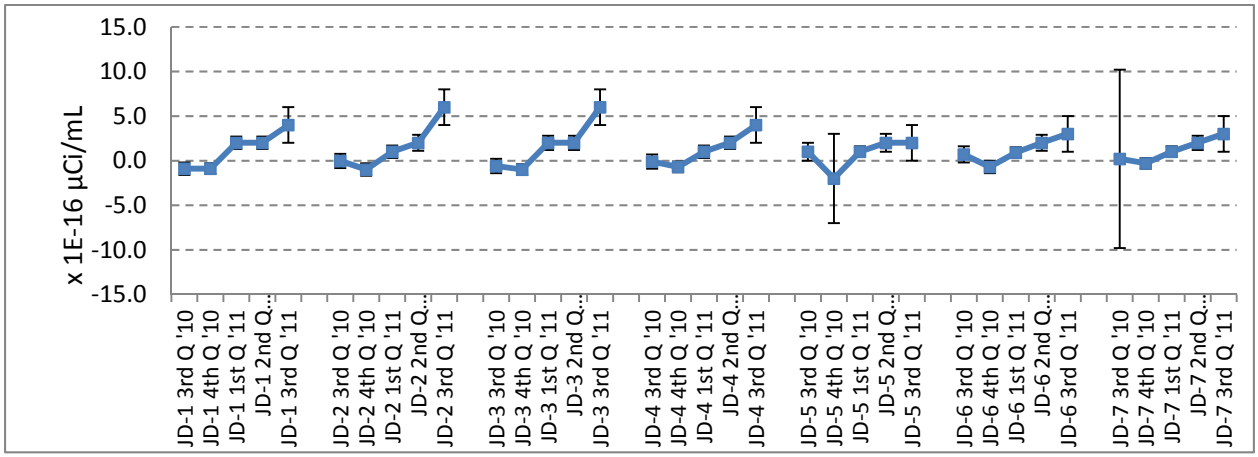

Figure 7. Jane Dough Unit preoperational Thorium-230 concentrations in air

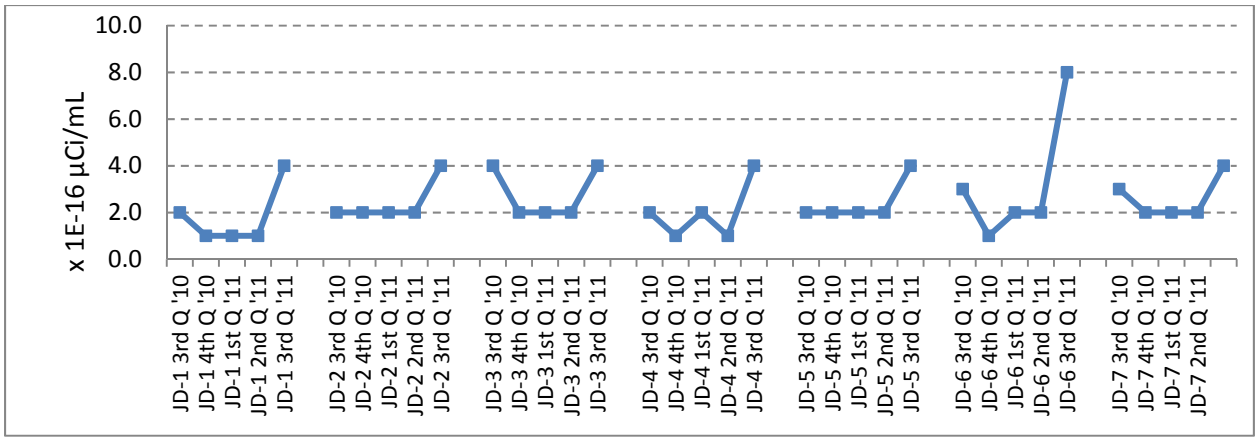

Figure 8. Jane Dough Unit preoperational Uranium concentrations in air

2.6.3.2 Radon Flux Monitoring

Regulatory Guide 4.14 (NRC 1980) recommends that radon flux measurements be conducted at eight locations within 1.5 km (0.9 mi) of the site. The licensee indicated that, because there are no tailing impoundments or evaporation ponds at the Nichols Ranch ISR Project, radon flux surveys are not applicable for background radiological characterization. The staff agrees that there are no tailing impoundments and evaporation ponds and concludes that radon flux measurements are not required.

2.6.3.3 Vegetation, Crop and Fish Sampling

As noted in the NRC's safety evaluation for the Nichols Ranch ISR Project (NRC 2011a), the licensee has developed a background sampling program which is modified from the guidance in Regulatory Guide 4.14 (NRC 1980) and which includes vegetation and grazing samples, but not fish and crop sampling. Because there are no nearby surface waters or crop land at the Nichols Ranch ISR Project, the NRC staff previously found this acceptable (NRC 2011a). This remains acceptable for the Jane Dough license amendment because there remain no nearby surface waters or crop land to the proposed Jane Dough Unit.

The licensee collected vegetation and grazing samples from all seven air sampler locations in the Jane Dough Unit (i.e., JD-01 through JD-07) and two additional browsing and grazing areas (i.e., Random-1 and Random-2). The results summarized in SER Table 12 indicate that lead-210 is present in vegetation in concentrations above the levels of radium-226, thorium-230, and uranium. This is expected because lead-210 is a naturally-occurring radionuclide which is present in both the root zone of the plants and in the atmosphere (see SER Figure 5 above), from which it deposits directly on vegetation and is absorbed.

Table 12. Comparison of Vegetation Sampling Average Results (pCi/kg)

Radionuclide	Jane Dough	Nichols Ranch	Hank
Uranium	53.2	119	32.5
Thorium-230	14.1	41.3	16.1
Radium-226	11.2	187	70.0
Lead-210	460	542	388

Based on the review described above, the NRC staff concludes that the information provided in the Jane Dough Technical Report meets the applicable acceptance criteria of SRP

Section 2.9.3, “Acceptance Criteria,” and the requirements of 10 CFR Part 40, Appendix A, Criterion 7.

2.6.3.4 Direct Radiation Monitoring

The NRC previously evaluated the licensee’s methods for direct radiation monitoring (Uranerz 2007) and found these methods acceptable (NRC 2011a). For the Jane Dough Unit, the licensee deployed the same Landauer X9 environmental dosimeters used to characterize the background in the Nichols Ranch Unit and Hank Unit. The dosimeters were deployed at each of the air sampler locations (i.e., JD-01 through JD-07) for each of four consecutive calendar quarters from July 2010 through June 2011. The first 3 quarters of results for Jane Dough are consistent with earlier results for Nichols Ranch and Hank. However, the NRC staff observed that results for the 2nd quarter 2011 (i.e., April through June 2011) averaged 11.3 mrem per quarter, which is well below the range of observed values for other quarters for the Jane Dough Unit, which is a minimum of 30.8 mrem (3rd Q 2010 at location JD-4) to a maximum of 49.4 mrem (4th Q 2010 at location JD-6). The licensee initially characterized this quarter as approximately 72% lower than the average of the other three quarters and as “somewhat low,” and it didn’t provide a credible explanation for the low values. The staff issued RAI 2.9-1 requesting that the licensee either explain the anomalous values or remove them from the Jane Dough Technical Report (NRC 2016a). The licensee responded that the data for 1st and 2nd quarter 2011 was incorrect and updated Jane Dough Technical Report Table 2-31b, “Baseline Gamma Exposure Rate at the Jane Dough Unit Air Monitoring Stations,” and Appendix JD-D11, Table JD-D11-7, “Baseline Gamma Exposure Rate at the Jane Dough Unit Air Monitoring Stations.” The NRC staff evaluated the revised data and finds it consistent with expected values. Therefore, the licensee has provided four quarters of valid baseline gamma exposure rate data for the Jane Dough Unit.

2.6.3.5 Background Gamma Survey

In addition to using environmental dosimeters used to characterize baseline direct radiation exposure levels over periods of a calendar quarter, as described in SER Section 2.6.3.4, “Direct Radiation Monitoring,” the licensee also measured instantaneous gamma radiation levels using a Ludlum Model 19 µR survey meter at 96 locations through the Jane Dough Unit. The licensee presented its results in Jane Dough Technical Report Section 2.9.2.5, “Jane Dough Unit Results.” These instantaneous measurements were taken in September 2011. The NRC staff evaluated the instantaneous measurements using the Ludlum Model 19 by comparing the instantaneous rate to an average hourly rate the NRC staff calculated using environmental dosimeter data. The results are presented below in SER Table 13. As shown in SER Table 13, the Ludlum Model 19 instantaneous results are comparable to the calculated results using quarterly environmental dosimeter data. Therefore, the NRC staff finds that the background gamma survey is an adequate characterization of baseline direct radiation exposure levels.

Table 13. Comparison of Background Gamma Survey with Direct Radiation Monitoring Results in the Jane Dough Unit

Sample Location	Ludlum Model 19 (September 2011) µR/hr	Environmental dosimeters (3rd Q 2010) µR/hr
JD-1	14	15.8
JD-2	14	17.7
JD-3	16	15.5
JD-4	13	14.1
JD-5	13	16
JD-6	15	17.1
JD-7	15	16.5

2.6.3.6 Soil Sampling

The licensee used the same soil sampling methodology for the Jane Dough Unit (Uranerz 2014f) as it previously used for the Nichols Ranch Unit and Hank Unit (Uranerz 2007). The NRC staff evaluated the licensee's soil sampling methodology in the safety evaluation report for the Nichols Ranch Unit and Hank Unit and found it acceptable (NRC 2011a).

The licensee collected 114 soil samples in the Jane Dough Unit. This includes 54 surface samples (i.e., to a depth of 15 cm [6 in]) and 39 subsurface soil samples (i.e., at depths of 15-30 cm [6-12 in]; 30-61 cm [12-24 in]; and 61-91 cm [24-36 in]) from the proposed well field locations; 14 surface samples from the general licensed area; and one surface sample at each of the 7 air sampler locations. The licensee analyzed the samples for uranium, lead-210, radium-226, and thorium-230. The summary statistics for the samples are provided in SER Table 14.

Table 14. Average (± 2σ) Radionuclide Concentrations in Surface and Subsurface Soil Samples and Sediment Samples in the Jane Dough Unit

	Uranium (mg/kg)	Pb-210 (pCi/g)	Ra-226 (pCi/g)	Th-230 (pCi/g)
Surface Soil	1.37 ± 0.91	0.77 ± 0.63	0.76 ± 0.54	0.61 ± 0.28
Subsurface Soil 6-12"	1.30 ± 0.50	0.40 ± 0.31	0.74 ± 0.51	0.52 ± 0.38
Subsurface Soil 12-24"	1.43 ± 1.02	0.46 ± 0.43	0.56 ± 0.53	0.48 ± 0.42
Subsurface Soil 24-36"	2.02 ± 2.53	0.58 ± 0.48	0.64 ± 0.61	0.54 ± 0.55
Sediment	2.60 ± 2.34	1.58 ± 0.64	0.79 ± 0.16	0.58 ± 0.14

The NRC staff evaluated the license's sampling results against the criteria in Regulatory Position C.1.1.4, "Soil and Sediment Samples," of Regulatory Guide 4.14 (NRC 1980). The licensee collected 68 surface soil samples plus 7 from air sampler locations, which meets the guidance in Regulatory Position C.1.1.4 of Regulatory Guide 4.14, which states that the licensee should take 40 surface soil samples in a radial pattern, plus one surface sample at each of 5 air sample locations. The licensee also took 39 sub-surface samples, which meets the guidance in Regulatory Position C.1.1.4, which states that the licensee should take 5 sub-surface soil samples (to a depth of 1 meter). The licensee also analyzed each sample for uranium, thorium-230, radium-226, and lead-210, in accordance with Regulatory Position C.1.1.4.

2.6.3.7 Sediment Sampling

The licensee used the same sediment sampling methodology for the Jane Dough Unit (Uranerz 2014f) as it previously used for the Nichols Ranch Unit and Hank Unit (Uranerz 2007). The NRC staff evaluated the licensee's sediment sampling methodology in the safety evaluation report for the Nichols Ranch Unit and Hank Unit and found it acceptable (NRC 2011a).

The licensee collected 19 sediment samples in the Jane Dough Unit in September 2011. The sample locations are shown in Exhibit 5-2, "Environmental Monitoring Locations," of the Jane Dough Technical Report. The staff examined Exhibit 5-2, a topographic map which shows elevation detail. Sediment samples were collected from ephemeral stream beds throughout the site. The licensee analyzed the samples for uranium, lead-210, radium-226, and thorium-230. The summary statistics for the samples are provided in SER Table 14. In Table 2-25a, "Radiological Baseline in Surface and Subsurface soil: Jane Dough Unit," of the Jane Dough Technical Report, the licensee compared the summary statistics for sediment sample results in the Jane Dough Unit with values it obtained for the Nichols Ranch Unit and Hank Unit. For example, the average concentration of natural uranium in sediment samples from the Jane Dough Unit was 2.6 mg/kg, where the values were 2.38 mg/kg in the Hank Unit, and 2.34 mg/kg in the Nichols Ranch Unit.

The NRC staff finds the licensee's pre-operational sediment sampling acceptable because the licensee collected samples upstream and downstream of proposed wellfields in ephemeral streams inside the Jane Dough Unit, and measured baseline radionuclide concentrations of uranium, lead-210, radium-226, and thorium-230, in accordance with guidance in Regulatory Position C.1.1.4 of Regulatory Guide 4.14 (NRC 1980).

2.6.3.8 Ground Water Sampling

The NRC staff's evaluation of the licensee's assessment of ground water and surface water quality in background samples is provided in SER Section 2.5. For this section, the NRC staff evaluated the licensee's description of background radiological ground water sample locations, frequency, and types of radiological analyses, as described in Appendix JD-D6, "Hydrology," of the Jane Dough Technical Report.

As described in Section 2.6.3.8 of the SER for the Nichols Ranch ISR Project (NRC 2011a), the applicable Regulatory Guide 4.14 guidance for pre-operational (background) radiological characterization of ground water is focused on ground water samples collected downgradient of mill tailings disposal areas, and not ISR facilities. However, the licensee characterized groundwater from 30 wells in and adjacent to the proposed Jane Dough Unit. The licensee collected samples over a period of about one year, with frequencies ranging from monthly to quarterly, from multiple aquifers, as follows: 33 samples from 8 on-site wells completed in the A Sand; 22 samples from 4 on-site wells completed in the B Sand; 5 samples from one on-site well completed in the C Sand; 14 samples from 3 wells completed in the F Sand, 8 samples from 2 wells completed in the G Sand; and 15 samples from 3 wells completed in the alluvial aquifer. An additional 33 samples were collected from private wells located near the northern and western boundaries of the Jane Dough Unit.

While the licensee collected samples from its on-site wells within the Jane Dough Unit, the licensee did not, in accordance with Regulatory Guide 4.14, collect samples from each domestic and stock water well within two kilometers of the monitoring well ring boundary. In Section

2.6.3.8 of the NRC staff's safety evaluation of the Nichols Ranch ISR Project Technical Report (NRC 2011a), the NRC staff determined that a pre-operational license condition would be imposed to require the licensee to collect semi-annual ground water samples within 2 km (1.2 mi) of the proposed monitoring well ring boundary. This was pre-operational license condition 12.10 in the initial license for the Nichols Ranch ISR Project (NRC 2011a). The NRC staff finds that this pre-operational requirement should also be imposed for the Jane Dough Unit. As described below in Section 2.6.4, the NRC staff will add license condition 12.15 to require the licensee to collect semi-annual ground water samples within 2 km (1.2 mi) of the proposed monitoring well ring boundary for the Jane Dough Unit.

In the NRC staff's safety evaluation of the Nichols Ranch ISR Project Technical Report (NRC 2011a), the NRC staff also explained why it was imposing license condition 11.7, which requires the licensee to collect samples annually from domestic and stock water wells within 1 km (0.6 mi) of the Nichols Ranch ISR Project monitoring well rings. As discussed in SER Section 5.3, "Ground Water and Surface Water Monitoring Programs," this license condition will be revised to include the Jane Dough Unit.

The licensee analyzed ground water samples for non-radiological water quality parameters (as described in Section 2.5 of this SER) and the following radiological parameters: radium-226, radium-228, gross alpha, gross beta, and natural uranium. The NRC staff finds the types of radiological analyses performed for these samples acceptable because natural uranium and radium isotopes are the primary soluble contaminants resulting from operation of an ISR wellfield, and gross alpha and gross beta analyses establish overall radiological conditions.

2.6.3.9 Surface Water Sampling

The NRC staff's evaluation of the licensee's assessment of ground water and surface water quality in background samples is provided in SER Section 2.5. For this section, the NRC staff evaluated the licensee's description of surface water sample locations, frequency, and types of radiological analyses, as described in Appendix JD-D6, "Hydrology," of the Jane Dough Technical Report.

The guidance in Regulatory Guide 4.14 addresses background surface water sampling around mill tailings impoundments (NRC 1980). However, some of the guidance is generally applicable to ISRs. For example, the guidance states pre-operational (background) radiological water samples should be collected quarterly from each onsite water impoundment and at least monthly from streams, rivers, any other surface waters or drainage systems cross the site boundary.

In Appendix JD-D6, "Hydrology," of the Jane Dough Technical Report, the licensee described samples collected from 13 water impoundments (i.e., reservoirs) on or near the Jane Dough site, two locations on Cottonwood Creek, and a self-sampler in Seventeen Mile Creek, an ephemeral stream located in the southwest corner of the Jane Dough site. The samples were analyzed for radiological parameters natural uranium and radium-226, water-soluble contaminants which could result from operation of an ISR wellfield. Samples were collected over 2 years on about a quarterly frequency. Less frequent samples were collected the ephemeral streams Cottonwood Creek and Seventeen Mile Creek because they are usually dry.

Based on the information provided in the Jane Dough Technical Report, the NRC staff concludes that the surface water sampling is consistent with Regulatory Guide 4.14, and the staff finds the preoperational surface water sampling and analysis acceptable.

2.6.4 Evaluation Findings

NRC has completed its evaluation of the background radiological characteristics of the Jane Dough Unit. This review included an evaluation using the review procedures in standard review plan Section 2.9.2, "Review Procedures," and acceptance criteria outlined in standard review plan Section 2.9.3, "Acceptance Criteria." The licensee has acceptably established the background radiological characteristics by providing (i) monitoring programs to determine background radiologic characteristics that include radionuclides monitored, sampling frequency, and methods, location, and density; (ii) air quality stations located consistent with the prevailing wind directions; (iii) time periods for preoperational monitoring that allow for 12 consecutive months of sampling; and (iv) radiological analyses of surface and sub-surface soil samples.

The NRC staff is imposing a new license condition 12.15 to require the licensee to collect pre-operational ground water samples from nearby domestic and stock wells.

> 12.15 Prior to commencing operations in the Jane Dough Unit, the licensee will submit monitoring results to the NRC that include sampling of domestic and livestock wells that are located within 2 kilometers of the proposed production area monitoring ring wells (MR-wells). Samples shall be collected, at a minimum, once every 6 months for one year. Samples shall be analyzed for the UCL parameters in Section 5.7.8.9 of the approved license application and for natural uranium and radium-226.

Based on the information provided in the Jane Dough Technical Report, and the detailed review conducted of the characterization of the background radiological characteristics at the *in situ* leach facility, the staff concludes that the information is acceptable to allow evaluation of the radiological background of the site and is in compliance with 10 CFR 40, Appendix A, Criteria 7.

3.0 DESCRIPTION OF PROPOSED FACILITY

The NRC staff evaluated the licensee's description of its in situ recovery (ISR) process and equipment, central processing plant and instrumentation and control systems proposed for use at the Jane Dough Unit as presented in its Jane Dough Technical Report (Uranerz 2014f). As noted below, several elements of the proposed facility description remain unchanged under the Jane Dough Unit amendment from what the NRC staff approved for the Nichols Ranch Project. NRC's evaluation of these unchanged elements is provided in the Safety Evaluation Report for the Nichols Ranch ISR Project (NRC 2011a).

3.1 In Situ Recovery Process and Equipment

This section describes the NRC staff's evaluation of the licensee's description of the in situ recovery process and equipment to be used at the Jane Dough Unit. The licensee provided information on ISR process and equipment at the Jane Dough Unit in Section 3 of the Jane Dough Technical Report (Uranerz 2014f). This information is needed to evaluate whether mining fluids can be contained within the equipment, systems and geologic formations as described in the Jane Dough Technical Report.

3.1.1 Regulatory Requirements

The staff determines if the licensee demonstrated that the equipment and processes used in the well fields during operation of the Jane Dough Unit meet the requirements of 10 CFR 40.32(c) and 40.41(c).

3.1.2 Regulatory Acceptance Criteria

Unless specifically stated otherwise, the Jane Dough Technical Report was reviewed for compliance with the applicable requirements of 10 CFR Part 40 using the acceptance criteria outlined in SRP Section 3.1.3, "Acceptance Criteria" (NRC 2003).

3.1.3 Staff Review and Analysis

The following sections present the staff's review and analysis of various aspects of the ISR processes and equipment proposed for the Jane Dough Unit at the Nichols Ranch ISR Project. Review areas addressed in this section include: well field infrastructure, operations in the production area aquifers and the proposed schedule for operations. Unless otherwise stated, the information reviewed in this section is from information, data, and maps submitted by Uranerz in its Jane Dough Technical Report (Uranerz 2014f).

3.1.3.1 Introduction

In Section 3 of the Jane Dough Technical Report (Uranerz 2014f) the licensee described the ISR process and equipment to be used at the Jane Dough Unit at the Nichols Ranch ISR Project. The Jane Dough Unit will occupy 1,490 ha (3,680 ac) of privately-owned land. Construction of the two proposed well fields will result in disturbing 40.9 ha (101 ac) of land surface. There will be no processing facilities located in the Jane Dough Unit and all wellfield fluids will be processed at the central processing plant located in the Nichols Ranch Unit.

The licensee stated that uranium at Jane Dough Unit will be extracted from an ore body in the A Sand at an approximate average depth of 168 m (550 ft) below ground surface. This is the

same stratigraphic unit as the A Sand in the Nichols Ranch Unit. The licensee stated that the ore body is a typical Powder River Basin type roll front deposit. The average ore grade is 0.1% and average thickness is 2.1 m (7 feet). The spatial distribution of the ore bodies is presented in Figure 3-11A, "Jane Dough Unit Production Areas," of the Jane Dough Technical Report.

As noted below, several aspects of the proposed facility and its operations at the Jane Dough Unit remain unchanged from that previously reviewed and found acceptable by NRC staff (NRC 2011a). In accordance with Appendix A, "Guidance for Reviewing Historical Aspects of Site Performance for License Renewals and Amendments," of NUREG-1569 these aspects were not reexamined.

3.1.3.2 Wellfield Operations

In Section 3.2.5, "Flow and Material Balance," of the Jane Dough Technical Report, the licensee stated that the Jane Dough Unit will be operated at a maximum rate of 13,248 Lpm (3,500 gpm), and that more fluid will be recovered than injected to maintain an inward hydraulic gradient in each well field in the ISR operation. The difference between the injection flow rate and the withdrawal flow rate, known as the bleed, is adjusted as necessary to maintain a ground water cone of depression to prevent excursions.

The licensee stated that the operating well field bleed at the Jane Dough Unit will be approximately 0.5-1.5 percent, with an average bleed anticipated to be 1 percent or 132 Lpm (35 gpm). Maintaining an inward hydraulic gradient which draws ground water flow into the well field is a critical aspect of operations at ISR facilities to prevent excursions and lixiviant escaping the ore zone. Existing license condition 10.9 of Source Materials License SUA-1597 requiring the licensee to maintain an inward hydraulic gradient in each individual production area also applies to operations in any production area, including the Jane Dough Unit.

In Section 3.4.6, "Well Casing Integrity," of the Jane Dough Technical Report, the licensee calculated the maximum surface injection pressure at the Jane Dough Unit that would not result in fracturing the production zone formation to be 1.14 megapascal (MPa) (165 pounds per square inch [psi]). This calculation is based on WDEQ methods and a fracture gradient value (0.8 psi/ft) that was previously reviewed and approved by the NRC staff for the Nichols Ranch Unit (NRC 2011a).

The licensee stated in Section 3.4.6, "Well Casing Integrity," that the lowest operating pressure rated component of the piping network is 1.03 MPa (150 psi) and committed to operating the system at pressures less than or equal to this operating pressure to prevent piping failures. As the design operating pressure is less than the wellhead pressure constraints, the NRC staff finds that the operating pressures are acceptable and will not cause the well to exceed the maximum bottomhole formation fracture pressure.

3.1.3.3 Lixiviant Composition

In Section 3.2.3.2, "Lixiviant Composition," of the Jane Dough Technical Report, the licensee stated that the lixiviant will be composed of varying concentrations and combinations of sodium carbonate, sodium bicarbonate, oxygen, and carbon dioxide added to native ground water. The staff notes that this composition of lixiviant with dissolved oxygen has been used in other ISR operations in confined aquifers and is known to be amenable to ground water restoration.

The licensee did not change the description of the proposed lixiviant composition from that which the NRC staff previously reviewed and found acceptable (NRC 2011a). The NRC staff finds nothing to invalidate its previous findings and previous staff conclusions remain valid. In addition, the NRC staff has not identified any unreviewed safety-related concerns pertaining to the use of this lixiviant at the Jane Dough site given its similarity to the currently licensed Nichols Ranch Unit. Existing standard license condition 10.1 of Source Materials License SUA-1597 regarding the composition of lixiviant applies to operations in any production area, including the Jane Dough Unit.

3.1.3.4 Plant Material Balance and Flow Rates

In Sections 3.2.5, "Flow and Material Balance," and 3.2.6, "Source of Plant Liquid Effluents and Disposal Methods," of the Jane Dough Technical Report, the license described the plant material balances and flow rates. The wellfield fluids collected from the Jane Dough Unit will be processed at the central processing plant located in the Nichols Ranch Unit. With the exception of the flow rates of liquid waste sent to the deep disposal wells, the licensee did not propose changes to Sections 3.2.5 and 3.2.6 of the Jane Dough Technical Report, as compared to the previous version of the technical report for the operating Nichols Ranch ISR Project (Uranerz 2007). The licensee explained that the addition of the Jane Dough Unit only extends the period of operation of the CPP and no changes to the CPP are required.

The licensee provided predicted deep well disposal flow rates for the life of the Nichols Ranch and Jane Dough Units. These units share the same deep disposal wells. The licensee is permitted to install four deep disposal wells, two of which have been installed and are operational. Section 3.2.6, "Sources of Plant Liquid Effluents and Disposal Methods," of the Jane Dough Technical Report indicates that the maximum flow rate sent to deep disposal is 541 Lpm (143 gpm) and occurs when production in the Jane Dough Unit and restoration in the Nichols Ranch Unit occur simultaneously. The NRC staff finds the predicted deep disposal well flow rate increase reasonable for the simultaneous operation of the Nichols Ranch and Jane Dough Unit, including restoration, during some years as shown in Figure 3-12, "Production, Restoration, and Reclamation Schedule," of the Jane Dough Technical Report (Uranerz 2014f).

The licensee is permitted to dispose of up to 568 Lpm (150 gpm) total in the four deep disposal wells located in the Nichols Ranch Unit. The NRC staff notes that adequate disposal capacity is critical for ISR operations and that the restoration phase flow rates exceed those of the production phase.

Based on operational data, each of the currently installed deep disposal wells has the capacity to dispose of at least 208 Lpm (55 gpm) without exceeding the injection pressure limit (Uranerz 2016l). This observed disposal capacity combined with the fact that the licensee is permitted to install two additional deep disposal wells provides reasonable assurance that the licensee has adequate disposal capacity to accommodate the proposed operations.

The NRC staff previously reviewed Sections 3.2.5, "Flow and Material Balance," and 3.2.6, "Source of Plant Liquid Effluents and Disposal Methods," of the Nichols Ranch ISR Project Technical Report (Uranerz 2007) and found acceptable the licensee's descriptions of plant material balances and flow rates at the Nichol's Ranch Unit (NRC 2011a). The NRC staff finds nothing to invalidate its previous findings and previous staff conclusions remain valid. In addition, the NRC staff has not identified any unreviewed safety-related concerns pertaining to these descriptions.

3.1.3.5 Well Design, Construction and Integrity Testing

In Section 3.4.5, "Well Completion," of the Jane Dough Technical Report the licensee described in detail the well installation procedures (including materials used and well development and cementing procedures) to protect overlying and underling aquifers and prevent cross-contamination. These wells will be installed to similar depths and in a similar subsurface environment as those in the currently licensed Nichols Ranch Unit.

Other than adding some additional descriptive text, the licensee did not propose changes to the well installation procedures from that previously reviewed and approved by NRC staff (NRC 2011a). Figures 3-13, "Typical Production (Injection/Recovery) Well Diagram," and 3-14, "Typical Monitor Well Construction Diagram," of the Jane Dough Technical Report which illustrate a typical well completion for an injection/recovery well and monitoring well, respectively. Although these figures have been revised since previous NRC staff review in 2011, the revisions represent minor clarifications rather than a significant change in design.

The licensee described the mechanical integrity test (MIT) procedures for all injection and extraction wells in Section 3.4.6, "Well Casing Integrity," of the Jane Dough Technical Report. With the exception of minor editorial revisions, the licensee did not propose changes to the MIT procedures from that previously reviewed and approved by NRC staff (NRC 2011a). Existing standard license condition 10.5 of Source Materials License SUA-1597 regarding the frequency of mechanical integrity testing also applies to operations in any production area, including the Jane Dough Unit.

The NRC staff finds that the licensee's proposed well design, construction and integrity testing consistent with that used at the currently licensed Nichols Ranch Unit. Therefore, staff has reasonable assurance that the licensee's proposed well design, construction and mechanical integrity testing procedures are relevant and effective for the Jane Dough Unit.

Staff finds nothing to invalidate the previous findings and previous staff conclusions remain valid. In addition, staff has not identified any unreviewed safety-related concerns pertinent to the mechanical integrity testing procedures at the Jane Dough Unit. In accordance with Appendix A, "Guidance for Reviewing Historical Aspects of Site Performance for License Renewals and Amendments," of NUREG-1569 (NRC 2003a), staff did not re-examine the licensee's discussion of the well design, construction and mechanical integrity testing procedures.

3.1.3.6 Excursion Monitoring Wells

The NRC staff observes that the licensee's proposed configuration and density of ground water monitoring wells are generally consistent with that of the currently licensed Nichols Ranch facility (Uranerz 2014f). In Section 5.7.8.2, "Monitor Well Spacing," of the Jane Dough Technical Report the licensee stated that the perimeter monitoring wells will be completed in the same zone as the ore zone (i.e., the A Sand) and will be located approximately 152 m (500 ft) from the production area boundary and 152 m (500 ft) apart.

In Section 5.7.8.2, "Monitor Well Spacing," of the Jane Dough Technical Report (Uranerz 2014f) the licensee stated that vertical excursion monitoring wells will be installed in the overlying and underlying aquifers at a density of one well per every four acres of wellfield. With the exception noted below, the licensee stated that excursion monitoring wells (overlying, underlying and perimeter ring) will be screened across the entire sand thickness in the aquifer in which they are completed.

The licensee stated in Section 2.7.2.2.3, “Aquifer Description,” of the Jane Dough Technical Report that where the AB mudstone is present, the B Sand, which overlies the AB mudstone, will be designated as the overlying aquifer relative to the A Sand production zone. The licensee stated that where the AB mudstone is absent (absence is defined as the AB mudstone being less than 3 m [10 ft] thick [Uranerz 2016a]), the B Sand sits directly upon the A sand and therefore the A and B sands effectively combine into a single aquifer unit. The licensee stated that where this is the case, the aquifer above the B Sand is designated as the overlying aquifer relative to the production zone. The licensee stated (Uranerz 2016a) that where the AB Sand is designated as the production zone, the perimeter ring monitoring wells would be completed in the A Sand only, rather than throughout the combined AB Sand. The NRC staff finds this approach to well screening acceptable as discussed in SER Section 5.3, “Ground Water and Surface Water Monitoring Programs.”

Based on the NRC staff’s review of information provided in the Jane Dough Technical Report and the licensee’s past experience with the above-referenced monitoring well pattern, the NRC staff finds that the licensee’s proposed monitoring well pattern is consistent with that used at the currently licensed Nichols Ranch facility. Staff previously found the licensee’s monitoring well pattern at its Nichols Ranch facility to be acceptable (NRC 2011a). Therefore, staff has reasonable assurance that the licensee’s monitoring well pattern is relevant and effective for the Jane Dough Unit. Staff finds nothing to invalidate the previous findings on the monitoring well pattern, and previous staff conclusions remain valid. In addition, staff has not identified any unreviewed safety-related concerns pertinent to the monitoring well pattern at the Jane Dough Unit. NRC staff finds the proposed excursion monitor well network for the Jane Dough Unit is sufficient and consistent with acceptance criteria presented in Section 3.1.3, “Acceptance Criteria,” of NUREG-1569 (NRC, 2003a). The licensee’s monitoring program and procedures for control excursions at the Jane Dough Unit are further discussed in SER Section 5.3, “Ground Water and Surface Water Monitoring Programs.”

3.1.3.7 Spills and Leaks

The licensee did not propose changes to the Section 3.5, “Plant Equipment, Instrumentation and Control,” of the Jane Dough Technical Report, as compared to the same section of the Nichols Ranch ISR Project Technical Report (Uranerz 2007), which relates to the methods for timely detection and cleanup of leaks from surface and near-surface pipes. The methods described include a control system that will contain high and low alarms for pressure and flow, which will alert control room personnel to make adjustments, and certain ranges of pressure and flow that will signal a potential pipe leak and trigger automatic shutoffs and shutdowns.

In Section 3.4.3, “Wellfield Injection and Recovery Patterns,” of the Jane Dough Technical Report, the licensee provided a description of the header houses that will be used to distribute injection fluid to injection wells and collect production solution. In Section 3.4.3, the licensee stated that the header houses will be metal buildings approximately 6.1 m by 12.2 m (20 ft by 40 ft) and contain floors that curb and/or slope to a sump with an automatic level control pump. The header house design is very similar to that previously reviewed and found acceptable by NRC staff (NRC 2011a). The design proposed for the Jane Dough Unit includes a basement that will contain the injection and recovery lines whereas the previous design utilized an at grade slab design. The NRC staff finds the description of the header house design acceptable.

The NRC staff previously reviewed Section 3.5, “Plant Equipment, Instrumentation, and Control,” of the Nichols Ranch ISR Project Technical Report (Uranerz 2007) and found

acceptable the licensee's plans for and descriptions of the methods for timely detection and cleanup of leaks from surface and near-surface pipes (NRC 2011a). The NRC staff finds nothing to invalidate its previous findings and previous staff conclusions remain valid. In addition, the NRC staff has not identified any unreviewed safety-related concerns pertaining to these methods.

Existing standard license condition 10.4 of Source Materials License SUA-1597 regarding the development and implementation of written standard operating procedures (SOPs) prior to operation including emergency procedures for potential accidents/unusual occurrences including significant equipment or facility damage, pipe breaks and spills also applies to operations in any production area, including the Jane Dough Unit.

3.1.3.8 Groundwater Modeling

The licensee prepared a ground water flow model for the Jane Dough Unit to evaluate the extent of the cone of depression, excursion control and capture behavior, and horizontal flare during production operations. The ground water model was presented in Addendum 3D of the Jane Dough Technical Report. The numerical groundwater flow model was developed using the United States Geological Survey MODFLOW 96 code (Harbaugh and McDonald 1996). This code is publically available and generally accepted to model groundwater flow. Therefore, the staff finds the use of this model acceptable.

As shown in Figure MPI.1-1, "Jane Dough Project Area MODFLOW Model Grid," of the Jane Dough Technical Report, the domain of the licensee's groundwater flow model covered approximately 13,080 square km (5,050 square mi) and includes both the Nichols Ranch and Jane Dough Units. The model grid size varies throughout the model domain. The grid is refined to 15 m x 15 m (50 ft x 50 ft) (the smallest cell size in the model) in the Jane Dough and Nichols Ranch permit areas. The model contains five layers, four representing the A sand and one representing the lower interval of the B Sand, each approximately 6.1 m (20 ft) thick.

The layer transmissivity ranged from approximately 0.74 m^2/day to 0.93 m^2/day (8 to 10 ft^2/day). The storage coefficient of the layers ranged from approximately 2E-5 to 6E-5. The NRC staff finds the assignment of these model parameters is reasonable and generally consistent with the transmissivity and storage coefficient determined from the site aquifer pumping test results. The vertical conductance between the A and B Sands was increased where the AB mudstone is missing. The AB mudstone, where present, separates the A and B sand and restricts groundwater flow between these sand layers.

The licensee simulated the natural groundwater gradient across the modeling using general head boundary conditions. The NRC staff notes that the licensee did not attempt to calibrate the model to ambient field measured water levels or pumping test data. No sensitivity analysis of input parameters was conducted. The NRC staff finds that without calibration or sensitivity analyses, the model is not considered a rigorous representation of the groundwater flow system. Nevertheless, the staff concludes it is still useful for general predictions of groundwater flow in the Jane Dough permit area because it uses parameters consistent with the site characterization data. The NRC staff notes that groundwater model simulations are inherently uncertain and are only one piece of information considered when making a safety determination. Other factors considered, as discussed in this safety evaluation, include site characterization, baseline wellfield testing, routine operational monitoring and license conditions. The groundwater modeling approach for the Jane Dough Unit is very similar to that

used for the Nichols Ranch Unit, which NRC staff previously reviewed and found to have some utility.

To simulate the groundwater flow during production, the licensee defined four production areas, two for the Nichols Ranch Unit and two for the Jane Dough Unit. Operations for the Nichols Ranch and Jane Dough Units were simulated as follows:

1. Nichols Ranch Production Area 1: model year 0 to model year 1.5
2. Nichols Ranch Production Area 2 model year 1.5 to model year 3
3. Jane Dough Production Area 1: model year 3 to model year 6
4. Jane Dough Production Area 2: model year 6 to model year 7.25

The total simulation time was 10.25 years, which included for 3 years of post-mining recovery.

Each well field simulation contained a combination of staggered injection and production wells arranged throughout the ore bodies. For modeling purposes, the ore zone was divided into the upper, middle and lower ore zones. The simulated injection and production wells for the Jane Dough Unit upper, middle and lower ore zones are shown in Jane Dough Technical Report Figures MPI.1-3, “Jane Dough Upper Ore Zone Model Configuration,” MPI.1-4, “Jane Dough Middle Ore Zone Model Configuration,” and MPI.1-5, “Jane Dough Lower Ore Zone Model Configuration,” respectively.

For Jane Dough Production Area 1, the licensee simulated a total of 337 production wells and 591 injection wells. The total recovery rate was 13,248 Lpm (3,499 gpm) (the limit of the central processing plant) with an average per well recovery rate of 39.4 Lpm (10.4 gpm). The injection well rate ranges from approximately 5.3 to 32.9 Lpm (1.4 to 8.7 gpm), resulting in a total injection rate of 13,111 Lpm (3,464 gpm) or approximately 1% bleed rate. Production Area 1 operations are only conducted within the middle ore zone.

The licensee simulated a total of 195 production wells and 356 injection wells for the operation of Jane Dough Production Area 2. Wells are simulated in the upper, middle and lower ore zones, however the majority of production is from the middle ore zone. The total recovery rate was 13,248 Lpm (3,500 gpm) and the total injection rate was 13,111 Lpm (3,464 gpm) corresponding to an approximate 1% bleed rate. The simulated recovery rate from individual wells was approximately 68.1 Lpm (18 gpm) while the simulated injection well rates ranged from 12.1 to 64.7 Lpm (3.2 to 17.1 gpm).

The licensee presented the modeled drawdown for the middle ore zone after 1 year of operations as shown in Figure MPI.1-6, “Predicted Drawdown for Middle Ore Zone of Production Area #1 After One Year of Mining,” of the Jane Dough Technical Report. Figure MPI.1-6 illustrates that the 1.5 m (5 ft) drawdown isocontour from the operation of the Jane Dough unit is mostly contained within the Jane Dough permit area. This figure also illustrates the large residual cone of depression from the simulated operations of the Nichols Ranch Unit to the north.

The licensee also presented the modeled drawdown for the middle ore zone at the end of simulated operations as Figure MPI.1-12, “Predicted Drawdown for Middle Ore Zone of Production Area #1 After 51 Months of Mining,” of the Jane Dough Technical Report. In this figure, the drawdown from the Nichols Ranch Unit is no longer readily discernable and the 1.5 m (5 ft) drawdown contour extends approximately 8 km (5 mi) from the center of the Jane Dough Unit.

The NRC staff notes that Figure 3-12, “Production, Restoration, and Reclamation Schedule,” of the Jane Dough Technical Report indicates that the durations of operations at the Nichols Ranch and Jane Dough Units are longer than that simulated in the groundwater flow model. Additionally, the licensee did not simulate the withdrawal of groundwater due to restoration activities. The NRC staff notes that conducting restoration activities for longer than assumed in the model will increase the magnitude and extent of drawdown, increasing the inward gradient which lessens the probability of an excursion.

Section 7.2.3.1, “Analytical Modeling,” of the Jane Dough Technical Report states that surface use agreements are in place between the licensee and nearby landowners to address mitigation measures in the event that drawdown from the operation of the Nichols Ranch ISR Project, which includes the Jane Dough Unit, impacts the use of a landowner’s well (Uranerz 2014f).

Section 7.2.3.1, “Analytical Modeling,” of the Jane Dough Technical Report states that these mitigation measures may include providing additional pumping capacity or replacing the well. The NRC staff notes that the drawdown in private wells is not a safety issue and therefore the NRC will not require any other commitment from the licensee to address this issue.

Figure MPI.1-7, “Potentiometric Surface for Middle Ore Zone After One Year of Mining,” of the Jane Dough Technical Report presents the modeled potentiometric contours for the middle ore zone of Production Area 1 after 1 year of operation. The simulated contours demonstrate that an inward gradient is maintained to prevent excursions. These simulated contours support the conclusion that an inward gradient would be maintained during anticipated production operations, and during restoration operations, which will have even greater consumptive use.

The NRC staff’s review of groundwater level data collected at the currently operating Nichols Ranch Unit (Uranerz 2015d) indicates that an inward gradient was created by the operations conducted at the Nichols Ranch Unit. The similarity of the proposed Jane Dough and Nichols Ranch operations coupled with the operations being conducted in the same geologic formation provides reasonable assurance that an inward gradient can be maintained at the Jane Dough Unit.

Additionally, existing licensee condition 10.9 of Source Materials License SUA-1597 regarding maintaining an inward hydraulic gradient in each individual production area throughout production and restoration applies to operations in any production area, including the Jane Dough Unit.

Finally, the licensee used the groundwater flow model to predict the potential for excursions and the ability to capture and an excursion.

First the licensee simulated a 60-day period of normal operations followed by a period of local imbalance. To simulate a local imbalance, the extraction rate for two middle ore zone recovery wells in the southwestern portion of Production Area 1 was reduced by 18.9 Lpm/well (5.0 gpm/well) for a 60-day period. This was followed by a 60-day stress period in which the extraction rate for the two designated wells was increased by 18.9 Lpm/well (5.0 gpm/well) to retrieve the excursion.

Jane Dough Technical Report Figure MPI.1-15, “Predicted Potentiometric Surface After 60 Days with Local Imbalance,” presents the predicted potentiometric surface for the 60-day well imbalance simulation. Figure MPI.1-15 shows that the imbalance created an area of outward

gradient that is over 274 m (900 ft) wide and extends more than 365 m (1,200 ft) from the well field. Thus, the staff concludes that the reduction in production rates results in a loss of inward gradient and, therefore, the potential for excursion over a large area. Based on this modeling, the licensee stated that because the area of outward gradient, or area containing production fluids is over 274 m (900 ft) wide, a distance of 152 m (500 ft) between perimeter monitoring wells would be adequate to detect excursions. The NRC staff finds the licensee's selection of spacing acceptable based on the modeling. The NRC staff note that this well spacing is also consistent with that used at the currently licensed Nichols Ranch Unit.

Figure MPI.1-16, "Predicted Potentiometric Surface After 60 Days with Local Overproduction," presents the predicted potentiometric surface after 60 days of increased production well pumping to retrieve the excursion. Figure MPI.1-16 shows that the inward gradient has been reestablished and extend 305 m (1,000 ft) from the production area. This modeling indicates that an excursion could be controlled should one occur.

Based on its review of the Jane Dough Technical Report, including modeling results and a commitment by the licensee in Section 5.7.8.3, "Production Area Pump Test," of the Jane Dough Technical Report to conduct additional multi-well pumping tests to confirm the hydrologic characteristics of the production area and the underlying and overlying aquifers within the production area, the staff concludes that the licensee provided an initial demonstration that inward gradients will be maintained during operations, a potential excursion could be retrieved and the proposed monitoring well network is sufficient to detect excursions at the Jane Dough Unit.

3.1.3.9 Disposal of Solid Byproduct Material

Existing standard license condition 9.9 of Source Materials License SUA-1597 states that the licensee shall dispose of solid byproduct material from the Nichols Ranch ISR Project operations at a site that is authorized by the NRC or an NRC Agreement State to receive byproduct material. Additionally, license condition 9.9 states that in the event that the agreement expires or is terminated, the licensee shall notify the NRC within 7 working days after the date of expiration or termination and a new agreement shall be submitted for NRC review within 90 days after expiration or termination. This license condition applies to operations in any production area, including the Jane Dough Unit.

3.1.4 Schedule

The licensee presented a revised general production, restoration, and decommissioning schedule for the Nichols Ranch ISR Project operation in Figure 3-12, "Production, Restoration, and Reclamation Schedule," of the Jane Dough Technical Report. This schedule shows the following:

- Nichols Ranch Unit PA #1—Production began in early 2014 and continue until mid-2019. Restoration will begin in mid-2019 and continue through early-2024.

- Nichols Ranch Unit PA #2—Production will begin in late 2016 and continue through mid-2022. Restoration will begin in mid-2022 and continue through mid-2024.

- Hank Unit PA #1—Production will begin in early 2025 and continue through mid-2027. Restoration will begin in mid-2027 and continue for 5 years through early 2032.

- Hank Unit PA # 2—Production will begin in late 2027 and continue through mid-2029. Restoration will begin until mid-2029 and continue through mid-2031.

- Jane Dough Unit PA #1—Production will begin in mid-2019 and continue through early 2025. Restoration will begin in early 2025 and continue through early 2028.

- Jane Dough Unit PA #2—Production will begin in early 2022 and continue through early late 2027. Restoration will begin in late 2027 and continue until mid-2029.

- Decommissioning will commence in the Nichols Ranch Unit, Hank Unit and Jane Dough well fields at the end of restoration. The licensee noted that these are proposed timelines which depend on the disposal well capacity, and restoration methods will be updated as necessary.

The NRC staff finds these estimates acceptable because restoration begins promptly upon completion of production in all Production Areas and because the estimates of groundwater restoration duration are generally consistent with the restoration experience at other ISR sites.

3.1.5 Evaluation Findings

The staff reviewed the ISR process and equipment proposed for use at the Jane Dough Unit in accordance with SRP Section 3.1.3, “Acceptance Criteria.”

The licensee described the well field infrastructure, equipment, and ISR operations and used the results from field testing and ground water modeling to support the safe application of ISR.

The licensee described the mineralized zone(s) and methods taken to protect against the vertical migration of water, proposed acceptable well designs and tests for well integrity, and demonstrated that the ISR process will meet the following criteria:

- Downhole injection pressures are less than formation fracture pressures.

- Overall production rates are higher than injection rates to create and maintain a cone of depression.

- Plant material balances and flow rates are appropriate.

- Disposal operations and capacity are sufficient (see SER Section 4.2.3.2, “Solid Waste,” for NRC staff’s findings on solid waste disposal).

NRC staff has determined that the confined and saturated aquifer conditions and properties at the Jane Dough Unit are similar to those observed at the currently licensed Nichols Ranch facility, which staff has determined can be operated safely while being protective of human health and the environment (NRC 2011a).

Based upon the review conducted by the staff as indicated above, the information provided in the Jane Dough Technical Report ,as supplemented by information to be collected in accordance with the license conditions during operations, the staff finds that the information is consistent with the applicable acceptance criteria of Section 3.1.3 ,”Acceptance Criteria,” and Appendix A, “Guidance for Reviewing Historical Aspects of Site Performance for License

Renewals and Amendments," of NUREG-1569 (NRC, 2003a), where noted, and the requirements of 10 CFR 40.32(c), and 10 CFR 40.41(c).

3.2 Central Processing Plant and Other Facilities

Processing of the wellfield fluids from the Jane Dough Unit will be conducted at the Central Processing Plant. The NRC's evaluation of the licensee's equipment used and materials processed in the Central Processing Plant, Hank Satellite, existing well fields and chemical storage facilities at the Nichols Ranch ISR Project is provided in the Safety Evaluation Report for the Nichols Ranch ISR Project (NRC 2011a).

The NRC staff has determined that some aspects of the proposed facility and its operations should not be reexamined. Appendix A, "Guidance for Reviewing Historical Aspects of Site Performance for License Renewals and Amendments," of NUREG-1569 states:

> If, after a review of these historical aspects of site operations, the staff concludes that the site has been operated so as to protect health and safety and the environment and that no unreviewed safety-related concerns have been identified, then only those changes proposed by the license renewal or amendment application should be reviewed using the appropriate sections of this standard review plan. Aspects of the facility and its operations that have not changed since the last license renewal or amendment should not be reexamined.

The licensee's proposed minor clarifying changes to Sections 3.2, 3.3, and 3.4 of the Jane Dough Technical Report include:

- Throughout, the addition of the words "and Jane Dough," or similar words, in appropriate sections where the existing operational units (i.e., Nichols Ranch Unit and Hank Unit) had been separately identified.

- Throughout, additional clarifying text which explains that the Jane Dough Unit will only contain wellfields and the uranium recovered will be processed at the existing Central Processing Plant located in the Nichols Ranch Unit.

In addition, the licensee proposed changes to Sections 3.2 and 3.4 of the Jane Dough Technical Report for which the NRC staff's evaluation is provided in SER Section 3.1. These proposed revisions include:

- In Section 3.2.5, "Flow and Material Balance," an explanation of the bleed rate for the Jane Dough Unit (1%) which is the same bleed rate of the Nichols Ranch Unit; and, in Section 3.2.6, "Sources of Plant Liquid Effluents and Disposal Methods," a description of the effect of wellfield operations in the Jane Dough Unit on liquid waste disposal capacity at the Nichols Ranch ISR Project.

- In Section 3.4, "Wellfields," proposed revisions to describe the Jane Dough wellfields and operations, the manner in which wells are completed, a description of well casing integrity monitoring, and the licensee's numerical modeling of groundwater flow.

The Jane Dough Unit includes two additional well fields of the same type used in the existing licensed activities. The Jane Dough header houses will be the same as used in the licensed

activities at the Nichols Ranch ISR Project. The licensee revised its description of header house design in the Jane Dough Technical Report Section 3.4.3, "Wellfield Injection and Recovery Patterns." However, these changes were reviewed and approved by the licensee's Safety and Environmental Review Panel in April 2015 as SERP No. SERP-5-2014 and pages changes to the existing technical report referenced in the license were submitted to NRC in the next semi-annual report. The licensee also provided corresponding page changes to the Jane Dough Technical Report (Uranerz 2015b). The NRC staff did not re-examine these changes because they were previously evaluated under the performance-based license condition 9.4 of Source Materials License SUA-1597.

The NRC staff previously reviewed Sections 3.2, "Site Facilities Layout," 3.3, "Chemical Storage Facilities," and 3.4, "Wellfields," of the Nichols Ranch ISR Project Technical Report (Uranerz 2007) and found acceptable the licensee's description of equipment used and materials processed in the Central Processing Plant, Hank Satellite, well fields and chemical storage facilities at the Nichols Ranch ISR Project (NRC 2011a). The NRC staff finds nothing to invalidate its previous findings and previous staff conclusions remain valid. In addition, the NRC staff has not identified any unreviewed safety-related concerns pertaining to the licensee's equipment and materials processed in the central processing plant.

3.3 Instrumentation and Control

The NRC's evaluation of the licensee's instrumentation and control at the Nichols Ranch ISR Project is provided in the Safety Evaluation Report for the Nichols Ranch ISR Project (NRC 2011a).

The NRC staff has determined that this aspect of the proposed facility and its operations, with the exception of wellfield operating pressures as discussed below, should not be reexamined. Appendix A, "Guidance for Reviewing Historical Aspects of Site Performance for License Renewals and Amendments," of NUREG-1569 states:

> If, after a review of these historical aspects of site operations, the staff concludes that the site has been operated so as to protect health and safety and the environment and that no unreviewed safety-related concerns have been identified, then only those changes proposed by the license renewal or amendment application should be reviewed using the appropriate sections of this standard review plan. Aspects of the facility and its operations that have not changed since the last license renewal or amendment should not be reexamined.

The licensee did not propose changes to Section 3.5, "Plant Equipment, Instrumentation, and Control" of the Jane Dough Technical Report, as compared to the same section of the Nichols Ranch ISR Project Technical Report (Uranerz 2007), other than to include the words "and Jane Dough," or similar words, in appropriate sections where the existing operational units (i.e., Nichols Ranch Unit and Hank Unit) had been previously identified. The NRC staff previously reviewed Section 3.5 of the Nichols Ranch ISR Project Technical Report (Uranerz 2007) and found acceptable the licensee's description of instrumentation and controls (NRC 2011a). The NRC staff finds nothing to invalidate its previous findings and previous staff conclusions remain valid.

The Jane Dough Unit includes two additional well fields of the same type used in the existing licensed activities. The instrumentation and controls in the new wellfields will not differ from those already in use in licensed activities at the Nichols Ranch ISR Project.

In Section 3.4.6, "Well Casing Integrity," of the Jane Dough Technical Report, the licensee stated that the maximum operating pressure for the wellfields is 1.03 MPa (150 psi). The licensee's calculated limiting surface injection pressure is 1.14 MPa (165 psi). Exceeding the limiting surface injection pressure could result in down-hole pressures which could generate new fractures or spread existing fractures causing the injection fluid to migrate to unauthorized zones. The licensee stated that the operating pressure is limited by the PVC casing pressure rating of 1.03 MPa (150 psi) rather than the limiting surface injection pressure of 1.14 MPa (165 psi). Because the maximum operating pressure is lower than the limiting surface injection pressure, injection pressures will not be high enough to cause or propogate fractures in the confining zone.

Based on the review described above, the staff concludes that the information provided in the Jane Dough Technical Report, meets SRP acceptance criteria 3.3.3(4) which relates to maintaining operating pressures below casing and formation rupture pressures to prevent vertical excursions (NRC 2003). In addition, the NRC staff has not identified any unreviewed safety-related concerns pertaining to the licensee's instrumentation and control systems.

4.0 EFFLUENT CONTROL SYSTEMS

The NRC staff evaluated the proposed ventilation, filtration, and confinement systems that the licensee proposes to use to control the release of radioactive materials to the atmosphere. The staff also evaluated analyses of equipment as designed and operated to prevent radiation exposures and to limit exposures and releases to as low as is reasonably achievable.

The NRC staff also evaluated the licensee's estimates of quantities and compositions of waste residues expected during construction and operation of the Jane Dough Unit and the procedures proposed for their management.

The NRC's evaluation of elements of the effluent control systems that were already reviewed and approved and remain unchanged in the Jane Dough Technical Report, such as the physical description of discharge stacks, types and estimated composition and flow rates of atmospheric effluents, and proposed methods for controlling such releases; design specifications for effluent control systems for liquids and solids; design specification for retention systems such as surface impoundments; plans to obtain any water quality certifications and discharge permits that may be necessary is provided in the Safety Evaluation Report for the Nichols Ranch ISR Project (NRC 2011a).

4.1 Gaseous and Airborne Particulates

This section describes the NRC staff's evaluation of the licensee's description of the design of effluent control systems for gaseous and airborne particulates at the Jane Dough Unit. The licensee provided information on gaseous and airborne particulates control systems at the Jane Dough Unit in the Jane Dough Technical Report (Uranerz 2014f). The purpose of the effluent control systems is to prevent and minimize the spread of gaseous and airborne particulate contamination to the atmosphere by the use of emission controls and to ensure compliance with radiation dose limits for the public.

4.1.1 Regulatory Requirements

For gaseous and airborne particulates generated at the Nichols Ranch ISR Project, the staff determines if the licensee has demonstrated compliance with Criterion 8 of Appendix A to 10 CFR Part 40, which requires that milling operations be conducted so that all airborne effluent releases are reduced to ALARA levels. Criterion 8 states, "Milling operations must be conducted so that all airborne effluent releases are reduced to levels as low as is reasonably achievable. The primary means of accomplishing this must be by means of emission controls." Although Criterion 8 focuses on effluent releases from the yellowcake dryer and tailings, it does not exclude radon releases from ISRs. The licensee must also demonstrate that releases of gaseous and airborne particulates comply with other relevant sections of 10 CFR Part 20 and 10 CFR Part 40.

4.1.2 Regulatory Acceptance Criteria

The Jane Dough Technical Report was reviewed for compliance with the applicable requirements of 10 CFR Part 20 and Part 40 using the acceptance criteria presented in SRP Section 4.1.3 (NRC 2003).

4.1.3 Staff Review and Analysis

The NRC staff's evaluation of the licensee's description of the design of effluent control systems for gaseous and airborne particulates at the Nichols Ranch Unit and Hank Unit, existing well fields, and chemical storage facilities at the Nichols Ranch ISR Project is provided in the Safety Evaluation Report for the Nichols Ranch ISR Project (NRC 2011a) and its safety evaluation report for license amendment 2 for Source Materials License SUA-1597 (NRC 2014).

The NRC staff has determined that this aspect of the proposed facility and its operations should not be reexamined. Appendix A, "Guidance for Reviewing Historical Aspects of Site Performance for License Renewals and Amendments," of NUREG-1569 states:

> If, after a review of these historical aspects of site operations, the staff concludes that the site has been operated so as to protect health and safety and the environment and that no unreviewed safety-related concerns have been identified, then only those changes proposed by the license renewal or amendment application should be reviewed using the appropriate sections of this standard review plan. Aspects of the facility and its operations that have not changed since the last license renewal or amendment should not be reexamined.

Effluent controls for the Jane Dough Unit are those required for radon-222 (radon), radon progeny, and radionuclide particulate matter emissions resulting from well field installation, operation and recovery within the Jane Dough Unit. The licensee proposes to install two well fields in the Jane Dough Unit and process lixiviant from these fields at the existing central processing plant in the Nichols Ranch Unit. Therefore, the potential radionuclide emissions are radon and radon progeny from both the Jane Dough well fields and central processing plant resulting from installation, operation and recovery of well fields in the Jane Dough Unit, and radionuclide particulate matter emissions resulting from processing of Jane Dough Unit lixiviant at the central processing plant

The licensee did not propose changes to Section 4.1, "Gaseous and Airborne Particulates," of the Jane Dough Technical Report, as compared to the same section of the Nichols Ranch ISR Project Technical Report (Uranerz 2007). Therefore, the NRC staff concludes that the licensee is proposing to use the same effluent control systems for gaseous and airborne particulates at the Jane Dough Unit as are already in use at the Nichols Ranch Unit. This is acceptable because the new wellfields in the Jane Dough Unit are similar to the wellfields already authorized. Similarly, the licensee is proposing to continue using the same effluent control systems at the central processing plant for lixiviant from the Jane Dough Unit. This is acceptable because the lixiviant from the Jane Dough Unit will be chemically similar to the lixiviant approved for use at the Nichols Ranch Unit and Hank Unit.

The NRC staff previously reviewed Section 4.1 of the Nichols Ranch ISR Project Technical Report (Uranerz 2007) and found acceptable the licensee's description of the design of effluent control systems for gaseous and airborne particulates (NRC 2011a). The NRC staff finds nothing to invalidate its previous findings and previous staff conclusions remain valid. In addition, the NRC staff has not identified any unreviewed safety-related concerns pertaining to the licensee's equipment and procedures for responding to and mitigating the consequences of accidents.

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4.1.4 Evaluation Findings

NRC has completed its review of the effluent control systems for gaseous and airborne particulates proposed for use at the Nichols Ranch ISR Project. This review included an evaluation using the review procedures in standard review plan Section 4.1.2, “Review Procedures,” and the acceptance criteria outlined in standard review plan Section 4.1.3, “Acceptance Criteria.”

The licensee has acceptably described the discharge stacks and the types, estimated composition, and flow rates of effluents released to the atmosphere. The licensee has designated monitoring and control systems (e.g., ventilation, filtration, and confinement) for the types of effluents generated. Also, the licensee has specified acceptable monitoring criteria and has located the facility monitoring and control systems for the required functions to optimally assess worker exposure in locations of likely maximum concentrations determined by the licensee’s analysis of airflow patterns. The licensee has demonstrated that ventilation systems are acceptable to prevent radon gas buildup where (i) recovery solutions enter the plant, (ii) tanks are vented during the extraction process, and (iii) drying and packaging operations occur. By providing information on the health and safety impacts of system failures and identifying contingencies for such occurrences, the licensee has acceptably shown that effluent control systems will limit radiation exposures under both normal and accident conditions. The licensee has committed to occupational radiation doses and doses to the general public that meet dose limits and as low as is reasonably achievable goals.

Based on the information provided in the Jane Dough Technical Report and the detailed review conducted of the effluent control systems for gaseous and airborne particulates for the *in situ* leach facility, the staff concludes that the proposed effluent control systems for gaseous and airborne particulates are acceptable and are in compliance with 10 CFR 20.1101, which requires that an acceptable radiation protection program that achieves as low as is reasonably achievable goals is in place and that a constraint on air emissions, excluding radon and its progeny, will be established to limit doses from these emissions; 10 CFR 20.1201, which defines the allowable occupational dose limits for adults; 10 CFR 20.1301, which defines dose limits allowable for individual members of the public; 10 CFR 20.1302, which requires compliance with dose limits for individual members of the public; 10 CFR Part 40, Appendix A, Criterion 5(G)(1), which requires that the chemical and radioactive characteristics of wastes be defined; and 10 CFR Part 40, Appendix A, Criterion 8, which provides requirements for control of airborne effluent releases. The related reviews of the 10 CFR Part 20 radiological aspects of the effluent control systems for gaseous and airborne radionuclides in accordance with standard review plan Sections 5.0, “Operations;” and 7.0, “Environmental Effects” are addressed elsewhere in this safety evaluation report.

4.2 Liquid and Solid Effluents

This section describes the NRC staff’s evaluation of the licensee’s description of the design of effluent control systems for liquid and solid effluents at the Jane Dough Unit. The licensee provided information on liquid and solid effluent control systems at the Jane Dough Unit in the Jane Dough Technical Report (Uranerz 2014f). The purpose of liquid and solid effluent control systems is to prevent and minimize the spread of liquid and solid contamination of the environment by the use of engineered controls and to ensure compliance with radiation dose limits for the public.

4.2.1 Regulatory Requirements

For liquid effluents generated at the Nichols Ranch ISR Project, the licensee must demonstrate compliance with 10 CFR 20.1301; 10 CFR 20.2002, "Method for Obtaining Approval of Proposed Disposal Procedures"; and 10 CFR 20.2007, "Compliance with Environmental and Health Protection Regulations." For solid effluents generated at the Nichols Ranch ISR Project, the licensee must demonstrate compliance with 10 CFR Part 40, Appendix A, Criterion 2.

4.2.2 Regulatory Acceptance Criteria

The Jane Dough Technical Report was reviewed for compliance with the applicable requirements of 10 CFR Part 20 and Part 40 using the acceptance criteria outlined in SRP Section 4.2.3 (NRC 2003).

4.2.3 Staff Review and Analysis

4.2.3.1 Liquid Waste

In its Jane Dough Technical Report, the licensee did not propose changes to its NRC-approved liquid waste systems at the Nichols Ranch ISR Project. The NRC staff finds this is acceptable because, as described in more detail below, proposed activities in the Jane Dough Unit are similar to existing licensed activities and, as a result, no new liquid waste systems would be needed.

The Nichols Ranch ISR Project liquid wastes that were previously evaluated by NRC include: (1) liquid byproduct material waste, which is regulated by NRC, (2) liquid waste generated during well development and pumping tests, which are not regulated by NRC but are regulated by the Wyoming Department of Environmental Quality (WDEQ), (3) domestic liquid wastes, such as wastes from restrooms and lunch facilities, which are not regulated by NRC, and (4) other hazardous and non-hazardous liquid wastes which are not regulated by NRC but which may be regulated by other Federal and State government agencies (NRC 2011a).

With regard to liquid byproduct material waste, the licensee will continue to use deep disposal wells located in the Nichols Ranch Unit. The staff's evaluation of compliance with alternative disposal requirements in 10 CFR 20.2002 is provided in its 2011 safety evaluation report for the Nichols Ranch ISR Project (NRC 2011a). In that analysis, the NRC staff estimated the dose rate from gamma radiation at the top of a 1,127 m (3,700 ft) deep disposal well that contains 100 curies of radium-226 in secular equilibrium with its daughters at the bottom of the well. The original 10 CFR 20.2002 analysis is very conservative because a total quantity of radium-226 injected for the life of the project was assumed to remain at the bottom of the well, in a direct line of sight to the surface, rather than spread laterally throughout the disposal formation. Even under these assumptions, the dose rate at the surface was estimated to be indistinquishable from natural background. The margin of safety in the staff's very conservative dose analysis for disposal of liquid byproduct material waste from the Nichols Ranch Unit is more than sufficient to accommodate additional wastes from operations in Jane Dough. Also, as noted in Section 1.3 of this SER, the licensee has installed two of four deep disposal wells that it is authorized by the State of Wyoming Department of Environmental Quality (WDEQ) to install and operate (WDEQ 2013a, 2013b). The licensee is also authorized to install 4 deep disposal wells at the Hank Unit. The staff finds that approval of the deep disposal wells by WDEQ satisfies 10 CFR 20.2007, which requires that disposal by injection in deep wells must meet any other applicable Federal, State, and local government regulations pertaining to deep well injection.

With regard to liquid waste generated during well development and pumping tests, the licensee will continue to comply with applicable WDEQ permit requirements.

With regard to domestic liquid wastes, the licensee is not proposing any new structures in the Jane Dough Unit and, therefore, does not expect changes in its operation of onsite septic systems.

With regard to other hazardous and non-hazardous liquid wastes which are not regulated by NRC but which may be regulated by other Federal and State government agencies, the nature of the well field operations in the Jane Dough Unit does not introduce any new regulated liquid wastes.

4.2.3.2 Solid Waste

In its Jane Dough Technical Report, the licensee did not propose changes to its NRC-approved solid waste systems at the Nichols Ranch ISR Project. The Jane Dough Technical Report states that the licensee will continue to dispose of 46 to 69 cubic meters (60 to 90 cubic yards) of 11.e(2) byproduct material waste per year. The NRC staff finds this is acceptable because, as described in more detail below, proposed activities in the Jane Dough Unit are similar to existing licensed activities and, as a result, no new solid waste systems would be needed.

The licensee has an agreement in place to dispose of NRC-regulated solid byproduct material (Uranerz 2013a). The NRC staff determined that the total quantity that may be disposed of under this agreement is several times greater than the total quantity the licensee expects to generate over the extended life of the project. The annual quantity of waste generated will remain the same because the licensee will not increase production rates, but will extend the life of the Nichols Ranch ISR Project to include uranium recovery from the Jane Dough Unit. Since the licensee expects to generate annually the same amount of solid 11.e(2) byproduct material waste if licensed activities in the Jane Dough Unit are approved, and the licensee has an agreement in place for several times greater volume than the total volume the licensee expects to generate over the extended life of the project, the NRC staff's assessment of disposal capacity remains unchanged. Therefore, the NRC staff finds the maximum total quantity of byproduct material provided for in this agreement is sufficient to dispose of additional waste generated as a result of operations in the proposed Jane Dough Unit. In addition, license condition 9.9 requires the licensee to notifiy the NRC if the agreement is terminated or expires, and to either provide to NRC for review any new agreement which may be put in place or cease further lixiviant injection.

With regard to solid non-byproduct material, the licensee plans to continue to collect onsite and dispose of this waste in nearby sanitary landfills (Uranerz 2014f).

4.2.4 Evaluation Findings

The staff reviewed the aspects of solid and liquid effluents results from adding operations in the Jane Dough Unit to the Nichols Ranch ISR Project in accordance with SRP Section 4.2.3, "Acceptance Criteria." The licensee described the solid and liquid effluents that would be generated. As described in SER Section 3.1, an acceptable disposal method (i.e., deep disposal wells) is identified for liquid byproduct material, and the disposal method would be of sufficient capacity to handle liquids from production and restoration efforts. The licensee also continues to maintain a disposal agreement for solid byproduct material.

The NRC staff concludes that the effluent control systems for liquids and solids generated by the facility meet the applicable acceptance criteria of SRP Section 4.2.3 and 10 CFR Part 20 and Part 40 requirements. This conclusion is based on the review conducted by the staff as indicated above, the information provided in the application, as updated, and the information required in accordance with the license condition 10.11.

5.0 OPERATIONS

The NRC staff has determined that much of this aspect of the proposed facility and its operations, with the exception of items discussed below, should not be reexamined. Appendix A, "Guidance for Reviewing Historical Aspects of Site Performance for License Renewals and Amendments," of NUREG-1569 states:

> If, after a review of these historical aspects of site operations, the staff concludes that the site has been operated so as to protect health and safety and the environment and that no unreviewed safety-related concerns have been identified, then only those changes proposed by the license renewal or amendment application should be reviewed using the appropriate sections of this standard review plan. Aspects of the facility and its operations that have not changed since the last license renewal or amendment should not be reexamined.

The following sections describes which operations descriptions were not changed in the Jane Dough Technical Report, and which did change and required re-examination by NRC staff.

5.1 Operations Descriptions Not Changed

The NRC staff has determined that the following aspects of the proposed license amendment request, as described in the licensee's Jane Dough Technical Report (Uranerz 2014f), should not be reexamined:

5.1, "Corporate Organization and Administrative Procedures"
5.2, "Management Control Program"
5.3, "Management Audit and Inspection Program"
5.4, "Qualifications for Personnel Conducting the Radiation Safety Program"
5.5, "Radiation Safety Training"
5.6, "Security"

and the following sub-parts of Section 5.7, "Radiation Safety Controls and Monitoring":

5.7.1, "Effluent Control Techniques"
5.7.2, "External Radiation Exposure Monitoring Program"
5.7.3, "Airborne Radiation Monitoring Program"
5.7.4. "Exposure Calculations"
5.7.5, "Bioassay Program"
5.7.6, "Contamination Control Program"

The licensee descriptions of the sections listed above in the Jane Dough Technical Report (Uranerz 2014f) were the same as those provided previously in the Nichols Ranch ISR Project Technical Report (Uranerz 2007). The NRC staff previously reviewed these sections of the Nichols Ranch ISR Project Technical Report (Uranerz 2007) and found acceptable the licensee's program descriptions (NRC 2011a). The NRC staff finds nothing to invalidate its previous findings and previous staff conclusions remain valid. In addition, the NRC staff has not identified any unreviewed safety-related concerns pertaining to the licensee's methodologies for conducting post-reclamation and decommissioning surveys.

The following three sections, "Airborne Effluent and Environmental Monitoring," and "Ground-Water and Surface-Water Monitoring Programs," and "Quality Assurance," address areas either

where the license amendment described information unique to the Jane Dough Unit or differences from the Nichols Ranch Unit or where the NRC staff have determined that there are aspects of the license that should be clarified with respect to the Jane Dough Unit.

5.2 Airborne Effluent and Environmental Monitoring

This section discusses the licensee's proposed changes to its airborne effluent and environmental monitoring program to include operations in the Jane Dough Unit, which focuses on radiation monitoring outside of the Nichols Ranch Unit CPP area during operations.

5.2.1 Regulatory Requirements

The staff determines if the licensee has demonstrated that proposed revisions to its airborne effluent and environmental monitoring program for the Nichols Ranch ISR Project meet the requirements of 10 CFR 20.1301, 10 CFR 20.1302, 10 CFR 20.1101(d), 10 CFR 20.1501 10 CFR 40.65, and Criterion 7 and 8 of Appendix A to 10 CFR Part 40.

5.2.2 Regulatory Acceptance Criteria

The Jane Dough Technical Report was reviewed for compliance with the applicable requirements of 10 CFR Part 20 and Part 40 using the acceptance criteria outlined in SRP Section 5.7.7.3, "Acceptance Criteria" (NRC 2003). Regulatory Guide 4.14, "Radiological Effluent and Environmental Monitoring at Uranium Mills" (NRC 1980), and Regulatory Guide 8.37, "ALARA Levels for Effluents from Materials Facilities" (NRC 1993b), provide guidance on how to demonstrate compliance with the applicable regulations.

5.2.3 Staff Review and Analysis

Unless otherwise stated, the information reviewed in this section is from information, data, and maps submitted by Uranerz in its Jane Dough Technical Report (Uranerz 2014f) and other sources, as described below. The following sections discuss the licensee's proposed revisions to its airborne effluent and environmental monitoring program. This includes radiation monitoring outside of the plant area during operations and environmental monitoring around the facility.

5.2.3.1 Airborne Effluent Monitoring

The NRC's evaluation of the licensee's airborne effluent monitoring program is provided in the Safety Evaluation Report for the Nichols Ranch ISR Project (NRC 2011a) and, as described in detail below, in a subsequent Safety Evaluation Report in support of removing preoperational license conditions (NRC 2014a). In the 2011 evaluation, NRC staff stated that "it has determined that it does not have adequate information to determine if the licensee's monitoring program for gaseous effluents is in compliance with 10 CFR [20.]1302(a), Criterion 8 of Appendix A to 10 CFR Part 40, and 10 CFR 40.65, nor can the staff determine if the program is consistent with Regulatory Guides 4.14 and 8.37. Therefore, the staff will impose the license condition described in SER Section 4.1.4, which will require the licensee to adequately describe its monitoring program for effluent releases to demonstrate compliance with the 10 CFR Part 20 and 10 CFR Part 40 requirements." The text of license condition 12.8 in the initial license was:

> "Prior to the preoperational inspection, the licensee shall provide for the following information for the airborne effluent and environmental monitoring program in

which it shall develop written procedures to:

(a) Discuss how, in accordance with 10 CFR 40.65, the quantity of the principal radionuclides from all point and diffuse sources will be accounted for, and verified by, surveys and/or monitoring.

(b) Evaluate the member(s) of the public likely to receive the highest exposures from licensed operations consistent with 10 CFR 20.1302.

(c) Discuss and identify how radon (radon-222) progeny will be factored into analyzing potential public dose from operations consistent with 10 CFR Part 20, Appendix B, Table 2.

(d) Discuss how, in accordance with 10 CFR 20.1501, the occupational dose (gaseous and particulate) received throughout the entire license area from licensed operations will be accounted for, and verified by, surveys and/or monitoring."

In response to the license condition described above, Uranerz submitted letters dated February 19, 2014, February 28, 2014, March 6, 2014, and March 11, 2014 (Uranerz 2014b, 2014c, 2014d, 2014e). These letters provided additional information about the licensee's monitoring program for air effluent releases. The NRC staff evaluated the program descriptions contained in these letters and, in April 2014, approved License Amendment 2 to remove license condition 12.8 (NRC 2014a). At that time, the NRC staff also revised license condition 9.2 of the Nichols Ranch ISR Project license SUA-1597 to state that the licensee shall conduct operations in accordance with licensee's commitments, representations, and statements contained in these four letters.

In a November 7, 2016, request (Uranerz, 2016o), the licensee consolidated into one letter its previous commitments contained in its letters dated February 19, 2014, February 28, 2014, March 6, 2014, and March 11, 2014 (Uranerz 2014b, 2014c, 2014d, 2014e). Therefore, as explained in Appendix B of this SER, the NRC staff will revise license condition 9.2 to include the November 7, 2016, letter, rather than the four previous letters.

A similar pre-operational license condition as described above (license condition 10.17) remains for future operations in the Hank Unit. The NRC staff has reviewed the commitments in the letter described above (Uranerz 2016o) and finds that the licensee's commitments, statements, and representations, are sufficiently broad to encompass operations at the Jane Dough Unit, as described further below.

The expansion of the Nichols Ranch ISR Project to include the Jane Dough Unit will involve the construction, operation, and restoration of new well fields, but no new central processing plant or satellite facility. Well fields are a source of diffuse emissions of gaseous radon, radon progeny, and radioactive particulate matter. Therefore, in this SER, the staff focused its review on the licensee's proposed revisions to its airborne effluent monitoring program to include diffuse emissions of gaseous radon and radon progeny, and radioactive particulate matter, from licensed wellfield activities in the Jane Dough Unit.

Effluent Monitoring

In accordance with the licensee's specific commitments regarding effluent monitoring (Uranerz 2016o), the licensee is required to measure airborne concentrations of radon progeny and radionuclide particulate matter emissions in well field header houses using the modified Kusnetz method (for radon progeny) and semi-annual isotopic analyses of monthly gross alpha sample filters (for particulate matter). The measured concentrations are used with estimates of the exhaust header house fan flow rates to estimate annual radionuclide release rates. In the wellfields, the licensee is required to sample ten percent of the recovery wells for radon progeny emissions using the modified Kusnetz method. The licensee will also measure radon progeny emissions from unplanned releases using the modified Kusnetz method.

The NRC staff previously reviewed and found acceptable the licensee's effluent monitoring procedures at its Nichol's Ranch ISR Project (NRC 2014a). The NRC staff finds nothing to invalidate its previous findings and previous staff conclusions remain valid.

Evaluating dose to the public

By letter dated March 6, 2014, the licensee identified the dose to the member of the public likely to receive the highest dose from its operations at the Nichols Ranch Unit and Hank Unit, based on an evaluation of categories of members of the public that are likely to spend at least 50 hours per year in the vicinity of the site (Uranerz 2014d). The licensee calculated a maximum public dose of 0.67 mrem/year for a coal bed methane (CBM) worker.

In its Jane Dough Technical Report, the licensee did not revise its March 2014 detailed evaluation of the maximally exposed member of the public to include licensed activities in the Jane Dough Unit. However, the licensee did provide in Addendum JD-D11-A, "MILDOS Report," of the Jane Dough Technical Report the results of an analysis using the MILDOS-AREA code. The MILDOS-AREA output in Addendum JD-D11-A shows that the licensee modeled doses to 19 off-site receptors within 20 km (12.5 mi) over 10 years of operations in all 3 areas (Nichols, Hank and Jane Dough) using 2 years of onsite meteorological data. The licensee also modeled collective doses for the offsite population within 80 km (50 mi). The licensee stated that particulate matter radionuclides do not contribute significantly to offsite dose. Therefore, the licensee modeled only radon-222 releases. From Jane Dough Technical Report Table JD-D11-23, the licensee estimated that the individual likely to receive the highest dose is a resident at the Pumpkin Butte Ranch in the years 2018 to 2020, who receives an effective dose equivalent of 0.4 mrem/year. The licensee stated all doses were below the 100 mrem per year dose standard in 10 CFR 20.1301 for individual members of the public.

To evaluate the licensee's calculation, the NRC staff used the licensee's detailed production schedule in Jane Dough Technical Report, Figure 3-12, "Production, Restoration, and Reclamation Schedule," the licensee's descriptions of individual emission sources, and the MILDOS-AREA computer code, to independently calculate the dose to the member of the public likely to receive the highest dose (NRC 2016e). The NRC staff modeled wellfield bleed from the Nichols Ranch Unit and Jane Dough Unit as point sources located at the Nichols Ranch CPP waste tank vent and wellfield bleed from the Hank Unit as a point source located at the Hank Satellite waste tank vent. The NRC staff also modeled wellfield leaks in each production area as separate area

sources. The NRC staff did not consider the relatively small emissions (i.e., less than 1% of the total emissions) associated with ion-exchange resin transfers. The NRC staff used 4 years of on-site meteorological data (Uranerz 2015c). The NRC staff used the 19-year production schedule included in Jane Dough Technical Report Figure 3-12, "Production, Restoration, and Reclamation Schedule," to estimate annual emissions from each source. The NRC staff evaluated nearby individuals likely to receive the highest dose, including: residents at T-Chair Ranch; Dry Fork Ranch, Pumpkin Butte Ranch, the CPP man camp, and a coal-bed methane worker located west of the CPP. The highest annual collective effective dose equivalent was estimated by the NRC staff to be 0.05 mSv (5 mrem) in the year 2023 at the Nichols Ranch CPP man camp. Figure 3-12, "Production, Restoration, and Reclamation Schedule," indicates that expected operations in the year 2023 include simultaneous restoration of both production areas in the Nichols Ranch Unit wellfields and wellfield production operations in both production areas in the Jane Dough Unit. For comparison with the licensee's estimate described above, the NRC staff's estimate of the highest dose to the resident at Pumpkin Butte Ranch is 0.01 mSv (1 mrem) in the year 2028 resulting from restoration and production activities in the Hank Unit. These doses are below the 1 mSv (100 mrem) per year dose standard in 10 CFR 20.1301 for individual members of the public and are, therefore, acceptable.

Consideration of radon-222 progeny

In accordance with commitments by the licensee made in the four letters described above, which includes operations in the Jane Dough Unit, the licensee is required to measure radon at the boundary of the unrestricted areas. At the Nichols Ranch ISR Project, unrestricted areas are located outside the CPP and outside well field production areas. At these boundaries, the annual average concentrations measured using RADTRAK detectors will be compared to 10 CFR Appendix B Table 2 radon progeny effluent concentrations to demonstrate compliance with 10 CFR 20.1302. This method is acceptable because it is consistent with the compliance demonstration described in 10 CFR 20.1302(b)(2).

Consistent with the two methods of compliance described in 10 CFR 20.1302(b), the licensee also described two alternative methods by which it could demonstrate compliance with public dose limits. In the first alternative method, the licensee will measure and calculate source terms for each point and diffuse source. The licensee will then use these source terms to calculate downwind concentrations of radionuclides using one of two computer codes, CAP88-PC or MILDOS-AREA. The licensee will use calculated concentrations to verify measured values at the controlled area boundary.

In the second alternative method, the licensee will perform a dose assessment for an individual in workforce housing and a coal bed methane worker using radon-222 concentrations measured at receptor locations. The licensee also committed to assume that radon-222 and its short-lived progeny are in 100% equilibrium until it develops a site-specific equilibrium value, and it will develop site-specific occupancy factors. The licensee will compare the calculated doses to the 100 mrem/year TEDE limit in 10 CFR 20.1301. These methods are acceptable because they are consistent with the methods for demonstrating compliance with 10 CFR 20.1301 described in 10 CFR 20.1302.

Accounting for occupational dose from radionuclides in air in the licensed area

The licensee is required to monitor occupational dose using the types and locations of monitoring described in Attachment 1 of its November 7, 2016, submittal (Uranerz 2016o), which will be documented in license condition 9.2. The licensee has not proposed revisions to these elements of its effluent monitoring program. Therefore, these elements will also be required for licensed activities in the Jane Dough Unit.

5.2.3.2 Environmental Monitoring

The licensee's operational environmental monitoring program is described in Jane Dough Technical Report Section 5.7.7, "Airborne Effluent and Environmental Monitoring," which the licensee did not change from the same section of the Nichols Ranch ISR Project Technical Report (Uranerz 2007). The operational monitoring program involves collection of environmental samples using the same methods and the same locations described for the pre-operational sampling program. The NRC staff's evaluation of sample locations and baseline radiological characterization for the Jane Dough Unit is described in Section 2.9 of this SER.

5.2.4 Evaluation Findings

NRC has completed its review of changes to the airborne effluent and environmental monitoring program at the Nichols Ranch ISR Project to include the Jane Dough Unit. This review included an evaluation using the review procedures in standard review plan Section 5.7.7.2, "Review Procedures," and the acceptance criteria outlined in standard review plan Section 5.7.7.3, "Acceptance Criteria."

The licensee has established acceptable airborne effluent and environmental monitoring programs at the Nichols Ranch ISR Project. The programs are consistent with guidance in Regulatory Guide 4.14 (NRC 1980). The licensee will continue to sample radon, air particulates, surface soils, subsurface soils, vegetation, direct radiation, and sediment. Locations of monitoring stations are consistent with Regulatory Guide 4.14 (NRC 1980). Instrumentation is appropriate.

Based on the information provided in the Jane Dough Technical Report and the detailed review conducted of the airborne effluent and environmental monitoring programs at the Nichols Ranch ISR Project, the staff concludes that the airborne effluent and environmental monitoring programs are acceptable and are in compliance with 10 CFR 20.1302, which requires effluent monitoring to determine dose to individual members of the public; 10 CFR 20.1501, which specifies survey and monitoring requirements; 10 CFR Part 20, Subpart L, which establishes record keeping requirements; and 10 CFR 40.65, which specifies effluent and environmental monitoring requirements.

5.3 Ground Water and Surface Water Monitoring Programs

5.3.1 Regulatory Requirements

The staff determines if the licensee has demonstrated that the proposed ground water and surface water monitoring program for the Jane Dough Unit meets the requirements of 10 CFR 40.32(c); 10 CFR 40.41(c); and 10 CFR Part 40, Appendix A, Criterion 5B(5) and 5D.

5.3.2 Regulatory Acceptance Criteria

The Jane Dough Technical Report was reviewed for compliance with the applicable requirements of 10 CFR Part 40 using the acceptance criteria outlined in SRP Section 5.7.8.3 (NRC 2003) regarding the early detection and timely restoration of excursions.

5.3.3 Staff Review and Analysis

Unless otherwise stated, the information reviewed in this section is from information, data, and maps submitted by Uranerz in the Jane Dough Technical Report (Uranerz 2014f). In this section, the staff reviewed the ground water and surface water monitoring programs to be implemented at the Jane Dough Unit to establish monitoring well placement, background water quality, and detect excursions during production operations. SER Section 2.5 addresses preoperational monitoring, and SER Section 6.1 addresses restoration monitoring.

The following sections address mine unit operation groundwater monitoring, new mine unit hydrologic packages, groundwater excursion monitoring and corrective action and other sampling.

5.3.3.1 Mine Unit Operational Groundwater Monitoring Locations

The licensee stated that the purpose of the operational groundwater monitoring program is to detect potential excursions of lixiviant outside of the production wellfield area or excursions into the overlying or underlying aquifers. The licensee indicated the operational monitoring program for all mine units will consist of excursion monitoring at designated wells in the surrounding perimeter monitoring well ring and in the overlying and underlying aquifers (Uranerz 2014f). In Section 5.7.8.2, “Monitor Well Spacing,” of the Jane Dough Technical Report the licensee stated that the perimeter monitoring wells will be completed in the same zone as the ore zone and will be located approximately 152 m (500 ft) from the production area boundary and 152 m (500 ft) apart as shown in the Jane Dough Technical Report Figure 3-8c, “Jane Dough Unit Proposed Monitor Well Locations,” and Figure 3-9 “Typical 5-Spot Well Pattern.”

In Section 5.7.8.2, “Monitor Well Spacing,” of the Jane Dough Technical Report (Uranerz 2014f) the licensee stated that vertical excursion monitoring wells will be installed in the overlying and underlying aquifers at a density of one well per every four acres of wellfield. In the case of the wellfield becoming very narrow where a line drive pattern may be utilized, overlying and underlying aquifer monitor wells will not be more than approximately 305 m (1,000 ft) apart from one another.

In Section 3.4.5, “Well Completion,” of the Jane Dough Technical Report (Uranerz 2014f) the licensee stated that excursion monitoring wells (overlying, underlying and perimeter ring) will be screened across the entire sand thickness in the aquifer in which they are completed.

The licensee stated in Section 2.7.2.2.3, “Aquifer Description,” of the technical report that where the AB mudstone is present, the B Sand, which overlies the AB mudstone, will be designated as the overlying aquifer relative to the A Sand production zone. The licensee stated that where the AB mudstone is absent (absence is defined as where the AB mudstone is less than 3 m [10 feet] thick (Uranerz 2016a)), the B Sand sits directly upon the A sand and therefore the A and B sands effectively combine into a single aquifer unit. The licensee stated that where this is the

case, the aquifer above the B Sand is designated as the overlying aquifer relative to the production zone. The licensee stated (Uranerz 2016a) that where the AB Sand is designated as the production zone, the perimeter ring monitoring wells would be completed in the A Sand only, rather than throughout the combined AB Sand. The NRC staff considers this approach acceptable because completing a monitoring well over the entire thickness of the AB Sand (approximately 91 m [300 ft]) could result in the dilution of indicator parameter concentrations such that a timely warning of an excursion is not provided. Completing the monitoring well in the A Sand will allow the licensee to detect horizontal excursions earlier than monitoring wells that are screened over a larger thickness by limiting the sampling zone (i.e., the well completion zone) to areas where production fluid migration is more likely to occur.

Consistent with its practice at the currently-licensed Nichols Ranch ISR Project, the licensee does not plan to install monitoring wells in the underlying aquifer (i.e., the 1 Sand) when the thickness of the confining unit that separates the 1 Sand from the production zone is greater than 15.2 m (50 ft) thick. This practice was approved by NRC (2013) for the Nichols Ranch Unit and is consistent with SRP acceptance criterion 5.7.8.3(3).

The NRC staff finds the licensee's planned density and location of monitoring wells consistent with the acceptance criteria in SRP Section 5.7.8.3(1) and Section 5.7.8.3(3). Existing standard license condition 11.3 of Source Materials License SUA-1597 regarding the establishment of background water quality also applies to operations in any production area, including in the Jane Dough Unit.

5.3.3.2 Ore Zone Groundwater Monitoring Locations

To establish baseline water quality with the A Sand (i.e., the ore zone) at the Jane Dough Unit, the licensee stated in Section 5.7.8.5.1, "Data Collection," of the Jane Dough Technical Report (Uranerz 2014f) that ore zone monitoring wells will be installed at a density of 1 well per 1.6 ha (4 ac) of production area. In Section 3.4.5, "Well Completion," of the Jane Dough Technical Report (Uranerz 2014f) the licensee stated that production zone (ore zone) monitoring wells do not have screens installed in them, although Figure 3-13, "Typical (Injection/Recovery) Well Construction Diagram," indicates a screen may be installed if needed. Jane Dough Technical Report Figure 3-13 also indicates that the ore zone wells will only be completed within the mineralized zone, as opposed to the entire sand thickness.

The NRC staff finds the licensee's planned density and location of monitoring wells consistent with the guidance criteria in SRP Section 5.7.8.3(1).
Existing standard license condition 11.3 of Source Materials License SUA-1597 regarding the establishment of background water quality also applies to operations in any production area, including in the Jane Dough Unit.

5.3.3.3 Baseline Data Water Quality Determination

In Section 5.7.8.5.1, "Data Collection," of the Jane Dough Technical Report (Uranerz 2014f) the licensee describes the data that will be collected to establish the baseline water quality of the ore zone aquifer, underlying aquifer and overlying aquifer. Four samples will be collected from each ore zone and excursion monitoring well. The samples will be collected at least 14 days apart. The samples will be analyzed for the parameters listed in Table D6-6a in Volume VI of Appendix D6 of the technical report

(Uranerz 2007). Samples will not be collected for parameters during third and fourth sampling events if results from the first and second sampling events are below minimum detection levels.

The licensee uses baseline water quality data to calculate restoration target values (RTVs) for the production area and Upper Control Limits (UCLs) for excursion monitoring wells. RTVs are used to determine and assess the effectiveness of groundwater restoration within a production area. The licensee proposes to establish RTVs for the ore zone aquifer on a parameter-by-parameter basis using either a production area average or well-specific basis, depending upon the variability of the water quality within the wellfield. The licensee stated in Section 5.7.8.6, "Statistical Assessment of Baseline Water Quality Data," of the Jane Dough Technical Report (Uranerz 2014f) that it will analyze the data for variability and outliers using statistical assessment methods outlined in the WDEQ-LQD, Guideline 4, guidance document (WDEQ-LQD 2000) or other accepted methods. The licensee listed the target restoration parameters in Jane Dough Technical Report Table 5-1. The RTVs will be set as the mean plus 2 standard deviations of the baseline data.

Section 5.7.8.8, "Upper Control Limits," of the Jane Dough Technical Report states that chloride, conductivity and total alkalinity will be the excursion monitoring parameters. UCLs are concentrations for the excursion monitoring parameters that provide early warning that leaching solutions are moving away from the wellfields.

Section 5.7.8.9, "Calculation of Upper Control Limits," of the Jane Dough Technical Report (Uranerz 2014f) states that the UCLs for total alkalinity and conductance will be established for each production area by calculating the baseline mean concentration and adding five standard deviations. The UCL for chloride will be set at the baseline mean concentration and adding either five standard deviations or 15 mg/L, whichever is higher.

The NRC staff finds the licensee's planned number of samples to be collected and target analyte list consistent with the acceptance criterion in SRP Section 5.7.8.3(1) and therefore acceptable to establish baseline water quality and new wellfields.

The NRC staff finds the licensee's selection of excursion indicator parameters and method for calculating UCLs acceptable because the selection of parameters and UCL method are consistent with the guidance criteria in SRP Section 5.7.8.3(2).

Existing standard license conditions 11.3 and 11.4 of Source Materials License SUA-1597 regarding the establishment of background water quality and upper control limits are applicable to any production area within the Nichols Ranch ISR Project and, therefore, will also apply to operations in the Jane Dough Unit.

The NRC staff previously reviewed and found acceptable the licensee's water quality sampling procedure at its Nichol's Ranch ISR Project (NRC 2011a). The NRC staff finds nothing to invalidate its previous findings and previous staff conclusions remain valid.

5.3.3.4 Groundwater Excursion Monitoring and Corrective Action

In Section 5.7.8.10.1, "Monitoring Frequency and Reporting," of the Jane Dough Technical Report the licensee stated that the excursion monitoring wells will be sampled twice per month at intervals approximately of two weeks for chloride, conductivity and total alkalinity. The

samples will be analyzed within 48 hours of collection. Each monitoring well will have a dedicated submersible pump. Static water levels will also be collected and recorded at the time wells are sampled. All static water levels and monitoring data will be submitted to WDEQ quarterly and kept on site for review by the NRC.

In Section 5.7.8.10.3, "Excursions," of the Jane Dough Technical Report the licensee stated that if any two of the three excursion indicators exceed UCLs, the licensee will verify the possible excursion by resampling the well(s) within 24 hours after reviewing the data from the first analysis. The licensee will split and analyze the verification sample in duplicate to assess analytical error. If a second sample does not verify the excursion, the licensee will take a third sample within 24 hours. If neither the second nor third sample confirms an exceedance, the first sample will be considered in error. If either the second or third sample confirms an exceedance, the well in question will be placed on excursion status. The NRC project manager will be notified within 24 hours by phone or e-mail, and in writing within 5 days.

NRC staff notes that the re-sampling and reporting time requirements described in Section 5.7.8.10.3, "Excursions," of the Jane Dough Technical Report are somewhat more restrictive than that listed in existing License Condition 11.5 of Source Materials License SUA-1597. However, in a subsequent request, the licensee only requested that the time requirement for notifying the NRC project manager by letter of a confirmed excursion be reduced from 7 days to 5 days (Uranerz 2016o) to align with Wyoming Department of Environmental Quality, Land Quality Division (WDEQ/LQD) Chapter 11 Non Coal Rules and Regulations. Therefore, the only revision to License Condition 11.5 will be to reduce to the time requirement for notifying the NRC project manager by letter of a confirmed excursion be reduced from 7 days to 5 days. This administrative change is described in SER Appendix B.

The licensee stated in Section 5.7.8.10.3, "Excursions," of the Jane Dough Technical Report that once an excursion is verified, it will implement corrective actions to recover the excursion. These actions may involve modifying the injection and recovery rates in the affected area until the excursion is mitigated. Sampling will also be increased to every 7 days at the affected wells until the excursion is corrected.

If the concentration of the excursion parameters do not begin to decline after 60 days, the licensee stated in the Jane Dough Technical Report that it will suspend all injection in the ore zone adjacent to the excursion and increase the net withdrawal from the excursion area.

Injection will remain suspended until a decreasing trend in the excursion parameters concentrations are established. The licensee stated that if a declining trend is not established in a reasonable time period, additional measures will be implemented. The licensee also stated that when the excursion parameter concentrations below UCLs are established, normal injection and extraction operations will resume.

The licensee stated in Section 5.7.8.10.3, "Excursions," of the Jane Dough Technical Report that if an excursion remains for more than 60 days, the surety will be increased to an amount that will cover the expected full cost of correcting and cleaning up the excursion. An excursion is considered corrected when the concentrations of excursion parameters are below the concentration levels defining an excursion for three consecutive weekly sample events.

The NRC staff finds the licensee's operational monitor program including the sampling frequency and criteria for determining when an excursion has occurred consistent with the guidance criterion in SRP Section 5.7.8.3(5). Additionally, the licensee's corrective action and

notification plans in the event of an excursion are consistent with the guidance criterion in SRP Section 5.7.8.3(5). Standard license condition 11.5 regarding excursion monitoring will also be imposed on the licensee for the Jane Dough Unit, with the administrative change described in SER Appendix B.

5.3.3.5 Wellfield Testing

In Section 5.7.8.3, "Production Area Pump Test," of the Jane Dough Technical Report, the licensee stated that multi-well pumping tests would be conducted to determine information about the hydrologic characteristics of the production area and the underlying and overlying aquifers within the production area.

The license stated that these tests would yield the following information: hydrologic characteristics of the ore zone aquifer, determination of any hydrologic communication between the ore zone aquifer and the overlying and underlying aquifers, the presence or absence of any hydrologic boundaries in the ore zone aquifer, determination of the degree of hydrologic communication between the ore zone and the monitor well ring, determination of groundwater flow paths, and the vertical permeability of the overlying and underlying confining units that have not already been tested.

In Section 5.7.8.3, "Production Area Pump Test," of the Jane Dough Technical Report the licensee stated that a production area pump test document for each license area will be completed describing the production area geology, hydrogeology, and pumping tests results in detail.

The NRC staff finds the licensee's wellfield testing procedures consistent with the acceptance criterion in SRP Section 5.7.8.3(4).

Existing license condition 10.8 of Source Material License SUA-1597 regarding the documentation and approval of the wellfield testing in the production area pump test (PAPT) document will be revised to include the requirement that the licensee submit for NRC review and written verification the PAPT document for Production Area 1 (the western production area) of the Jane Dough Unit. Production Area 1 is located in a complex hydrogeological setting where the AB mudstone may be absent in some eastern portions of the production area. The presence or absence of the AB mudstone will impact the screening intervals of overlying excursion monitoring wells. NRC staff notes that based on the hydrogeological information provided in the PAPT document for Jane Dough Unit Production Area 1, NRC staff may request additional characterization or monitoring such as trend wells to ensure production fluids are contained within the production zone. A similar requirement in license condition 10.8 that pertained to the Nichols Ranch Unit and Hank Unit will be revised to be consistent with the Jane Dough Unit requirement and to remove reference to the Nichols Ranch Unit Production Area 1 PAPT, which has already been approved by NRC (NRC 2013).

5.3.3.6 Other Sampling

In addition to well field monitoring, the licensee stated in Jane Dough Technical Report Section 5.7.8.10.1, "Monitoring Frequency and Reporting," that any private wells within 1 km (0.6 mi) of the well field area boundaries completed in the same sand as the ore will be sampled quarterly for natural uranium and radium-226. The licensee did not identify wells meeting this criteria.

SRP Section 5.7.7.3, “Water Samples,” suggests that the intent of Regulatory Guide 4.14, “Radiological Effluent and Environmental Monitoring at Uranium Mills,” Regulatory Position C., 2.1, “Operational Sampling Program,” (NRC 1980) should be followed for environmental monitoring. Regulatory Guide 4.14 suggests sampling of all private wells within 2 km (1.2 mi) of a tailings impoundment. While an ISR well field is not a tailings impoundment, the staff agrees that sampling of private wells near a source of byproduct material, such as the ISR well field, is prudent and protective of public health and safety. The NRC staff previously reviewed Section 5.7.8.10.1 of the Nichols Ranch ISR Project Technical Report (Uranerz 2007) and found the sampling distance of 1 km (0.6 mi) from the well field acceptable and consistent with that used by other NRC-licensed ISR facilities (NRC 2011a).

However, the NRC staff found that the sampling of only those wells completed in the same sand as the ore is unacceptable, noting that excursions at ISR facilities are possible in aquifers above, below, and adjacent to the ore zone. The NRC staff, therefore, required by license condition 11.7 of Source Materials License SUA-1597 that all private wells, such as domestic and stock wells, within 1 km (0.6 mi) be sampled yearly for UCL parameters, natural uranium, and radium-226. License condition 11.7 will be revised to include the requirement that the licensee sample all domestric and livestock wells located within 1 kilometer of the production area monitoring ring wells for the Jane Dough Unit.

The licensee stated in Section 5.7.8.11, “Operational Surface Water Monitoring Program,” of the Jane Dough Technical Report that surface water samples will be collected in the same locations that were used during the preoperational background sampling for the Jane Dough Unit. The surface water samples will be collected and measured for the constituents listed in Jane Dough Technical Report Table JD-D6A.1-1, “Surface Water Quality,” of the whenever water is present. The measurements will be reported to the NRC in the semiannual monitoring report. The NRC staff reviewed the groundwater and surface water monitoring program for the proposed Jane Dough Unit in accordance with SRP Section 5.7.8.3(6).

5.3.4 Evaluation Findings

The NRC staff notes that the surface water and groundwater program proposed for the Jane Dough Unit is consistent with that used for the currently licensed Nichols Ranch Unit.

As described in SER Section 5.3.3.5, “Wellfield Testing,” the NRC staff is revising license condition 10.8 of Source Material License SUA-1597 regarding the documentation and approval of the wellfield testing in the production area pump test (PAPT) document to include the requirement that the licensee submit for NRC review and approval the PAPT document for the first production area in the Jane Dough Unit.

10.8 Production Area Pump Test Document

> The licensee *shall submit to NRC* the Production Area Pump Test (PAPT) document for the first production area~~s~~ at the ~~Nichols Ranch and~~ Hank Unit~~s~~ *and shall receive written verification* prior to lixiviant injection into the production area.
>
> *The licensee shall submit to NRC the PAPT document for Production Area 1 (the western production area) at the Jane Dough Unit and shall receive written verification prior to lixiviant injection into the production area.*

The licensee will provide PAPT documents for each additional *Nichols Ranch ISR project* production area for NRC review. The PAPT document will provide all background ground water data, restoration target values, upper control limits at each monitoring well, as well as the information outlined in Section 5.7.8.4 of the license application.

License condition 11.7 is being revised to include the Jane Dough Unit.

11.7 The licensee shall identify the location, screen depth, and estimated pumping rate of any new ground water wells or new use of an existing well within the license area and within 2 kilometers of any production area. The licensee shall evaluate the impact of ISR operations on potential ground water users and recommend any additional monitoring or other measures to protect ground water users. The evaluation shall be submitted as part of the annual reporting to the NRC for review.

After the commencement of uranium recovery operations *in any new production area*, the licensee will sample all domestic and livestock wells that are located within 1 kilometer of the production area monitoring ring wells (MRwells) ~~of the Nichols Ranch and Hank Units~~. Samples shall be collected annually and submitted as part of annual reporting to the NRC until ground water restoration is approved at the production area. Samples shall be analyzed for the UCL parameters in Section 5.7.8.9 of the approved license application and for natural uranium and radium-226.

Based on its review (described above) of the information provided in the Jane Dough Technical Report, as supplemented by the noted license conditions, the NRC staff concludes that the ground water and surface water monitoring programs meet the applicable acceptance criteria of SRP Section 5.7.8.3 and comply with the following regulations:

- 10 CFR 40.32(c), which requires the applicant's proposed equipment, facilities, and procedures to be adequate to protect health and minimize danger to life and property
- 10 CFR 40.41(c), which requires the applicant to confine source or byproduct material to the location and purposes authorized in the license
- 10 CFR Part 40, Appendix A, Criterion 5B(5), which provides concentration limits for hazardous constituents
- 10 CFR Part 40, Appendix A, Criterion 5D, which requires a ground water corrective action program
- 10 CFR Part 40, Appendix A, Criterion 7A, which requires a detection monitoring program

5.4 Quality Assurance

The NRC staff has determined that this aspect of the proposed facility and its operations, "Quality Assurance," should not be reexamined. Appendix A, "Guidance for Reviewing Historical Aspects of Site Performance for License Renewals and Amendments," of NUREG-1569 states:

> If, after a review of these historical aspects of site operations, the staff concludes that the site has been operated so as to protect health and safety and the environment and that no unreviewed safety-related concerns have been identified, then only those changes proposed by the license renewal or amendment application should be reviewed using the appropriate sections of this standard review plan. Aspects of the facility and its operations that have not changed since the last license renewal or amendment should not be reexamined.

The licensee did not propose changes to Section 5.7.9, “Quality Assurance,” of the Jane Dough Technical Report, as compared to the same section of the Nichols Ranch ISR Project Technical Report (Uranerz 2007), except to change the verb tense in the first two sentences to reflect the fact that a quality assurance program (QAP) has been developed. In Section 5.7.9 of the Jane Dough Technical Report, the licensee stated that a QAP has been established for all radiological, effluent, and environmental programs. When NRC staff originally issued Source Materials License SUA-1597, the license contained pre-operational license condition 12.13, which stated:

> At least 30 days prior to the preoperational inspection, the licensee will submit a Quality Assurance Program (QAP) to the NRC for review to verify the license application statement that the QAP will be consistent with Regulatory Guide 4.15.

The licensee provided a QAP plan on February 13, 2014 (Uranerz 2014a). The NRC staff evaluated the licensee’s QAP prior to the preoperational inspection at the Nichols Ranch ISR Project, as described in an April 2014 Safety Evaluation Report in support Amendment No. 2 of Source Materials License SUA-1597 (NRC 2014a). The NRC staff evaluated the QAP and removed license condition 12.13 and added license condition 10.16, which states:

> The licensee will maintain and implement a Quality Assurance Program consistent with Regulatory Guide 4.15 "Quality Assurance for Radiological Monitoring Programs (Normal Operations) – Effluent Streams and the Environment," as revised.

This license condition, and the licensee’s QAP, are not changed as a result of the Jane Dough license amendment request. As stated above, the NRC staff’s previous findings on the licensee’s QAP are contained in its 2014 SER for the Nichol’s Ranch ISR Project (NRC 2014).

6.0 GROUNDWATER QUALITY RESTORATION, SURFACE RECLAMATION, AND FACILITY DECOMMISSIONING

The NRC staff's evaluation in this section of the SER is focused on the licensee's description of its ground-water quality restoration program, surface reclamation, and facility decommissioning for the Jane Dough Unit. The NRC staff previously reviewed the licensee's plans for ground-water quality restoration, surface reclamation, and facility decommissioning at the Nichols Ranch ISR Project (Uranerz 2007), in its 2011 SER for the Nichols Ranch ISR Project (NRC 2011a). In the Jane Dough Technical Report, the licensee made relatively few changes to its descriptions of its ground-water quality restoration program, surface reclamation plans, and facility decommissioning plans. Therefore, in accordance with Appendix A of the SRP (NRC 2003), the NRC staff has determined that only those changes proposed in the Jane Dough Technical Report (Uranerz 2014f) should be reviewed using the appropriate sections of the SRP (NRC 2003). Aspects of the facility and its operations that have not changed since the last license renewal or amendment will not be re-examined. The NRC staff's evaluation of any changes to these programs and plans is provided in the following sections.

6.1 Plans and Schedules for Ground Water Quality Restoration

6.1.1 Regulatory Requirements

The staff determines if the licensee has demonstrated that the proposed plans and schedules for ground water quality restoration for the Jane Dough Unit meet the requirements of 10 CFR 40.32(c), 10 CFR Part 40.42, and Criterion 5B(5) of Appendix A to 10 CFR Part 40.

6.1.2 Regulatory Acceptance Criteria

Unless specifically stated otherwise, the Jane Dough Technical Report was reviewed for compliance with the applicable requirements of 10 CFR Part 40, using the acceptance criteria presented in Section 6.1.3 of NUREG-1569 (NRC 2003).

6.1.3 Staff Review and Analysis

The NRC staff has determined that several aspects of the proposed facility and its operations, "Plans and Schedules for Ground Water Quality Restoration" should not be reexamined. Appendix A, "Guidance for Reviewing Historical Aspects of Site Performance for License Renewals and Amendments," of NUREG-1569 states:

> If, after a review of these historical aspects of site operations, the staff concludes that the site has been operated so as to protect health and safety and the environment and that no unreviewed safety-related concerns have been identified, then only those changes proposed by the license renewal or amendment application should be reviewed using the appropriate sections of this standard review plan. Aspects of the facility and its operations that have not changed since the last license renewal or amendment should not be reexamined.

The licensee did not propose significant changes to Section 6.1 "Groundwater Restoration" of the Jane Dough Technical Report (Uranerz 2014f), as compared to the same sections of the Nichols Ranch ISR Project Technical Report (Uranerz 2007). The

NRC staff previously reviewed Section 6.1 of the Nichols Ranch ISR Project Technical Report (Uranerz 2007) and found acceptable the licensee's plans for and descriptions of restoration standards, restoration methods, post-restoration stability monitoring, deep well injection of restoration wastewater and methods for abandoning wells at its Nichol's Ranch ISR Project (NRC 2011a). The NRC staff finds nothing to invalidate its previous findings and previous staff conclusions remain valid. In addition, the NRC staff has not identified any unreviewed safety-related concerns pertaining to these plans.

6.1.3.1 Pore Volume Estimates

The licensee estimated that seven pore volumes will be required for restoration of the production zones at the Jane Dough Unit. This is the same number of pore volumes estimated for the Nichols Ranch ISR Project. The NRC staff previously found the licensee's estimate acceptable as is was consistent with experience at other ISR sites (NRC 2011a). The NRC staff finds nothing to invalidate the previous findings and therefore the NRC staff concludes that the licensee's estimate for the number of pore volume required for restoration is applicable at the Jane Dough Unit.

The licensee did not provide an estimated pore volume required for restoration of the affected ore zone. As noted in Section 3.1.3.3 of the SER for the Nichols Ranch ISR Project (NRC 2011a), the pore volume is used as a basis for determining the surety cost for restoration, but its value is otherwise not a safety issue. This estimate will be provided in the financial surety estimate for the Jane Dough Unit. The financial surety arrangement must be in place before startup of operations and will be held by an approved State agency or the NRC. The estimated pore volume required for restoration of the affected ore zone will be reviewed at the time the Jane Dough Unit financial surety estimate is submitted.

6.1.3.2 Restoration Schedule

Jane Dough Technical Report Table 3-12, "Production, Restoration, and Reclamation Schedule," provides a preliminary well field restoration schedule. The licensee reported that it will take approximately 3 years to restore Jane Dough Unit PA #1 and 2 years to restore Jane Dough Unit PA #2. These initial estimates and schedule for the Jane Dough Unit are consistent with restoration performance at other NRC-licensed ISR facilities and are acceptable to the staff. In addition, the ore body in the Jane Dough Unit is not located with an unconfined aquifer, as is the case for the Hank Unit. Therefore, the NRC staff's evaluation of the restoration schedule for the Hank Unit, as described in Section 6.1.3.9 of the SER for the NIchols Ranch ISR Project (NRC 2011a), does not apply to the Jane Dough Unit.

While NRC has no regulations which specify the time in which restoration must be completed, the licensee is required to meet the requirements in 10 CFR 40.42(h)(1), which states the licensee must complete decommissioning within 24 months of initiating decommissioning or submit an alternate schedule for decommissioning for NRC review and approval in accordance with 10 CFR 40.42(i). NRC staff finds that the licensee's schedule for restoration is consistent with 10 CFR 40.42 and is, therefore, acceptable.

6.1.4 Evaluation Findings

As stated above, the NRC staff's previous findings on the licensee's plans for and descriptions of restoration standards, restoration methods, post-restoration stability

monitoring, deep well injection of restoration wastewater and methods for abandoning wells are contained in its 2011 SER for the Nichol's Ranch ISR Project (NRC 2011a).

The NRC staff reviewed the licensee's estimated number of pore volumes required for restoration of the production zones at the Jane Dough Unit. The NRC staff finds this value consistent with that estimated for the Nichols Ranch ISR Project and is consistent with experience at other ISR sites and is therefore acceptable.

The NRC staff concludes based on regulation, regulatory guidance, and standard industry practice that the licensee has committed to an acceptable schedule for the restoration of the production zones at the Jane Dough Unit.

6.2 Plans for Reclaiming Disturbed Lands

6.2.1 Regulatory Requirements

The purpose of this section is to determine whether the licensee has demonstrated that the proposed plans for reclaiming disturbed lands for the Jane Dough Unit will meet the requirements of 10 CFR 40.42 and Criterion 6(6) of Appendix A to 10 CFR Part 40.

6.2.2 Regulatory Acceptance Criteria

Unless specifically stated otherwise, the Jane Dough Technical Report was reviewed for compliance with the applicable requirements of 10 CFR Part 40, using the acceptance criteria presented in Section 6.2.3, "Acceptance Criteria," of NUREG-1569 (NRC, 2003).

6.2.3 Staff Review and Analysis

The NRC staff has determined that this aspect of the proposed facility and its operations, "Plans for Reclaiming Disturbed Lands" should not be reexamined. Appendix A, "Guidance for Reviewing Historical Aspects of Site Performance for License Renewals and Amendments," of NUREG-1569 states:

> If, after a review of these historical aspects of site operations, the staff concludes that the site has been operated so as to protect health and safety and the environment and that no unreviewed safety-related concerns have been identified, then only those changes proposed by the license renewal or amendment application should be reviewed using the appropriate sections of this standard review plan. Aspects of the facility and its operations that have not changed since the last license renewal or amendment should not be reexamined.

The licensee did not propose changes to Section 6.2, "Surface Reclamation and Decommissioning" of the Jane Dough Technical Report, as compared to the same section of the Nichols Ranch ISR Project Technical Report (Uranerz 2007). The NRC staff previously reviewed Section 6.2 of the Nichols Ranch ISR Project Technical Report (Uranerz 2007) and found acceptable the licensee's plans for reclaiming disturbed lands at its Nichol's Ranch ISR Project (NRC 2011a). The NRC staff finds nothing to invalidate its previous findings and previous staff conclusions remain valid. In addition, the NRC staff has not identified any unreviewed safety-related concerns pertaining to the

licensee's methodologies for conducting post-reclamation and decommissioning surveys.

6.2.4 Evaluation

As stated above, the NRC staff's previous findings on the licensee's plans for reclaiming disturbed lands are contained in its 2011 SER for the Nichol's Ranch ISR Project (NRC 2011a).

6.3 Removal and Disposal of Structures, Waste Material, and Equipment

6.3.1 Regulatory Requirements

The NRC staff determines if the licensee has demonstrated that the proposed plans for removal and disposal of structures, waste material and equipment for the proposed Jane Dough Unit meet the requirements of 10 CFR 40.42.

6.3.2 Regulatory Acceptance Criteria

The Jane Dough Technical Report was reviewed for compliance with the applicable requirements of 10 CFR Part 40 using the acceptance criteria outlined in SRP Section 6.3.3 (NRC, 2003).

6.3.3 Staff Review and Analysis

The NRC staff has determined that this aspect of the proposed facility and its operations, "Removal and Disposal of Structures, Waste Materials, and Equipment" should not be reexamined. Appendix A, "Guidance for Reviewing Historical Aspects of Site Performance for License Renewals and Amendments," of NUREG-1569 states:

> If, after a review of these historical aspects of site operations, the staff concludes that the site has been operated so as to protect health and safety and the environment and that no unreviewed safety-related concerns have been identified, then only those changes proposed by the license renewal or amendment application should be reviewed using the appropriate sections of this standard review plan. Aspects of the facility and its operations that have not changed since the last license renewal or amendment should not be reexamined.

The licensee did not propose changes to Section 6.2.6.2 "Removing and Disposing of Structures and Equipment" of the Jane Dough Technical Report, as compared to the same section of the Nichols Ranch ISR Project Technical Report (Uranerz 2007). The NRC staff previously reviewed Section 6.2.6.2 of the Nichols Ranch ISR Project Technical Report (Uranerz 2007) and found acceptable the licensee's methodologies for removing and disposing of structures and equipment at its Nichol's Ranch ISR Project (NRC 2011a). The NRC staff finds nothing to invalidate its previous findings and previous staff conclusions remain valid. In addition, the NRC staff has not identified any unreviewed safety-related concerns pertaining to the licensee's methodologies for conducting post-reclamation and decommissioning surveys.

6.3.4 Evaluation Findings

As stated above, the NRC staff's previous findings on the licensee's methodologies for removal and disposal of structures, waste material and equipment are contained in its 2011 SER for the Nichol's Ranch ISR Project (NRC 2011a).

6.4 Methodologies for Conducting Post-Reclamation and Decommissioning Surveys

6.4.1 Regulatory Requirements

The purpose of this section is to determine whether the licensee has demonstrated that the proposed methodologies for conducting post-reclamation and decommissioning radiological surveys for the Jane Dough Unit meet the requirements of Criterion 6(6) of Appendix A to 10 CFR Part 40.

6.4.2 Regulatory Acceptance Criteria

The Jane Dough Technical Report was reviewed for compliance with the applicable requirements of 10 CFR Part 40 using the acceptance criteria outlined in SRP Section 6.4.3, Acceptance Criteria" (NRC 2003).

6.4.3 Staff Review and Analysis

The NRC staff has determined that this aspect of the proposed facility and its operations, "Methodologies for Conducting Post-Reclamation and Decommissioning Surveys," should not be reexamined. Appendix A, "Guidance for Reviewing Historical Aspects of Site Performance for License Renewals and Amendments," of NUREG-1569 states:

> If, after a review of these historical aspects of site operations, the staff concludes that the site has been operated so as to protect health and safety and the environment and that no unreviewed safety-related concerns have been identified, then only those changes proposed by the license renewal or amendment application should be reviewed using the appropriate sections of this standard review plan. Aspects of the facility and its operations that have not changed since the last license renewal or amendment should not be reexamined.

The licensee did not propose changes to Section 6.2.6 "Site Decontamination and Decommissioning" of the Jane Dough Technical Report, as compared to the same section of the Nichols Ranch ISR Project Technical Report (Uranerz 2007). The NRC staff previously reviewed Section 6.2.6, "SIte Decontamination and Decommissioning," of the Nichols Ranch ISR Project Technical Report (Uranerz 2007) and found acceptable the licensee's methodologies for conducting post-reclamation and decommissioning surveys at its Nichol's Ranch ISR Project (NRC 2011a). The NRC staff finds nothing to invalidate its previous findings and previous staff conclusions remain valid. In addition, the NRC staff has not identified any unreviewed safety-related concerns pertaining to the licensee's methodologies for conducting post-reclamation and decommissioning surveys.

6.4.4 Evaluation Findings

As stated above, the NRC staff's previous findings on the licensee's methodologies for conducting post-reclamation and decommissioning surveys are contained in its 2011 SER for the Nichol's Ranch ISR Project (NRC 2011a).

6.5 Financial Assurance

6.5.1 Regulatory Requirements

The regulatory requirements for financial assurance for the Nichols Ranch ISR Project are contained in Criterion 9 of Appendix A to 10 CFR Part 40.

6.5.2 Regulatory Acceptance Criteria

The regulatory acceptance criteria for the requirements in Criterion 9 of Appendix A to 10 CFR Part 40 are presented in presented in Section 6.5.3 of NUREG-1569 (NRC 2003).

6.5.3 Staff Review and Analysis

The NRC staff has determined that this aspect of the proposed facility and its operations, "Financial Assurance," should not be reexamined. Appendix A, "Guidance for Reviewing Historical Aspects of Site Performance for License Renewals and Amendments," of NUREG-1569 states:

> If, after a review of these historical aspects of site operations, the staff concludes that the site has been operated so as to protect health and safety and the environment and that no unreviewed safety-related concerns have been identified, then only those changes proposed by the license renewal or amendment application should be reviewed using the appropriate sections of this standard review plan. Aspects of the facility and its operations that have not changed since the last license renewal or amendment should not be reexamined.

The licensee did not propose changes to Section 6.2.8, "Financial Assurance" of the Jane Dough Technical Report, as compared to the same section of the Nichols Ranch ISR Project Technical Report (Uranerz 2007), except to state: (1) the Nichols Ranch ISR Project is in operation; (2) the surety bond estimate has been approved by the Wyoming Department of Environmental Quality Land Quality Division (WDEQ-LQD) and NRC; (3) the bond instrument has been accepted by WDEQ-LQD, and (4) the surety estimate will be revised and re-calculated before commencing mining activity in the proposed Jane Dough Unit. The license also stated that groundwater restoration in the Jane Dough Unit will require a similar number of pore volumes of groundwater to be treated as the Nichols Ranch Unit (one pore volume of sweep and six pore volumes of water circulated through the reverse osmosis unit) because the two units have similar flare factor, porosity, and average well completed thickness. The NRC staff previously reviewed Section 6.2.8 of the Nichols Ranch ISR Project Technical Report (Uranerz 2007), and several annual financial assurance updates, and found acceptable the licensee's surety methodologies at its Nichol's Ranch ISR Project (NRC 2011a).

Uranerz has maintained a financial surety arrangement for the Nichols Ranch ISR Project that is consistent with 10 CFR 40, Appendix A, Criterion 9. The current financial assurance instrument

is a surety bond with a face value of $6,235,956 in favor of the WDEQ. Because Uranerz does not have a standby trust agreement (STA) in place at this time as required by 10 CFR Part 40, Appendix A, Criterion 9, in accordance with 10 CFR 40.14(a), NRC has elected to grant an exemption to the STA requirements in 10 CFR Part 40, Appendix A, Criterion 9, through the 2016 financial assurance cycle (NRC 2014c).

The financial surety amount has been revised annually in accordance with Byproduct and Source Materials License SUA-1597. Each annual revision to the surety amount has been based on an annual detailed cost estimate provided by Uranerz and approved by the NRC. The NRC staff observes that NRC's previous approval of Uranerz's annual surety estimates have demonstrated that the licensee has maintained sufficient funds in the surety for completion of the above-referenced activities by an independent contractor (NRC 2014c).

Byproduct and Source Materials License SUA-1597 license condition 9.5 requires that at least 90 days prior to beginning construction associated with any planned expansion or operational change, which was not included in the annual surety update, the licensee shall provide, for NRC approval, an updated surety to cover the expansion or change (NRC 2015). Thereafter, the licensee will be required to provide annual surety updates to the NRC to include estimated annual costs for the Nichols Ranch ISR Project each year in accordance with requirements of its license (NRC 2015).

The NRC staff observes that future annual surety estimates under Byproduct and Source Materials License SUA-1597 will also cover activities in the Jane Dough Unit. The NRC staff observes that the previous methodology of estimating surety costs for the above-referenced activities at the currently licensed Nichols Ranch ISR Project will also be used for the Jane Dough Unit. The NRC staff previously found the licensee's methodology of estimating surety costs at its licensed facility to be acceptable (NRC 2014c). Therefore, the NRC staff has reasonable assurance that the licensee's methodology of estimating surety costs is relevant and effective for the Jane Dough Unit. The NRC staff finds nothing to invalidate the previous findings on the methodology of estimating surety costs and previous staff conclusions remain valid. In addition, the NRC staff has not identified any unreviewed safety-related concerns pertinent to the methodology of estimating surety costs in the Jane Dough Unit. In accordance with Appendix A, "Guidance for Reviewing Historical Aspects of Site Performance for License Renewals and Amendments," of NUREG-1569 (NRC 2003), staff is not reexamining the licensee's methodology of estimating surety costs.

6.5.4 Evaluation Findings

Uranerz is required to maintain a financial surety with sufficient funds that would be available for completion of the Nichols Ranch ISR Project (ground water restoration, decontamination and decommissioning, and surface reclamation) by an independent contractor (NRC 2015). Uranerz is required to update the financial surety amount to cover estimated Nichols Ranch ISR Project costs in accordance with the requirements of its Byproduct and Materials License SUA-1597 (NRC 2015). Based staff's review of the existing financial surety under Uranerz's license (SUA-1597) and information provided in the Jane Dough Technical Report, NRC staff concludes that the financial surety and its methods of estimation to cover the Nichols Ranch ISR Project project are acceptable and consistent with requirements of 10 CFR Part 40, Appendix A, Criterion 9.

7.0 ACCIDENTS

The NRC's evaluation of the licensee's plans to address potential accidents at the Nichols Ranch ISR Project which comply with 10 CFR 40.32(c), which requires that the licensee's proposed procedures be adequate to protect public health and minimize danger to life or property, is provided in the Safety Evaluation Report for the Nichols Ranch ISR Project (NRC 2011a).

The NRC staff has determined that this aspect of the proposed facility and its operations should not be reexamined. Appendix A, "Guidance for Reviewing Historical Aspects of Site Performance for License Renewals and Amendments," of NUREG-1569 states:

> If, after a review of these historical aspects of site operations, the staff concludes that the site has been operated so as to protect health and safety and the environment and that no unreviewed safety-related concerns have been identified, then only those changes proposed by the license renewal or amendment application should be reviewed using the appropriate sections of this standard review plan. Aspects of the facility and its operations that have not changed since the last license renewal or amendment should not be reexamined.

The licensee did not propose changes to Section 7.5, "Effects of Accidents" of the Jane Dough Technical Report, as compared to the same section of the Nichols Ranch ISR Project Technical Report (Uranerz 2007), other than to include reference to the Jane Dough Unit in appropriate sections where the existing operational units (i.e., the Nichols Ranch Unit and Hank Unit) had been previously identified. With regard to 3 conventional oil/gas wells and 47 coal bed methane wells within the Jane Dough Unit, the licensee stated in Section 2.2.5, "Industrial," of the Jane Dough Technical Report that, "According to the Wyoming Oil and Gas Conservation Commission, no further oil and gas development would take place in the Nichols Ranch ISR Project." The NRC staff evaluated the types of accidents previously considered by the licensee, including gas pipeline failures described in Section 7.5.3.2, "Coal Bed Methane Gas Pipeline Failure," of the Jane Dough Technical Report. The NRC staff also evaluated the types of facilities proposed for use by the licensee (e.g., wellfield header houses and process pipelines), which were also previously analyzed by the licensee to identify appropriate accident mitigation measures. The NRC staff did not identify any new hazards or unreviewed safety-related concerns that would be present in the Jane Dough Unit.

The NRC staff previously reviewed Section 7.5, "Effects of Accidents," of the Nichols Ranch ISR Project Technical Report (Uranerz 2007) and found acceptable the licensee's equipment and procedures for responding to and mitigating the consequences of accidents (NRC 2011a). The NRC staff finds nothing to invalidate its previous findings and previous staff conclusions remain valid. In addition, the NRC staff has not identified any unreviewed safety-related concerns pertaining to the licensee's equipment and procedures for responding to and mitigating the consequences of accidents.

8.0 REFERENCES

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Wyoming Department of Environmental Quality (WDEQ). 2013b. Letter from D. Fischer, WDEQ to M. Thomas, Uranerz, dated December 20, 2013, RE: Uranerz Energy Corporation – NICH DW-4 Injection Well Permit 10-392 Authorization to inject. ADAMS Accession No. ML13364A091.

Wyoming Department of Environmental Quality (WDEQ). 2013c. "Guideline No. 4: In Situ Mining Noncoal." Cheyenne, Wyoming: Wyoming Department of Environmental Quality, Land Quality Division.

Appendix A

Historical Aspects of Site Performance: Nichols Ranch ISR Project

The guidance in NUREG-1569, "Standard Review Plan for In Situ Leach Uranium Extraction License Applications," Appendix A, "Guidance for Reviewing Historical Aspects of Site Performance for License Renewals and Amendments," (NRC 2003), describes specific areas relating to the licensee's compliance history or record of site operations and changes that the NRC staff should review as part of licensing actions. Appendix A states,

> If, after a review of these historical aspects of site operations, the staff concludes that the site has been operated so as to protect health and safety and the environment and that no unreviewed safety-related concerns have been identified, then only those changes proposed by the license renewal or amendment application should be reviewed using the appropriate sections of this standard review plan. Aspects of the facility and its operations that have not changed since the last license renewal or amendment should not be reexamined.

The NRC staff has reviewed historical aspects of site operations, as described below. On the basis of this review, the NRC staff concludes that the Nichols Ranch ISR Project has been operated so as to protect health and safety and the environment and has identified no unreviewed safety-related concerns. Therefore, the NRC staff has determined that only those elements in the Jane Dough Technical Report (Uranerz 2014) which represent changes from previous descriptions in the Nichols Ranch ISR Project Technical Report (Uranerz 2007), should be reviewed using the appropriate sections of the standard review plan. The NRC staff has not reexamined those aspects of the Nichols Ranch ISR Project and its operations that have not changed since the last license renewal or amendment.

A.1 Amendments and changes to operating practices or procedures

NRC has issued four license amendments since issuance of Source Materials License SUA-1597 in July 2011. As shown in the table below, two of these amendments are related to annual updates in the financial assurance provisions required by License Condition 9.5. The table below also shows the NRC's Agencywide Documents Access and Management Systems (ADAMS) accession number for the individual amendments. The NRC staff's evaluation of financial assurance related to the Jane Dough license amendment request is addressed in Sections 1 and 6.5 of this SER. Pre-operational license conditions are those conditions which the licensee met prior to receiving authorization to operate the Nichols Ranch ISR Project. The licensee's statements, commitments, and representations, that were relied upon to meet pre-operational license conditions are provided in correspondence included in License Condition 9.2. These statements, commitments, and representations, remain unchanged as part of the Jane Dough license amendment request. The changes requested in Amendment 4 have been included in the Jane Dough license amendment request.

License SUA-1597 Amendment No.	Reason for Amendment	ADAMS Accession No.
Amendment 1	Annual Surety Update	ML13227A378
Amendment 2	Pre-operational License Conditions	ML14087A244
Amendment 3	Annual Surety Update	ML14203A358
Amendment 4	Designee for Daily Inspections	ML15215A412

A.2 Changes to Operating Practices or Procedures

From 2012 through 2015, the licensee made 27 changes to the licensing basis approved by its Safety & Environmental Review Panel (SERP). The individual SERP process determinations are listed in the table below with the ADAMS accession number for the licensee's semi-annual reports containing a summary of each change. During routine inspections, the inspectors review licensee-initiated changes made through the SERP process to evaluate if program changes, tests, or experiments require an NRC license amendment prior to implementation. The inspectors concluded that the licensee had implemented the SERP process in accordance with license condition 9.4 of Source Materials License SUA-1597.

Year	SERP Nos.	ADAMS Accession No.
2012	SERP-3-2012; SERP-5-2012; SERP-6-2012; SERP-8-2012	ML13037A310
2013	SERP-7-2012; SERP-1-2013; SERP-2-2013; SERP-3-2013; SERP-4-2013; SERP-5-2013; SERP-6-2013; SERP-7-2013; SERP-8-2013; SERP-9-2013; SERP-10-2013	ML14051A560
2014	SERP-1-2014; SERP-2-2014; SERP-3-2014; SERP-6-2014;	ML15076A032
2015	SERP-4-2014; SERP-5-2014; SERP-1-2015; SERP-2-2015; SERP-3-2015; SERP-4-2015; SERP-5-2015; SERP-6-2015;	ML16091A186

A.3 License violations

The licensee has not been cited for violations of NRC requirements at the Nichols Ranch ISR Project since Source Materials License SUA-1597 was issued in July 2011.

A.4 Excursions, incident investigations, or root cause analyses

The licensee has had zero excursions, incident investigations, or root cause analyses. Excursion status since the Nichols Ranch ISR Project began operations was reported in the Following WDEQ/LQD/NRC Quarterly Reports:

Report Date	ADAMS Accession	Report Date	ADAMS Accession
July 23, 2014	ML14212A051	July 28, 2015	ML15229A141
October 28, 2014	ML14310A421	October 19, 2015	ML15303A395
January 28, 2015	ML15036A064	January 25, 2016	ML16040A256
April 29, 2015	ML15128A334	April 27, 2016	ML16126A104

The licensee has issued 10 unplanned release reports in accordance with its Permit to Mine No. 778, Volume IX Mine Plan, Section 3.19.2. Copies of these reports are provided to NRC. None of these events met NRC reporting criteria in either 10 CFR 20, Subpart M or 10 CFR 40.60.

Date	Volume	Substance Spilled	Location	ADAMS Accession No.
August 14, 2013	500 gallons	grey water	DDW No. 1 drill pad	ML13248A028
June 5, 2014	2,500 gallons	injection solution	well N1B-052	ML14168A359
June 13-14, 2014	720 gallons	injection solution	well N1C-003-1	ML14175B517
July 17, 2014	3,500 gallons	recovery solution	well N1A-002	ML14199A626
September 8, 2014	12,975 gallons	recovery solution	well N1A-051	ML14262A042
November 2, 2014	1,745 gallons	injection solution	well N1A-034	ML14309A289
December 2, 2014	606 gallons	injection solution	well N1A-095	ML14353A116
October 20, 2015	45 gallons	Type II mineral oil	43 N, R 76W, Section 17, NWNW	ML15314A089
November 5, 2015	655 gallons	injection solution	well N1A-078	ML15329A188
August 11, 2016	670 gallons	injection solution	well EH-102	ML16225A185

A.5 Radiation-related regulatory exceedences

There have been no occupational or public radiation-related regulatory exceedences reported in either semi-annual effluent reports submitted in accordance with 10 CFR 40.65 or the annual ALARA audits. These reports provided since the Nichols Ranch ISR Project began operating are listed below.

Report Period	ADAMS Accession Nos.
1st Half 2014	ML14241A024, ML14329B171
2nd Half 2014	ML15076A032
1st Half 2015	ML15314A793
2nd Half 2015	ML16091A186
1st Half 2016	ML16252A287

A.6 Site characterization and land use

Section 2 of the Jane Dough Technical Report contains Jane Dough Unit site characterization information important to the evaluation of exposure pathways and doses, including site location and layout; uses of adjacent lands and waters; population distributions; meteorology; the geologic and hydrologic setting; ecology; and background radiological characteristics.

A.7 References

NRC (U.S. Nuclear Regulatory Commission). 2003. *Standard Review Plan for In Situ Leach Uranium Extraction License Applications*. NUREG-1569, Washington, D.C. ADAMS Accession No. ML032250177.

Uranerz (Uranerz Energy Corporation). 2007. Letter from M. Thomas, Uranerz to NRC, dated November 30, 2007, RE: Submittal of Source Material License Application to Construct and Operate the Nichols Ranch ISR Project Located in Campbell and Johnson Counties, Wyoming. ADAMS Accession No. ML080080594. Supplemented by letters dated August 21, 2008, March 11, 2009, February 24, 2010, September 15, 2010, September 22, 2010, October 3, 2013 (ML13282A301), February 13, 2014 (ML14050A023); February 18, 2014

(ML14063A068); February 19, 2014 (ML14051A113); February 28, 2014 (ML14063A214); March 4, 2014 (ML14064A128); March 5, 2014 (ML14065A018); March 6, 2014 (ML14066A051), and March 11, 2014 (ML14071A092).

Uranerz (Uranerz Energy Corporation). 2014. Letter from M. Thomas, Uranerz to B. Holian, NRC dated May 8, 2014, RE: Uranerz Energy Corporation, Nichols Ranch ISR Project, NRC License SUA-1597, Docket No. 40-9067 Jane Dough Unit License Amendment Request. ADAMS Accession No. ML14164A274. Supplemented by letters dated October 29, 2014 (ML14309A118); April 13, 2015 (ML15118A122); June 26, 2015 (ML15182A013); May 24, 2016 (ML16148A166); July 19, 2016 (ML16207A054); August 17, 2016 (ML16232A096); September 7, 2016 (ML16253A028); September 15, 2016 (3 submittals: ML16263A080, ML16263A167, and ML16263A177); September 26, 2016 (ML16271A093); September 28, 2016 (ML16278A624); October 31, 2016 (ML16307A100); November 1, 2016 (ML16307A176); and November 7, 2016 (2 submittals: ML16313A470, ML17019A241).

Appendix B

Administrative Changes to License Conditions, Source Material License SUA-1597, Nichols Ranch ISR Project

B.1 Introduction

The purpose of this Appendix is to describe the NRC staff's evaluation of administrative changes to certain license conditions in Source Material License SUA-1597 for the Nichols Ranch ISR Project. The NRC staff will revise license conditions in Source Material License SUA-1597 after completing its safety evaluation of a May 8, 2014, license amendment request (Uranerz 2014). In the May 8, 2014, license amendment request, the licensee proposed to add ISR wellfields in the proposed Jane Dough Unit to existing operations at the Nichols Ranch ISR Project authorized by Source Material License SUA-1597.

The NRC staff has identified two groups of new or modified license conditions that are addressed in this SER. The first group includes license conditions, new or modified, which relate directly to the NRC staff's evaluation of Jane Dough Unit license amendment request. Some of these modifications were requested by the licensee (Uranerz 2016). The changes to license conditions in this first group, which are directly related to the Jane Dough Unit amendment, are described in the body of this SER.

The licensee also requested clarifying changes to other existing license conditions (Uranerz 2016). These changes are part of a second group of license conditions, in which changes are not directly related to the staff's evaluation of ISR operations in the new Jane Dough Unit wellfields. The NRC staff's evaluation of modifications within the second group of license conditions, which are entirely administrative changes, is provided in Section B.2. below.

B.2 Evaluation of License Condition Changes

Note: In the revised license conditions in this Appendix, new text is printed in *underlined italics* and text being removed is struck out.

License condition 9.7

In addition to requiring licensees to follow guidance set forth in several NRC radiation safety-related regulatory guides, license condition 9.7 also includes requirements for qualified designees to perform daily inspections in the absence of the RSO(s) and radiation safety technician(s) (RSTs). The licensee requested a minor change to remove the words "and time" from the fifth sentence of the third paragraph (Uranerz 2016). This change was requested because the RSO or RST is expected to annotate his or her review on the designees' reports "by the close of business of the first day an RSO or RST returns to work." The precise time of day by which the annotation must be made is not specified. For this reason, the licensee requested that the RSO's or RST's annotation only include the date. Because no time was specified by which the RSO or RST must annotate the designees' reports, the NRC staff is removing the words "and time" from the fifth sentence of the third paragraph.

9.7 The licensee shall follow the guidance set forth in NRC, Regulatory Guides 8.22, "Bioassay at Uranium Mills" (as revised), and 8.30, "Health Physics Surveys in Uranium Recovery Facilities" (as revised), or NRC-approved equivalent.

The licensee shall follow the guidance set forth in Regulatory Guide 8.31, "Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Recovery

Facilities Will Be as Low as Is Reasonably Achievable" (as revised), or NRC-approved equivalent, with the following exception:

The licensee may identify qualified designee(s) to perform daily inspections in the absence of the RSO(s) and radiation safety technician(s) (RSTs). The qualified designee(s) shall have health physics training as specified in the licensee's training program. The qualified designee(s) shall only perform the inspections on weekends or holidays when the RSO(s) and RST(s) are not present, and in any case no more than three (3) consecutive days per week, except when a holiday falls on a Monday or Thanksgiving (4 days). Reports from qualified designees shall be reviewed by the RSO(s) or RST(s) by the close of business on the first day an RSO or RST returns to work. The RSO or RST review shall be annotated with date ~~and time~~ on the report or other document that can be inspected upon request. If neither an RSO nor an RST can review documents and perform the walk-through for more than three (3) days (e.g., holidays or adverse weather events), an RSO or RST shall call the qualified designee and review previous un-reviewed reports and current operational conditions over the phone.

Any proposed exceptions to the guidance are subject to review and written verification by the NRC that the proposed exception does not require a license amendment.

[Applicable Amendment: 5]

License condition 10.4

The original license condition 10.4 required the licensee to develop and implement written standard operating procedures (SOPs) prior to operation of the Nichols Ranch ISR Project. License condition 10.4 is being revised in the current license amendment to state that these existing SOPs shall be "maintained," rather than developed and implemented, because Uranerz has: written these SOPs; these SOPs have been reviewed and found adequate by NRC staff and inspectors following a pre-operational inspection (NRC 2014); and the Nichols Ranch ISR Project is now operational. The NRC staff is also removing the second paragraph of license condition 10.4 for the same reason – these specific SOPs were developed and implemented prior to operation of the Nichols Ranch ISR Project. The NRC staff is also removing the last sentence of license condition 10.4, which stated that the listed SOPs are subject to NRC inspection because NRC inspection procedures, not license conditions, are commonly used to define the scope of NRC staff's inspections. This is an administrative change to clarify the current status of these SOPs. The changes below do not reflect new or modified requirements regarding the content of these SOPs.

10.4 The licensee shall *maintain* ~~develop and implement~~ written standard operating procedures (SOPs) prior to operation for: (1) all operational activities involving radioactive and nonradioactive materials associated with licensed activities that are handled, processed, stored, or transported by employees; (2) all nonoperational activities involving radioactive materials including in-plant radiation protection and environmental monitoring; and (3) emergency procedures for potential accidents/unusual occurrences including significant equipment or facility damage, pipe breaks and spills, loss or theft of yellowcake or sealed sources, significant fires, and other natural disasters. The SOPs shall include appropriate radiation safety practices to be followed in accordance with 10 CFR Part 20. SOPs for operational activities shall enumerate pertinent radiation safety practices to be followed. A copy of the current written procedures shall be kept in the area(s) of the production facility where they are utilized.

~~The licensee shall also develop and implement SOPs prior to operation for the following:~~

~~A. Maintenance of surveys and monitoring records in accordance with 10 CFR Part 20, Subpart L, to demonstrate compliance with 10 CFR Part 20 requirements.~~

~~B. Internal exposure calculation methods and applicable equations for determining the dose(committed effective dose equivalent (CEDE)) from airborne sampling and bioassay data. This methodology will be in accordance with 10 CFR 20.1201, 10 CFR 20.1204, and Regulatory Guides 8.30, (as revised), 8.34, "Monitoring Criteria and Methods To Calculate Occupational Radiation Doses," (as revised), and 8.36, "Radiation Dose to the Embryo/Fetus," (as revised).~~

~~C. Conduct of its bioassay program and the determination of internal dose (e.g. CEDE) from bioassay data 60 days prior to commencing operations. The licensee will provide a plan or operating procedures to limit the soluble intake to 10 mg per week for uranium.~~

~~D. Procedures for emergencies identified in Section 7.0 of the licensee's approved application.~~

~~These SOPs are subject to all inspections, including the preoperational inspection specified in LC 12.3.~~

[Applicable Amendment: 5]

License condition 10.7.B.

License condition 10.7.B required the licensee to update or confirm the restoration schedule for Hank Unit Production Areas #1 and #2 at the completion of the hydrologic test in the Hank Unit required by License condition 10.7.A. License condition 10.7.B addressed a deficiency in the original Nichols Ranch ISR Project license application. The regulations in 10 CFR 40.42(d)(3) and 40.42(d)(4) require the licensee to begin decommissioning activities no later than 24 months after the cessation of principal activities conducted under the license or in any separate building or outdoor area that contains residual radioactivity such that the building or area is unsuitable for release. Contrary to this regulation, the licensee showed in Figure 3-12," Production, Restoration, and Reclamation Schedule," of its license application that it planned to delay restoration in Hank Unit Production Area #2 for 3 years after cessation of operations in that area, but it did not explicitly state that it would seek approval to delay or postpone initiation of decommissioning in accordance with 10 CFR 40.42(f). Therefore, the staff imposed license condition 10.7.B to require the licensee to either revise the restoration schedule for Hank Unit Production Areas #1 and #2 to conform to the 24-month schedule required by 10 CFR 40.42(d)(3) or 40.42(d)(4), or request NRC staff approval to delay or postpone initiation of decommissioning under 10 CFR 40.42(f). However, the requirement to submit for approval an alternative schedule, as needed, is already stated in the first paragraph of license condition 10.6. Therefore, the requirement in license condition 10.7.B is redundant and will be deleted from the amended license. This is an administrative change to clarify existing requirements in the license by removing a redundant requirement.

10.7 Hank Unit Hydrologic Test

A. Prior to lixiviant injection at the Hank Unit, the licensee will conduct a hydrologic test. The hydrologic test must be scaled and designed to simulate proposed injection and extraction operational conditions at the Hank Unit to demonstrate that an inward hydraulic gradient can be maintained that prevents excursions beyond

the perimeter production zone monitoring well ring. The licensee will report the results of the hydrologic test to the NRC for review and approval prior to lixiviant injection into the production area.

B. *[DELETED by Amendment 5]*~~The licensee will update or confirm the restoration schedule for Hank Unit Production Area (PA) #1 and #2 at the completion of the hydrologic test in the Hank Unit as required by this license. The licensee will provide a basis to the NRC for review and approval for any alternate schedule request that meets the requirements of 10 CFR 40.42.~~

License condition 10.10

License condition 10.10 addressed a deficiency in the original Nichols Ranch ISR Project license application. The regulations in 10 CFR 40.42(d)(3) and 40.42(d)(4) require the licensee to begin decommissioning activities no later than 24 months after the cessation of principal activities conducted under the license or in any separate building or outdoor area that contains residual radioactivity such that the building or area is unsuitable for release. Contrary to this regulation, the licensee showed in Figure 3-12 of its license application that it planned to delay restoration in Nichols Ranch Unit Production Area #2 for 2 years after cessation of operations in that area, but it did not explicitly state that it would seek approval to delay or postpone initiation of decommissioning in accordance with 10 CFR 40.42(f). Therefore, the staff imposed license condition 10.10 to require the licensee to either revise the restoration schedule for Nichols Ranch Unit Production Area #2 to conform to the 24-month schedule required by 10 CFR 40.42(d)(3) or 40.42(d)(4), or request NRC staff approval to delay or postpone initiation of decommissioning under 10 CFR 40.42(f). However, the requirement to submit for approval an alternative schedule, as needed, is already stated in the first paragraph of license condition 10.6. Therefore, the requirement in license condition 10.10 is redundant and will be deleted from the amended license. This is an administrative change to clarify existing requirements in the license by removing a redundant requirement.

10.10 *[DELETED by Amendment 5]* ~~The licensee will update or confirm the restoration schedule for the Nichols Ranch Unit PA #2 and provide a basis to the NRC for review and approval for any alternate schedule request that meets the requirements of 10 CFR 40.42.~~

License condition 10.11

The original license condition 10.11 required the licensee to obtain the necessary permits and construct a minimum of two Class I Underground Injection Control (UIC) deep disposal wells prior to the commencement of operations of the Nichols Ranch ISR project.

License condition 10.11 is being revised in the current license amendment because Uranerz has installed and is operating, two UIC deep disposal wells. Additionally, repetitive language in the license condition has been removed. In addition, the NRC staff revised the third paragraph of license condition 10.11 to remove the phrase “exists at each unit” because the Nichols Ranch Unit and Jane Dough Unit production areas share four deep disposal wells located on the Nichols Ranch Unit, and there is no need for separate deep disposal wells inside the Jane Dough Unit. This is an administrative change to clarify the current status of the UIC deep disposal wells. The changes below do not reflect new or modified requirements regarding these wells.

10.11 All liquid effluents from process buildings and other process waste streams, with the exception of sanitary wastes, shall be returned to the process circuit or disposed of as

allowed by NRC regulations. Additionally, the licensee is authorized to dispose of process solutions, injection bleed, and restoration brine using deep well injection, as permitted by WDEQ and described in the approved license application.

~~The licensee will obtain the necessary permits and construct a minimum of two Class I Underground Injection Control (UIC) deep disposal wells prior to the commencement of operations of the Nichols Ranch ISR Project. The licensee shall ensure the deep disposal wells shall have enough capacity to handle the disposal of the total liquid effluent generation as stated in Section 3.2.6 of the license application.~~

The licensee will ensure adequate deep well disposal capacity ~~exists at each unit~~ to dispose of liquids from each unit under normal operating conditions during production, production and restoration, and restoration phases as stated in Section 3.2.6 of the license application.

The licensee will notify the NRC within 24 hours if a disposal well is shut down and becomes inoperable, with the exception of routine maintenance or required testing that is completed within 48 hours of shutdown. If necessary, the licensee will use additional deep well capacity, surge tanks or cease injection activities until the disposal well is restored to use as written in Section 3.2.6 of the application. The licensee will notify the NRC when the disposal well is placed back into service and report any repairs or service completed on the well that is not associated with routine maintenance.

The licensee shall maintain a record of the volumes of solution disposed in each disposal well and submit this information in the annual monitoring report.

[Applicable Amendment: 5]

License condition 10.14

The second paragraph of license condition 10.14 requires the licensee to evaluate in-plant air samples collected within the first year after commencement of operations, and to develop from these air sample results a technical basis for whether surface contamination limits are warranted for Th-230, Ra-226, Po-210, and Pb-210. The licensee was required to submit this information for NRC staff review and verification. By letter dated January 21, 2016 (NRC 2016a), NRC staff verified the licensee's December 7, 2015 (Uranerz 2015), submittal, which explained why no surface contamination limits for Th-230, Ra-226, Po-210, and Pb-210 are required. Therefore, the second paragraph of license condition 10.14 is satisfied and is being removed in this amendment. This is an administrative change to update the license now that the second paragraph of license condition 10.14 has been satisfied. The changes below do not reflect new or modified requirements.

10.14 The licensee shall conduct radiological characterization of airborne samples for natural U, Th-230, Ra-226, Po-210, and Pb-210 for each restricted area air particulate sampling location at a frequency of once every 6 months for the first 2 years, and annually thereafter to ensure compliance with 10 CFR 20.1204(g). The licensee shall also evaluate changes to plant operations to determine if more frequent radionuclide analyses are required for compliance with 10 CFR 20.1204(g).

~~The licensee shall determine if surface contamination limits are warranted for Th-230, Ra-226, Po-210, and Pb-210 identified in airborne sample analyses. Within 1 year of commencement of operations, the licensee shall provide for NRC review and written~~

~~verification a technical basis for surface contamination limits for the applicable radionuclides of concern.~~

[Applicable Amendment: 5]

License condition 11.5

License condition 11.5 is a standard license condition that specifies the frequency of excursion monitoring well sampling and the process and timeframes for notifying NRC staff if an excursion has occurred.

The licensee requested that the time requirement for notifying the NRC project manager by letter of a confirmed excursion be reduced from 7 days to 5 days (Uranerz 2016). The licensee stated that this change was requested to align with Wyoming Department of Environmental Quality, Land Quality Division (WDEQ/LQD) Chapter 11 Non Coal Rules and Regulations. The NRC staff finds this is reasonable because it ensures NRC receives notification even sooner than previously required, and because it reduces the potential for confusion caused by different NRC and State reporting requirements.

11.5 Excursion Monitoring. Monitoring for excursions shall occur twice monthly and at least 10 days apart for all wells with a UCL. An excursion shall have occurred if, in any monitor well, any two UCL parameters exceed their respective UCLs. A verification sample shall be taken within 48 hours after results of the first analyses are received. If the second sample shows that the excursion criterion is exceeded, an excursion shall be confirmed. If the second sample does not show that the excursion criterion is exceeded, a third sample shall be taken within 48 hours after the second set of sampling data was acquired. If the third sample shows that the excursion criterion is exceeded, an excursion shall be confirmed. If the third sample does not show that the excursion criterion is exceeded, the first sample shall be considered to be an error and the well is removed from excursion status.

Upon confirmation of an excursion, the licensee shall notify the NRC, as discussed below, implement corrective action, and increase the sampling frequency for the indicator parameters at the excursion well to once every 7 days. Corrective actions for confirmed excursions may be, but are not limited to, those described in Section 5.7.8.10.3 of the approved license application. An excursion is considered corrected when the concentrations of the indicator parameters are below the concentration levels defining an excursion for three consecutive weekly samples.

If an excursion is not corrected within 60 days of confirmation, the licensee shall either: (a) terminate injection of lixiviant within the production area until the excursion is corrected; or (b) increase the surety in an amount to cover the full third-party cost of correcting and cleaning up the excursion. The surety increase shall remain in force until the NRC has verified that the excursion has been corrected and cleaned up. The written 60-day excursion report shall identify which course of action the licensee is taking. Under no circumstances does this condition eliminate the requirement that the licensee must remediate the excursion to meet ground water protection standards as required by LC 10.6 for all constituents established per LC 11.3.

The licensee shall notify the NRC Project Manager by telephone or e-mail within 24 hours of confirming a lixiviant excursion, and by letter within *5*~~7~~ days from the time the excursion is confirmed, pursuant to LC 11.6. A written report describing the excursion event, corrective actions taken, and the corrective action results shall be submitted to

the NRC within 60 days of the excursion confirmation. For all wells that remain on excursion after 60 days, the licensee shall submit a report as discussed in LC 11.1(A).

[Applicable Amendment: 5]

License condition 11.9

License condition 11.9 is a facility-specific license condition which addressed a deficiency in the original Nichols Ranch ISR Project license application. At the time the license was issued, the licensee committed to following Regulatory Guide 4.14, "Radiological Effluent and Environmental Monitoring at Uranium Mills," (NRC 1980) except that it had not demonstrated that the environmental air sample stations are located at the predicted highest downwind concentrations for radioactive effluents released from the facility. Samples collected at environmental air sample stations are used to estimate radon and particulate matter concentrations. An additional measurement at these stations is used to estimate gamma radiation exposure rates. The NRC staff explained in its SER that locations of environmental air sample stations should be determined using onsite meteorological data to predict the highest downwind airborne concentrations (NRC 2011a). Onsite meteorological data was not available at the time the application was submitted, nor had the applicant demonstrated that nearby meteorological data adequately represented conditions at the Nichols Ranch ISR Project. As a result, the NRC staff imposed license condition 11.9 to address these deficiencies. However, the same deficiency in environmental air sample locations was also addressed in license condition 10.15 regarding the representativeness of on-site meteorological data, and in pre-operational license condition 12.7, which addressed the licensee's proposed methods of air effluent sampling and public and occupational dose assessments. Because the licensee's plan for air effluent sampling and public and occupational dose assessments was previously approved in Amendment 2, license condition 11.9 is no longer needed. As explained in the body of the SER, the licensee's description of its air effluent sampling and public and occupational dose assessment program is addressed in correspondence dated November 7, 2016 (Uranerz 2016). As a result, license condition 11.9 is being deleted and the correspondence dated November 7, 2016, is being added to license condition 9.2.

11.9 *[DELETED by Amendment 5]*~~Radiological monitoring will be conducted for airborne particulate radioactivity and radon-222 at appropriate environmental monitoring locations in accordance with the criteria in Regulatory Guide 4.14 (as revised) during operations to demonstrate compliance with 10 CFR 20.1301, 10 CFR 20.1501 and 10 CFR Part 40, Appendix A, Criterion 7.~~

~~Consistent with Regulatory Guide 4.14 (as revised), the licensee shall establish air particulate sampling stations in the three sectors with the highest predicted radioactivity concentrations resultant from operations and co-locate radon air samplers and direct radiation and soil sampling with the air particulate sampling stations.~~

License condition 12.1

License condition 12.1 requires the licensee to obtain all necessary permits and licenses prior to operations in any production area and submit copies of permits to the NRC. Since the Nichols Ranch ISR Project is operational, the scope of this pre-operational condition should be clarified. The licensee should continue to obtain all necessary permits and licenses from the appropriate regulatory authorities prior to operations in new production areas in which licensed activities are otherwise authorized by the license but that have not been constructed, and provide copies to NRC of all permits for Class I and III underground injection wells. Therefore, this license condition is being added as license condition 11.10 to facility-specific conditions in Source

Material License SUA-1597, Section 11, “Monitoring, Recording, and Bookkeeping Requirements,” and deleted from Section 12, “Pre-operational Requirements.” These changes do not add a new requirement or modify an existing requirement, but rather clarify that this requirement is an ongoing recording and bookkeeping requirement for all new production areas.

11.10 Prior to commencement of operations in any production area, the licensee shall obtain all necessary permits and licenses from the appropriate regulatory authorities. The licensee shall also submit a copy of all permits for its Class I and Class III underground injection wells.

12.1 *[DELETED by Amendment 5]* ~~Prior to commencement of operations in any production area, the licensee shall obtain all necessary permits and licenses from the appropriate regulatory authorities. The licensee shall also submit a copy of all permits for its Class I and Class III underground injection wells.~~

License condition 12.2

License condition 12.2 requires the licensee to coordinate off-site emergency response prior to commencement of operations and maintain documentation of such coordination on-site. The NRC staff reviewed the licensee’s off-site emergency response coordination activities during the pre-operational inspection and concluded that this condition has been met (NRC 2014). Therefore, the part of this condition which should remain in the license is maintenance on-site of the documentation of completed coordination activities. Therefore, this license condition is being revised and added as a new license condition 11.11 to facility-specific conditions in Source Material License SUA-1597, Section 11, “Monitoring, Recording, and Bookkeeping Requirements,” and deleted from Section 12, “Pre-operational Requirements.” These changes do not add a new requirement or modify an existing requirement, but rather clarify that this requirement is an ongoing recording and bookkeeping requirement.

11.11 The licensee shall maintain on-site its documentation of its coordination of emergency response requirements with local authorities, fire department, medical facilities, and other emergency services.

12.2 *[DELETED by Amendment 5]* ~~Prior to commencement of operations, the licensee shall coordinate emergency response requirements with local authorities, fire department, medical facilities, and other emergency services. The licensee shall document these coordination activities and maintain such documentation on-site.~~

License condition 12.3

License condition 12.3 does not authorize operations at the Nichols Ranch ISR Project until the NRC performs a pre-operational inspection to verify specified programs are in place and tests have been completed. These pre-operational inspections have been performed for operations at the Nichols Ranch Unit, including all ISR activities from wellfield operations through the precipitation and elution circuit at the Central Processing Plant (NRC 2016b). However, as of the date of this SER, the licensee has not installed the dryer circuit at the Central Processing Plant or begun construction of the Hank Unit wellfields and satellite facility. Because a dryer circuit and satellite facility contain much more equipment and procedures used to ensure occupational and public safety than a wellfield, NRC staff will perform a pre-operational inspection of the dryer circuit and satellite facility, but will not perform a pre-operational inspection of the Jane Dough Unit wellfields. Therefore, the scope of this condition is being clarified to include the specific remaining activities authorized by the license for which an NRC pre-operational inspection is required prior to operations. This change does not add a new

requirement, but rather modifies an existing requirement to clarify the scope of future licensed operations requiring a pre-operational inspection.

12.3 The licensee shall not commence operations *in the dryer circuit at the Central Processing Plant or in the Hank Unit* until the NRC performs a preoperational inspection to confirm that written operating procedures and approved radiation safety and environmental monitoring programs are in place, and that preoperational testing is complete.

The licensee should inform the NRC at least 90 days prior to the expected commencement of operations to allow the NRC sufficient time to plan and perform the preoperational inspection.

License condition 12.4

License condition 12.4 requires the licensee to identify information regarding new ground water wells, or new use of existing wells, since the application for the Nichols Ranch ISR Project was submitted in 2007. This information required by license condition 12.4 was submitted and reviewed as part of the pre-operational inspection (Uranerz 2013b; NRC 2014). Furthermore, an ongoing requirement to annually identify new wells, and new uses of existing wells, is already required by license condition 11.7. Therefore, the staff is deleting this condition because it has been satisfied and license condition 11.7 is an ongoing requirement for the licensee to annually review this same information.

12.4 *[DELETED by Amendment 5]*~~The licensee shall identify the location, screen depth, and estimated pumping rate of any new ground water wells or new use of an existing well within the license area and within 2 kilometers of any proposed production area since the application was submitted to the NRC. The licensee shall evaluate the impact of ISR operations to potential ground water users and recommend any additional monitoring or other measures to protect ground water users. The evaluation shall be submitted to the NRC for review within 6 months of discovery of such well use.~~

License condition 12.5

License condition 12.5 requires the licensee to submit the qualifications of radiation safety staff members for NRC review prior to commencement of operations. The NRC reviewed the radiation safety staff qualifications in 2013 (NRC 2013), before NRC authorized operations at the Nichols Ranch ISR Project in 2014. After the licensee received authorization to operate, the qualifications of additional radiation safety staff members has been reviewed by the licensee in accordance with the licensee's NRC-approved policies and procedures, which are based on criteria contained in Regulatory Guide 8.31, "Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Recovery Facilities Will Be As Low As Is Reasonably Achievable," (NRC 2002). Therefore, the NRC staff is removing this condition.

12.5 *[DELETED by Amendment 5]*~~Prior to commencement of operations, the licensee shall submit the qualifications of radiation safety staff members for NRC review.~~

License Condition 12.6

License condition 12.6 requires the licensee to submit the solid byproduct material disposal agreement to the NRC prior to commencement of operations. By letter dated September 27, 2013, the license provided the solid byproduct material disposal agreement and this information was reviewed by NRC during the pre-operational inspection (Uranerz 2013a; NRC 2014). In addition, license condition 9.9 imposes ongoing operational requirements related to the solid

byproduct material disposal agreement, including where the licensee must store the agreement and what actions are required when it is renewed or expired. Therefore, this pre-operational condition is no longer required and will be removed.

12.6 *[DELETED by Amendment 5]*~~Prior to commencement of operations, the licensee shall submit a copy of the solid byproduct material disposal agreement to the NRC.~~

License Conditions 12.13 and 12.14

License conditions 12.13 and 12.14 were included as pre-operational license conditions in the initial license for the Nichols Ranch ISR Project. They were removed in Amendment 2, along with several other pre-operational conditions. However, NRC staff inadvertently omitted the usual note indicating that license conditions 12.13 and 12.14 are deleted. These notes are being restored in this amendment.

12.13 *[DELETED by Amendment 2]*

12.14 *[DELETED by Amendment 2]*

B.4 References

10 CFR Part 40. *Code of Federal Regulations*, Title 10, Energy, Part 40, "Domestic Licensing of Source Material."

10 CFR Part 51. *Code of Federal Regulations*, Title 10, Energy, Part 51, "Environmental protection regulations for domestic licensing and related regulatory functions."

NRC (U.S. Nuclear Regulatory Commission). 1980. Regulatory Guide 4.14, "Radiological Effluent and Environmental Monitoring at Uranium Mills," Washington DC: NRC, Office of Standards Development. Accession No. ML003739941.

NRC (U.S. Nuclear Regulatory Commission). 2002. Regulatory Guide 8.31, "Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Recovery Facilities Will Be As Low As Is Reasonably Achievable," Washington DC: NRC, Office of Nuclear Regulatory Research. Accession No. ML021260630.

NRC (U.S. Nuclear Regulatory Commission). 2011. Safety Evaluation Report for the Nichols Ranch In Situ Recovery Project, Campbell and Johnson Counties, Wyoming. ADAMS Accession No. ML102240206.

NRC (U.S. Nuclear Regulatory Commission). 2013. Letter from R. Linton, NRC to M. Thomas, Uranerz Energy Corporation, dated July 2, 2013, RE: Radiation Safety Officer Qualifications, Nichols Ranch In Situ Recovery Project, Source Material License SUA-1597, TAC J00706. ADAMS Accession No. ML13183A096.

NRC (U.S. Nuclear Regulatory Commission). 2014. Letter from L. Howell, NRC to M. Thomas, Uranerz Energy Corporation, dated April 17, 2014, RE: NRC Team Inspection 040-09067/13-001. ADAMS Accession No. ML14107A507.

NRC (U.S. Nuclear Regulatory Commission). 2016a. Letter from R. Linton, NRC to D. Kolkman, Uranerz Energy Corporation, dated January 21, 2016, RE: Uranerz Energy Corporation, Nichols Ranch In-Situ Recovery (ISR) Project, Source Materials License SUA-1597, Verification of Technical Basis for Surface Contamination Limits (License Condition 10.14) (TAC No. L00797). ADAMS Accession No. ML16011A449.

NRC (U.S. Nuclear Regulatory Commission). 2016b. Letter from R. Kellar, NRC to J. McCarthy, Uranerz Energy Corporation, dated February 2, 2016, RE: NRC Inspection 040-09067/2016-001 and Authorization to Begin Yellowcake Slurry Producing Operations. ADAMS Accession No. ML16033A344.

Uranerz (Uranerz Energy Corporation). 2010. Letter from M. Thomas, Uranerz Energy Corporation, to R. Linton, NRC, dated September 15, 2010, RE: Text Revisions to the Open Issues to the Safety Evaluation Report for the Nichols Ranch ISR Project License Application (TAC J00553, Docket No. 040-09067). ADAMS Accession No. ML102650554.

Uranerz (Uranerz Energy Corporation). 2013a. Letter from M. Thomas, Uranerz Energy Corporation to NRC, dated September 27, 2013, RE: Nichols Ranch ISR Project Affidavit to Withhold Contractual Information from Public Disclosure in Response to SUA-1597 License Condition 9.9. ADAMS Accession No. ML13288A153.

Uranerz (Uranerz Energy Corporation). 2013b. E-mail from M. Thomas, Uranerz Energy Corporation to R. Linton, NRC, dated December 30, 2013, RE: License Condition 12.4 – Domestic Water Well Evaluation. ADAMS Accession No. ML14002A030.

Uranerz (Uranerz Energy Corporation). 2014. Letter from M. Thomas, Uranerz to B. Holian, NRC dated May 8, 2014, RE: Uranerz Energy Corporation, Nichols Ranch ISR Project, NRC License SUA-1597, Docket No. 40-9067 Jane Dough Unit License Amendment Request. ADAMS Accession No. ML14164A274. Supplemented by letters dated October 29, 2014 (ML14309A118); April 13, 2015 (ML15118A122); June 26, 2015 (ML15182A013); May 24, 2016 (ML16148A166); July 19, 2016 (ML16207A054); August 17, 2016 (ML16232A096); September 7, 2016 (ML16253A028); September 15, 2016 (3 submittals: ML16263A080, ML16263A167, and ML16263A177); September 26, 2016 (ML16271A093); September 28, 2016 (ML16278A624); October 31, 2016 (ML16307A100); November 1, 2016 (ML16307A176); and November 7, 2016 (2 submittals: ML16313A470, ML17019A241).

Uranerz (Uranerz Energy Corporation). 2015. Letter from M. Thomas, Uranerz Energy Corporation to A. Persinko, NRC, RE: Uranerz Energy Corporation Nichols Ranch ISR Project, SUA-1597, Response to NRC Comments on Technical Basis for Surface Contamination Limits, License Condition 10.14 (TAC No. L00797). ADAMS Accession No. ML15351A493.

Uranerz (Uranerz Energy Corporation). 2016. Letter from D. Kolkman, Uranerz to NRC, dated November 7, 2016, RE: Uranerz Energy Corporation, Nichols Ranch ISR Project, NRC License SUA-1597, Request for Administrative Revisions to the License with Jane Dough License Amendment (TAC J00726, J00875). ADAMS Accession No. ML17019A241.