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Draft

UTAH DIVISION OF WATER QUALITY

CLASS V AREA PERMIT

UNDERGROUND INJECTION CONTROL (UIC) PROGRAM

UIC Permit Number: UTU-27-AP-BDCCF0C

Millard County, Utah

Issued to:

Advanced Clean Energy Storage I, LLC (ACES I)
3165 East Millrock Drive, Suite 330
Holladay, Utah 84121

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PART I. AUTHORIZATION TO CONSTRUCT AND INJECT

Pursuant to the Safe Drinking Water Act (SDWA) and Utah Underground Injection Control (UIC) Program Regulations in Utah Administrative Code (UAC) R317-7 and federal regulations incorporated by reference therein the Director of the Utah Division of Water Quality (hereinafter "Director") hereby authorizes,

Advanced Clean Energy Storage I, LLC
(ACES I)
3165 East Millrock Drive, Suite 330
Holladay, Utah 84121

to operate and maintain Class V injection wells and caverns for the storage of hydrogen gas. This Class V Permit contains requirements for the storage of hydrogen, which begins after individual injection well and cavern systems have been constructed in accordance with UIC Class III Permit No. UTU-27-AP-718D759 in the Project Area centered approximately at UTM Northing: 205364015 (NAD 83, UTM 12, Meters) and UTM Easting: 500135.217 (NAD 83, UTM 12, Meters), located in Millard County, Utah. A general location map is included as Attachment A. The UIC Class V Permit Area is identical to the UIC Class III Permit Area.

The purpose of solution mining activity conducted under the UIC Class III Permit is the construction of underground storage caverns in a thick salt body that exists under the project area. The unique geology of the subsurface limits the area where cavern construction can occur. A two mile area of review (AOR) was defined under the UIC Class III Permit for the identification of any USDWs and artificial penetrations in the project area as required under the provisions in UAC 317-7, Sections 7-3.1(B), 7-3.4, 7-10.1(A)(1), and 7-11 40 CFR 146.6. This UIC Class V Permit regulates the operation, maintenance, monitoring and reporting of the injection and withdrawal of hydrogen from constructed caverns for the storage and retrieval of hydrogen gas. In addition, this permit regulates limited cavern maintenance to address salt creep during operations through the use of freshwater displacement. This permit also provides requirements for hydrogen well and cavern closure and abandonment and financial assurance in the event of ACES I's insolvency.

Although the Class III UIC Permit No. UTU-27-AP-718D759 regulates cavern construction and this Class V UIC Permit regulates storage of hydrogen in those caverns, both permits shall apply concurrently until the caverns are solution mined to the full extent permitted, to allow construction of individual wells and/or cavern expansion, if applicable, under the Class III UIC Permit while certain wells/storage caverns are operated and maintained under the provisions of this Class V UIC Permit.

Part III (F) of this permit details the process for requesting Director approval to transfer any particular well/storage cavern from the purview of the Class III UIC Permit to this Class V UIC Permit for operation and maintenance, as well as all well/storage caverns that have moved from the purview of this Class V UIC Permit to the Class III UIC Permit for construction and/or expansion.

The Project Area, defined in the permit application, is located west of the intersection of Highway 174, also known as Brush-Wellman Road, and Jones Road; approximately 3 ½ miles east-northeast of Sugarville, Utah and 9 miles north of Delta, Utah.

The legal description of the Project Area within which the operation and maintenance of Class V well/storage caverns may occur is included in Attachment B along with maps showing the facility property boundary, the Project Area, and the Area of Review.

This permit does not convey any mineral rights nor does it convey any contractual rights that may be necessary to operate the caverns and/or to store product(s) in the caverns subject to this permit.

All references to, Utah Administrative Code R317-7, and to Title 40 of the Code of Federal Regulations (40 CFR) are to all regulations that are in effect on the date this permit becomes effective. The following are incorporated as enforceable attachments to this permit:

Attachment A - General Location Map of the ACES I Storage Project, Millard County.

Attachment B - Map of the ACES I Storage Project Area of Review including the Class III Solution Mining Injection Wells and the Permit Area

Attachment C - Storage Cavern Field Operating Plan

Attachment D - Well and Cavern Closure and Abandonment Plan

Attachment E - Financial Assurance

This permit is based upon representations made by the permittee and other information contained in the administrative record. **It is the responsibility of the permittee to read and understand all provisions of this permit.**

Any person who violates the Utah Water Quality Act (UWQA), or any permit, rule, or order adopted under it, is subject to the provisions of section UCA 19-5-115 of the UWQA governing violations.

This permit shall become effective____________, **2022.**

This permit and the authorization to inject and store shall be issued for five years and must be renewed prior to expiration as described in Part II D.2 – Duty to Reapply

Signed this   day of ________________, **2022**

____

Erica Gaddis, Ph.D.
Director
Utah Division of Water Quality

PART II. GENERAL PERMIT CONDITIONS

A. EFFECT OF PERMIT

The permittee is allowed to engage in underground injection in accordance with the conditions of this permit. The permittee, authorized by this permit, shall not construct, operate, maintain, convert, plug, abandon or conduct any other injection activity in a manner that allows the movement of fluid containing any contaminant into underground sources of drinking water (USDW), if the presence of that contaminant may cause a violation of any primary drinking water standard under the Utah Public Drinking Water Administrative Rules, UAC R309-200 and 40 CFR Part 141, or may otherwise adversely affect the health of persons. Any underground injection activity not specifically authorized in this permit is prohibited unless otherwise authorized-by-rule or by another UIC permit. Compliance with this permit does not constitute a defense to any action brought under the Utah Water Quality Act (UWQA) Title 19, Chapter 5 Utah Code, or any other common or statutory law or regulation. Issuance of this permit does not authorize any injury to persons or property, any invasion of other private rights, or any infringement of State or local law or regulations. Nothing in this permit shall be construed to relieve the permittee of any duties under applicable regulations.

B. SEVERABILITY

The provisions of this permit are severable. If any provision of this permit or the application of any provision of this permit to any circumstance is held to be invalid, the application of such provision to other circumstances and the remainder of this permit shall not be affected thereby.

C. CONFIDENTIALITY

In accordance with Utah Code 19-1-306 (Records of the Department of Environmental Quality), Utah Code 63G-2-309 (Confidentiality Claims), and Utah Code 19-5-113 (DWQ Records and Reports Required by Owners/Operators) any information deemed by the permittee to be entitled to trade secret protection submitted to the DWQ pursuant to this permit may be claimed as confidential by the submitter. Any such claim must be asserted at the time of submission by stamping the words "Confidential Business Information" on each page containing such information. If no claim is made at the time of submission, the DWQ may make the information available to the public without further notice. If a claim is asserted, the information will be treated in accordance with the procedures detailed in Utah Code 63G-2 and the federal Freedom of Information Act (FOIA). Claims of confidentiality for the following information will be denied:

1. The name and address of the permittee.
2. Information that deals with the existence, absence or level of contaminants in drinking water.

D. CONDITIONS APPLICABLE TO ALL UIC PERMITS (40 CFR 144.51)

The following conditions are required for all UIC permits. Specific requirements for implementing these conditions are included in Part III of this permit, as necessary.

1. Duty to Comply (40 CFR 144.51(a))

   The permittee shall comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Safe Drinking Water Act and the UWQA and is grounds for enforcement action, permit termination, revocation and re-issuance, modification; or for denial of a permit renewal application; except that the permittee need not comply with the provisions of this permit to the extent and for the duration such noncompliance is authorized in an emergency permit issued in accordance with UAC R317-7-8 (40 CFR 144.34).

2. Duty to Reapply (40 CFR 144.51(b))

   If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. The permittee shall submit a complete permit renewal application at least 180 days before this permit expires. This permit shall be reviewed by the Director at least once every five years to determine whether it should be modified, revoked and reissued, or terminated.

3. Need to Halt or Reduce Activity Not a Defense (40 CFR 144.51(c))

   It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

4. Duty to Mitigate (40 CFR 144.51(d))

   The permittee shall take all reasonable steps to minimize or correct any adverse impact on the environment resulting from noncompliance with this permit.

5. Proper Operation and Maintenance (40 CFR 144.51(e))

   The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of this permit.

6. Permit Actions

   (40 CFR 144.51(f), 40 CFR 124.5)
   This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permitee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

All requests shall be in writing and shall contain facts or reasons supporting the request. The filing of a request for a permit modification, revocation and re-issuance, or termination on the part of the permittee, does not stay any permit condition. This permit may be transferred according to the procedures given in section d).

a) Modify or Revoke and Re-Issue Permits (40 CFR 144.39)

When the Director receives any information (for example, inspects the facility, receives information submitted by the permittee as required in the permit, receives a request for modification or revocation and reissuance, or conducts a review of the permit file), the Director may determine whether or not one or more of the causes listed in paragraphs (1) and (2) of this section for modification or revocation and reissuance or both exist. If cause exists, the Director may modify or revoke and reissue the permit accordingly, subject to the limitations of paragraph (3) of this section and may request an updated application if necessary. When a permit is modified, only the conditions subject to modification are reopened. If a permit is revoked and reissued, the entire permit is reopened and subject to revision and the permit is reissued for a new term. If cause does not exist under this section a) or under section c) for minor modifications, the Director shall not modify or revoke and reissue the permit. If a permit modification satisfies the criteria for minor modifications in section c) the permit may be modified without a draft permit or public review. Otherwise, a draft permit must be prepared and other procedures in 40 CFR 124, incorporated by reference into the Utah UIC Program rules must be followed.

(1) Causes for modification. The following may be causes for revocation and reissuance as well as modification.

i. Alterations. There are material and substantial alterations or additions to the permitted facility or activity which occurred after permit issuance which justify the application of permit conditions that are different or absent in the existing permit.

ii. Information. The Director has received information. For UIC area permits, this cause shall include any information indicating that cumulative effects on the environment are unacceptable.

iii. New regulations. The standards or regulations on which the permit was based have been changed by promulgation of new or amended standards or regulations or by judicial decision after the permit was issued.

iv. Compliance schedules. The Director determines good cause exists for modification of a compliance schedule, such as an act of God, strike, flood, or materials shortage or other events over which the permittee has little or no control and for which there is no reasonably available remedy. See also paragraph (3) under section c) – Minor Modification of Permit).

(2) Causes for modification or revocation and reissuance. The following are causes to modify or, alternatively, revoke and reissue a permit:

i. Cause exists for termination under section b), and the Director determines that modification or revocation and reissuance is appropriate.

ii. The Director has received notification (as required in the permit, see paragraph (4) under section c) – Minor Modification of Permit) of a proposed transfer of the permit. A permit also may be modified to reflect a transfer after the effective date of an automatic transfer (see paragraph (2) of section d) – Transfer of Permit) but will not be revoked and reissued after the effective date of the transfer except upon the request of the new permittee.

iii. A determination that the waste being injected is a hazardous waste as defined in 40 CFR 261.3 either because the definition has been revised, or because a previous determination has been changed.

(3) Facility siting. Suitability of the facility location will not be considered at the time of permit modification or revocation and reissuance unless new information or standards indicate that a threat to human health or the environment exists which was unknown at the time of permit issuance.

b) Termination of Permit (40 CFR 144.40)

(1) The Director may terminate a permit during its term, or deny a permit renewal application for the following causes:

i. Noncompliance by the permittee with any condition of the permit;

ii. The permittee's failure in the application or during the permit issuance process to disclose fully all relevant facts, or the permittee's misrepresentation of any relevant facts at any time; or

iii. A determination that the permitted activity endangers human health or the environment and can only be regulated to acceptable levels by permit modification or termination;

iv. A change in any condition that requires either a temporary or permanent reduction or elimination of any discharge or disposal practice controlled by the permit.

(2) The Director shall follow the applicable procedures in 40 CFR 124 in terminating any permit under this section.

c) Minor Modification of Permit (40 CFR 144.41)

Upon the consent of the permittee, the Director may modify a permit to make the corrections or allowances for changes in the permitted activity listed in this section, without following the procedures of 40 CFR 124. Any permit modification not processed as a minor modification under this section must be made for cause and with 40 CFR 124 draft permit and public notice as required in section a). Minor modifications may only:

(1) Correct typographical errors;

(2) Require more frequent monitoring or reporting by the permittee;

(3) Change an interim compliance date in a schedule of compliance, provided the new date is not more than 120 days after the date specified in the existing permit and does not interfere with attainment of the final compliance date requirement; or

(4) Allow for a change in ownership or operational control of a facility where the Director determines that no other change in the permit is necessary, provided that a written agreement containing a specific date for transfer of permit responsibility, coverage, and liability between the current and new permittees has been submitted to the Director.

(5) Change quantities or types of fluids injected which are within the capacity of the facility as permitted and, in the judgment of the Director, would not interfere with the operation of the facility or its ability to meet conditions described in the permit and would not change its classification.

(6) Change construction requirements approved by the Director pursuant to 40 CFR 144.52(a)(3) (establishing UIC permit conditions), provided that any such alteration shall comply with the requirements of 40 CFR 144 and 40 CFR 146.

(7) Amend a plugging and abandonment plan which has been updated.

d) Transfer of Permit (40 CFR 144.38)

(1) Transfers by Modification. Except as provided in paragraph (2) of this section, a permit may be transferred by the permittee to a new owner or operator only if the permit has been modified or revoked and reissued (under paragraph (2)(ii) under section a)), or a minor modification made (under paragraph (4) of section (c)) to identify the new permittee and incorporate such other requirements as may be necessary under the Safe Drinking Water Act.

(2) Automatic Transfers. As an alternative to transfers under paragraph (1) of this section, any UIC permit for a well not injecting hazardous waste or injecting carbon dioxide for geologic sequestration may be automatically transferred to a new permittee if:

i. The current permittee notifies the Director at least 30 days in advance of the proposed transfer date referred to in paragraph (2)(ii) of this section;

ii. The notice includes a written agreement between the existing and new permittees containing a specific date for transfer of permit responsibility, coverage, and liability between them, and the notice demonstrates that the following financial responsibility requirements of 40 CFR 144.52(a)(7) will be met by the new permittee:

iii. The Director does not notify the existing permittee and the proposed new permittee of intent to modify or revoke and reissue the permit. A modification under this paragraph may also be a minor modification under section c) – Minor Modification of Permit. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in paragraph (2)(ii) of this section.

7. Property Rights (40 CFR 144.51(g))

This permit does not convey any property rights of any sort, or any exclusive privilege.

8. Duty to Provide Information (40 CFR 144.51(h))

The permittee shall furnish to the Director within a time specified, any information which the Director may request to determine whether cause exists for modifying, revoking and re-issuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Director upon request, copies of records required to be kept by this permit.

9. Inspection and Entry (40 CFR 144.51(i))

The permittee shall allow the Director, or an authorized representative, upon the presentation of credentials and other documents as may be required by the law, to:

a) Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

b) Have access to and copy, at reasonable times, any records that are kept under the conditions of this permit;

c) Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and

d) Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the SDWA and / or UWQA, any substances or parameters at any location.

10. Monitoring and Records (40 CFR 144.51(j))

a) Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

b) The permittee shall retain records of all monitoring information, including the following:

(1) Calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample,

measurement, report, or application. This period may be extended by request of the Director at any time; and

(2) The nature and composition of all injected fluids until three years after the completion of any plugging and abandonment as appropriate. The Director may require the owner or operator to deliver the records to the Director at the conclusion of the retention period.

c) Records of monitoring information shall include:

(1) The date, exact place, and time of sampling or measurements;
(2) The individual(s) who performed the sampling or measurements;
(3) The date(s) analyses were performed;
(4) The names of individual(s) who performed the analyses;
(5) The analytical techniques or methods used; and
(6) The results of such analyses.

11. Signatory Requirements (40 CFR 144.51(k))

All reports or other information, submitted as required by this permit or requested by the Director, shall be signed and certified as follows:

a) Applications. All permit applications shall be signed as follows:

(1) For a corporation: by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means;
   i. A president, secretary, treasurer, or vice president of the corporation in charge of a principal business function, or any other person who performs similar policy- or decision-making functions for the corporation, or
   ii. the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

Note:
DEQ does not require specific assignments or delegations of authority to responsible corporate officers identified in 40 CFR 144.32(a)(1)(i). DEQ will presume that these responsible corporate officers have the requisite authority to sign permit applications unless the corporation has notified the Director to the contrary. Corporate procedures governing authority to sign permit applications may provide for assignment or delegation to applicable corporate positions under 40 CFR 144.32(a)(1)(ii) rather than to specific individuals.

(2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or

(3) For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official. For purposes of this

section, a principal executive officer of a Federal agency includes: (i) The chief executive officer of the agency, or (ii) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of EPA).

b) Reports. All reports required by permits and other information requested by the Director shall be signed by a person described in section a), or by a duly authorized representative of that person. A person is a duly authorized representative only if:

(1) The authorization is made in writing by a person described in paragraph a) of this section;

(2) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, or position of equivalent responsibility. (A duly authorized representative may thus be either a named individual or any individual occupying a named position); and

(3) The written authorization is submitted to the Director.

c) Changes to authorization. If an authorization under section b) is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of section b) must be submitted to the Director prior to or together with any reports, information, or applications to be signed by an authorized representative.

d) Certification. Any person signing a document under section a) or b) shall make the following certification:

"I CERTIFY UNDER PENALTY OF LAW THAT THIS DOCUMENT AND ALL ATTACHMENTS WERE PREPARED UNDER MY DIRECTION OR SUPERVISION IN ACCORDANCE WITH A SYSTEM DESIGNED TO ASSURE THAT QUALIFIED PERSONNEL PROPERLY GATHER AND EVALUATE THE INFORMATION SUBMITTED BASED ON MY INQUIRY OF THE PERSON OR PERSONS WHO MANAGE THE SYSTEM, OF THOSE PERSONS DIRECTLY RESPONSIBLE FOR GATHERING THE INFORMATION, THE INFORMATION SUBMITTED IS, TO THE BEST OF MY KNOWLEDGE AND BELIEF, TRUE, ACCURATE, AND COMPLETE. I AM AWARE THAT THERE ARE SIGNIFICANT PENALTIES FOR SUBMITTING FALSE INFORMATION, INCLUDING THE POSSIBILITY OF FINE AND IMPRISONMENT FOR KNOWING VIOLATIONS."

12. <u>Reporting Requirements (40 CFR 144.51(l))</u>

Specific requirements for reporting the following items are included in Part III of the permit.

a) Planned Changes. The permittee shall give written notice to the Director, as soon as possible, of any planned physical alterations or additions to the UIC-permitted facility. Notification of planned changes on the part of the permittee, does not stay any permit condition.

b) Anticipated Noncompliance. The permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity that may result in noncompliance with permit requirements. Notification of anticipated noncompliance on the part of the permittee does not stay any permit condition.

c) Permit Transfers. This permit is not transferable to any person except in accordance with section d) of Permit Actions – Transfer of Permit. The Director may require modification or revocation and re-issuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary under the SDWA and/or the UWQA.

d) Monitoring Reports. Monitoring results shall be reported at the intervals specified in Part III of this permit.

e) Compliance Schedules. Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule specified in Part III B of this permit shall be submitted no later than 30 days following each schedule date.

f) Endangering Noncompliance
The permittee shall report to the Director any noncompliance that may endanger health or the environment, as follows:

(1) Twenty-four Hour Reporting
Endangering noncompliance information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. Such reports shall include, but not be limited to, the following information:

i. Any monitoring or other information that indicates any contaminant may cause an endangerment to a USDW, or

ii. Any noncompliance with a permit condition, or malfunction of the injection system, which may cause fluid migration into or between USDWs.

(2) Five-day Reporting
A written submission shall be provided within five days of the time the permittee becomes aware of the circumstances of the endangering noncompliance. The written submission shall contain a description of the noncompliance and its cause, the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

g) Other Noncompliance
The permittee shall report all instances of noncompliance not reported under 12d) (Monitoring Reports), 12e) (Compliance Schedule Reports), or 12f) (Endangering Noncompliance Monitoring) of this section in the next Monitoring Report. The reports shall contain a description of the noncompliance and its cause, the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the

anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.

h) Other Information

When the permittee becomes aware of a failure to submit any relevant facts in the permit application or submitted incorrect information in a permit application or in any report to the Director, the permittee shall submit such facts or information within 10 days after becoming aware of the failure to submit relevant facts.

13. Requirements Prior to Commencing Injection (40 CFR 144.51(m))

a) For a new injection well authorized by an individual permit, a new injection well may not commence injection until construction is complete, and

(1) The permittee has submitted notice of completion of construction to the Director; and

(2) Either of the following:

i. The Director has inspected or otherwise reviewed the new injection well and finds it is in compliance with the conditions of the permit; or

ii. The permittee has not received notice from the Director of his or her intent to inspect or otherwise review the new injection well within 13 days of the date of the notice in section a), in which case prior inspection or review is waived and the permittee may commence injection. The Director shall include in his notice a reasonable time period in which he shall inspect the well.

b) For new injection wells authorized by an area permit under UAC R317-7-7 (40 CFR 144.33), requirements prior to commencing injection shall be specified in Part III of the permit.

14. Notification Prior to Conversion or Abandonment. (40 CFR 144.51(n))

The permittee shall notify the Director at such times as the permit requires before conversion or abandonment of the well or in the case of area permits before closure of the project.

15. Plugging and Abandonment Requirements. (40 CFR 144.51(o))

This Class V Permit shall include conditions for plugging and abandonment that meet the applicable requirements of the SDWA and UAC R317-7 to ensure that plugging and abandonment of wells will not allow the movement of fluids into or between USDWs. If the plan meets the plugging and abandonment requirements of UAC R317-7, the Director shall incorporate it into the permit as a permit condition. Where the review of the plan submitted in the permit application indicates the plan is inadequate, the Director may require the applicant to revise the plan, prescribe conditions meeting the requirements of this paragraph, or deny the permit. For purposes of this paragraph, temporary or intermittent cessation of injection operations is not abandonment. Requirements for implementing the approved well and cavern closure and abandonment plan are specified in Part III Section I and Attachment D of this permit including hydrogen storage cavern closure requirements that are specifically added for this permit in addition to the plugging and abandonment requirements in the Class III Permit.

Plugging and Abandonment reporting requirements (40 CFR 144.51(p)) are specified in Part III Section I of this permit and in the well and cavern closure and abandonment plan found in Attachment D. These requirements apply to both the Class III and Class V permits.

16. <u>Duty to Establish and Maintain Mechanical Integrity. (40 CFR 144.51(q))</u>

a) The owner or operator shall establish prior to commencing injection or on a schedule determined by the Director, and thereafter maintain mechanical integrity as defined in 40 CFR 146.8.

This Class V Permit imposes the same the Mechanical Integrity requirements as the Class III Permit. Specifically, when the Director determines that a Class V well lacks mechanical integrity pursuant to 40 CFR 146.8, written notice of this determination shall be given to the owner or operator. Unless the Director requires immediate cessation, the owner or operator shall cease injection into the well within 48 hours of receipt of the Director's determination. The Director may allow plugging of the well pursuant to the requirements of UAC R317-7 or require the permittee to perform such additional construction, operation, monitoring, reporting and corrective action as is necessary to prevent the movement of fluid into or between USDWs caused by the lack of mechanical integrity. The owner or operator may resume injection upon written notification from the Director that the owner or operator has demonstrated mechanical integrity pursuant to 40 CFR 146.8.

b) The Director may allow the owner/operator of a well which lacks internal mechanical integrity pursuant to 40 CFR 146.8(a)(1) to continue or resume injection, if the owner or operator has made a satisfactory demonstration that there is no movement of fluid into or between USDWs.

PART III. SPECIFIC PERMIT CONDITIONS

A. DURATION OF PERMIT
(R317-7-9.5 and 40 CFR 144.36)

This UIC Class V Operating Permit shall be in effect for a period of five (5) years from the date of issuance.

B. COMPLIANCE SCHEDULE
(40 CFR 144.53)

In addition to Part II (D)(13) of this permit, the requirements of the UIC Class III Permit must be met prior to commencing storage under the UIC Class V Permit. Failure to do so may result in the termination of the permit according to Part II(D)(6)(b) of this permit. Before commencing hydrogen storage, the Operator shall submit or complete the following:

1. Well Completion Data / Report

   The operator shall submit to the DWQ Director for review an injection well completion report consisting of:

   a) All available logging and testing data on the well;
   b) Primary cement calculations and evidence of cement returns to surface;
   c) Results of satisfactory demonstration of mechanical integrity;
   d) Actual maximum injection pressure and injection flow rate;
   e) Results of the formation testing program, if applicable;
   f) Actual solution mining procedures;
   g) Status of all wells requiring corrective action within the area of review, if applicable;
   h) Detailed 'As-Built' Well Schematic including:
      (1) Casing details including size, weight, grade and setting depths,
      (2) Cement details including type, special formulations, calculated volumes, actual pumped volumes, and yield (cubic feet / sack),
      (3) Formation horizons,
      (4) Ground water horizons,
      (5) Pilot hole.
   i) Hanging strings shall be removed to complete sonar surveys of the cavern after each solution mining phase and may be replaced with production strings for cavern operations before commencement / re-commencement of product storage

j) Sonar surveys of the cavern, cavern floor and cavern roof shall be conducted after each solution mining phase and before commencement / re-commencement of product storage, and

k) Nitrogen/brine interface MIT shall be conducted according to Part III (H) after each solution mining phase and before commencement / re-commencement of product storage,

l) Submittal of well/cavern completion report required by Part III (G)(1) after each solution mining phase and before commencement / re-commencement of product storage, and

m) Written approval from the Director of DWQ to commence / re-commence product storage shall be required.

C. CORRECTIVE ACTION
(40 CFR 144.52(2). 40 CFR 144.55, 40 CFR 146.7)

As of the effective date of this permit no wells have been identified within the area of review for the ACES I Hydrogen Storage Project that require corrective action under the UIC Class III Permit. As the Class V Draft Permit Area coincides with the Class III Permit no additional corrective actions are needed to address artificial penetrations in the Permit Area. Any corrective actions described in this section are specific to hydrogen injection/production wells/caverns encompassed by this UIC Class V Draft Permit.

This UIC Class V Permit contains specific conditions for regulatory oversight of the operation and maintenance of hydrogen injection/production from well/cavern systems and monitoring and reporting for hydrogen migration and leakage. A Corrective action plan will be developed per the operating, monitoring and reporting plan required under Part III Section E of this permit in the event that hydrogen leakage is detected in the well/cavern systems.

D. OPERATING, MONITORING AND REPORTING PLAN
(40 CFR 144.54, and 40 CFR 146.51)

The Storage Cavern Field Operating, Monitoring and Reporting Plan (SCFOMRP) is included as Attachment C of this permit. The SCFOMRP is enforceable as a condition of this UIC Class V Permit.

1. Contents of Storage Cavern Field Operating, Monitoring and Reporting Plan

   The SCFOMRP includes provisions governing Operation and Maintenance, Monitoring, Testing and Inspection and Agency Reporting and Notification, and Records Retention.

2. Monitoring Equipment and Methods

   In accordance with the SCFOMRP, all monitoring equipment shall be properly selected, installed, used, and maintained according to the manufacturer's specifications so as to yield data which are representative of the monitored activity. All monitoring methods shall be properly selected and implemented at appropriate intervals and frequency so as to yield data which are representative of the monitored activity. Documentation verifying, if applicable, the proper selection, installation, use, and maintenance of monitoring equipment and the proper implementation of monitoring methods shall be made available to the Director upon request.

3. Required Monitoring and Testing

ACES I shall conduct monitoring and testing to include mechanical integrity testing in accordance with the applicable methods identified in 40 C.F.R. § 146.33 and 40 C.F.R. §146.8 and Class III Permit requirements during operations to ensure a stable shape and configuration is maintained, and to ensure the Required Pillar Width is maintained. Monitoring and testing reports should be submitted with Class V reports to the extent necessary to comply with the conditions and enforcement of the Class V Permit but duplicate Class III and Class V reporting is not necessary.

4. Operating Requirements

a) Cavern Configuration, Spacing, and Standoff Requirements

Each cavern shall be developed and spaced with sufficient salt back (salt above the roof of the cavern), standoff (set back from the boundary of the salt body) and set back from the permit area boundary to maintain during operations mechanical integrity of the caverns, containment of hydrogen gas through the salt web (the in-situ mass separating adjacent underground caverns and caverns and the edge of the salt body), and migration of hydrogen through the overburden during all modes of cavern development, operation and abandonment for the lifetime of the facility.

ACES I shall maintain at all times, including but not limited to, cavern siting, development, expansion, and operation, a salt roof thickness equal to 75 percent of the maximum cavern height or depth, minimum spacing between all hydrogen storage caverns of a two-to-one (2:1) pillar-to-diameter ratio (P:D), which is the equivalent of a three-to-one (3:1) center-to-center or S:D ratio, where S is the distance between the centers of two caverns or between a cavern and the edge of the salt body, D is the average of the maximum diameter of the two caverns, and P is the minimum pillar thickness between adjacent caverns (the "Required Pillar Width").

The Required Pillar Width for the storage cavern field shall be defined by a geomechanical analysis required by Part III.D.2 of the Class III UIC Permit.

b) Maximum Allowable Operating Pressure Gradient (MaxAOPG)

Except during well stimulation, the maximum allowable operating pressure gradient (MaxAOPG) shall be calculated to assure that pressure in the injection zone during injection does not initiate new fractures or propagate existing fractures in the injection zone. In no case shall the injection pressure initiate fractures in the confining zone or cause the migration of injection or formation fluids into an USDW.

In accordance with 40 CFR Part 146 and based on the geomechanical analysis of the salt formation in the MH-1 exploratory well, the upper limit of operating pressures is 0.92 psi/ft of depth to the last cemented casing seat. However, ACES I has completed additional geomechanical testing for hydrogen storage that indicates .85 psi/ft is the recommended maximum operating pressure gradient. Therefore, ACES I shall provide additional protection by operating at pressure gradients below 0.85 psi/ft of depth as follows:

(1) The typical operating pressure gradient of a cavern will be 0.55 psi/ft of depth to the last cemented casing seat.

(2) The maximum allowable operating pressure gradient (MaxAOPG) will not be greater than 0.80 psi/ft of depth to the last cemented casing seat, unless ACES I submits for approval a geomechanical analysis providing justification for a higher MaxAOPG and providing a safety factor. A higher MaxAOPG shall not be implemented without written approval from the Director. At no time will the caverns be subjected to pressures above the approved MaxAOPG including pressure pulsations and during abnormal operating conditions.

(3) The maximum allowable MIT test pressure gradient will not exceed 0.85 psi/ft of depth to the last cemented casing seat.

(4) The hydrogen storage specific operating pressures specified in subsections i through iii above are within the allowable pressures for solution mining under the Class III Permit so there will be no exceedance of pressure limits within the cavern or along the length of the well casing during solution mining or hydrogen storage and withdrawal under Class V Permit operations.

c) Minimum Allowable Operating Pressure Gradient (MinAOPG)

The permittee shall maintain a minimum operating pressure gradient during the creation and operation of each cavern that is protective of the integrity of the wells, caverns, salt web, and overburden. ACES I shall maintain a MinAOPG of 0.30 psi/ft of depth based on the geomechanical analysis of the salt formation in the MH-1 exploratory well and an additional factor of safety for hydrogen storage.

d) Borehole – Casing Annulus Injection Prohibited

Injection between the outermost casing protecting USDW's and the well bore is prohibited.

E. REPORTING REQUIREMENTS
(R317-7-10.4(B) and 40 CFR 144.54)

1. Quarterly Monitoring Reports

a) Schedule for Submitting Quarterly Monitoring Report

Quarter	Report Due On:

1st Quarter	January 1 – March 31	April 30
2nd Quarter	April 1 – June 30	July 31
3rd Quarter	July 1 – September 30	October 31
4th Quarter	October 1 – December 31	January 31

b) Content of Quarterly Monitoring Reports

(1) Quarterly monitoring reports shall be provided for product injection/withdrawal. The report will track any inventory that is injected and withdrawn to confirm an inventory balance. Appendix D provides the methodology and the inventory report form.

i. If a discrepancy over 5% is identified by the inventory verification, an internal evaluation shall be initiated within 24-hours to determine the cause. If a discrepancy of 8% or more is identified by the inventory verification, an internal evaluation will be initiated within 24-hours to determine the cause and a summary report with the results of any storage cavern internal evaluation will be submitted to DWQ within 30 days after completion.

(2) Subsidence monitoring survey results will also be provided quarterly moving to annually after the first year of operations.

i. In the event a surface elevation change is detected that is in excess of 0.50 foot since the previous survey, DWQ, SITLA and Millard County will be notified within 24 hours.

2. Annual and Supplemental Reports

a) Submittal of annual reports will be with the first quarterly report submittal described in F(1) above.

b) Content of the annual and supplemental reports are described in the SCFOMRP Attachment C of this Permit and are consistent with the applicable monitoring and testing outlined in 40 C.F.R. § 146.33 and acceptable industry standards for the operation of solution mined salt caverns.

3. Endangering Noncompliance Reporting

a) The permittee shall report to the Director any noncompliance that may endanger health or the environment, as specified in Part II Section D.12.f of this UIC Class V Permit. Planned Changes

The permittee shall give written notice to the Director, as soon as possible, of any planned physical alterations or additions to the UIC-permitted facility. Notification of planned changes on the part of the permittee, does not stay any permit condition.

4. Anticipated Noncompliance

The permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity that may result in noncompliance with permit requirements. Notification of anticipated noncompliance on the part of the permittee does not stay any permit condition.

5. Permit Transfers

   This permit is not transferable to any person except in accordance with Part II (D)(6)(d) of this permit. The current permittee shall notify the Director at least 30 days in advance of the proposed transfer date. Notification shall comply with the requirements in Part II(D)(6)(d) of this permit.

6. Compliance Schedule Reporting

   Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule specified in Part III B of this permit shall be submitted no later than 30 days following each schedule date.

7. Mechanical Integrity Reporting

   a) Loss of Mechanical Integrity –

      (1) In the event of a mechanical integrity failure which may potentially endanger an USDW, report to the Director verbally within 24 hours followed by submission of a written report within 5 days.

      (2) Within 14 days after loss of MI, submit to the Director a schedule indicating what will be done to restore MI to the well, or if it will be plugged.

8. Closure and Abandonment ("As-Plugged") Report

   a) If a well/cavern system is required to be closed and abandoned the following requirements shall apply:

      (1) Within 60 days after permanently or temporarily plugging and abandoning a well, the permittee shall submit a Closure and Abandonment Report to the Director. The report shall be certified as accurate by the person who performed the closure and abandonment operation, and shall consist of either:

      (2) A statement that the well was plugged in accordance with the Well and Cavern Closure and Abandonment Plan (Attachment D), required by Part III (I) of this permit, previously submitted to, and all conditions of approval provided by, the Director; or

      (3) If the actual closure and abandonment needs to deviate from the approved plan(s), the permittee shall submit a statement and diagrams defining the proposed closure and abandonment and why the Director should approve such deviation. Any unapproved deviation from the previously approved individual plans required by this permit which may endanger waters of the State of Utah, including USDWs, is cause for the Director to require the operator to re-plug the well.

9. Permit Review Report

Within 30 days after receipt of this permit, the permittee shall report to the Director that the person(s) responsible for implementing this permit has read and is personally familiar with all terms and conditions of this permit.

10. Electronic Reporting

In addition to submittal of the hard copy data, the permittee shall submit the required monitoring data in the electronic format specified by the Director.

F. NOTICE PROCEDURES FOR IDENTIFYING APPLICABLE UIC PERMIT

1. Notice of Applicable UIC Permit

Because this Class V UIC Permit governs operations and maintenance of the well/cavern systems and the Class III UIC Permit governs construction and development of the well/cavern systems, ACES I shall request director approval when it intends to move from construction under the Class III UIC Permit to operations under this Class V UIC Permit. Such request may concern one particular well/cavern system or multiple well/cavern systems.

a) The request shall identify the Well(s)/Cavern System(s) that are moving from construction to operation. ACES I shall identify particular well(s)/cavern system(s) that will be commencing operations at least thirty (30) days prior to commencing product storage, including a Well/Cavern Completion Report required under the UIC Class III solution mining permit consisting of:

(1) All available logging and testing data on the well/cavern system not previously submitted with the well completion report;

(2) Results of mechanical integrity testing for well/cavern system;

(3) Detailed 'As-Built' well/cavern schematic including any changes made to the original well 'As-Built' schematic;

(4) Sonar survey of the cavern including floor and roof surveys;

b) Director's Approval to Commence Operations within the Well / Cavern System

Within 14 days after receiving the Request and all components of the Well/Cavern Completion Report required by a) above, the Director shall provide written notice granting or denying approval to commence operations under this permit.

c) Application of Class V Permit

ACES I shall comply with all requirements of this Class V UIC Permit and DWQ orders prior to the commencement of product storage, if applicable as explained in Part I of this permit.

2. Re-Commencing of Construction of Individual Well/Cavern System

   a) In the event ACES I desires to re-commence active solution mining of a cavern previously in operation under this Class V UIC permit, ACES I shall submit a letter requesting Director approval to inject water into the well/cavern(s) for solution mining under the concurrently open Class III UIC Permit at least sixty (60) days prior to re-commencing solution mining. The letter shall include, as attachments:

      (1) Previous history of freshwater enlargement.

      (2) A chronology of all geophysical surveys/tests conducted during the time the cavern was released from this permit including a brief summary of the results.

      (3) Reports of any mechanical integrity tests and sonar surveys that were conducted during the time the cavern was released from this permit.

      (4) An updated, current tabulation of the information required in Part III (F)(1)(b)(7) of this permit

      (5) Other relevant information that may affect the DWQ's decision to authorize injection under the UIC Class III Permit.

   b) ACES I shall conduct monitoring and testing to include mechanical integrity testing every 5 years in accordance with the applicable methods identified in 40 C.F.R. § 146.33 and 40 C.F.R. §146.8 as required under the UIC Class III Permit. The same report should be submitted with Class V reports to the extent necessary to comply with the conditions and enforcement of the Class V Permit but duplicate sonar surveys are not necessary.

   c) ACES I shall conduct and submit a report of a sonar survey of the entire individual well/cavern system from the last cemented casing to the cavern floor as required every 5 years or otherwise as required under the UIC Class III Permit. The same report should be submitted with Class V reports to the extent necessary to comply with the conditions and enforcement of the Class V Permit but duplicate sonar surveys are not necessary.

   d) DWQ shall review all information required in this section including any requests for variance. The Director shall provide written notice denying or granting approval to re-commence active solution mining within the 60-day period indicated in a) above.

   e) No solution mining shall occur if the UIC Class III Permit is not current. However, ACES I shall be permitted under this Permit to inject freshwater injection during UIC Class V Draft Permit operations of hydrogen storage and withdrawal solely for the purpose of cavern maintenance only to recover storage volume capacity associated with salt creep. The amount of volume recovery is limited to no more than 10 percent under this permit.

   f) The hydrogen storage specific operating pressures specified in Part III, Section E.4.b, subsections i through iii, and in Part III, Section E.4.c above are within the allowable pressures for solution mining under the Class III Permit so there will be no exceedance of pressure limits within the cavern or along the length of the well casing during solution mining or hydrogen storage and withdrawal under Class V Permit operations if the UIC Class III Permit is not current.

G. MECHANICAL INTEGRITY

(R317-7-10.3(B) and 40 CFR 146.8)

1. Class V Injection Well Mechanical Integrity Standards

Mechanical integrity testing requirements for each Class V well are those set forth in R317-7-10.3(B) and 40 CFR 146.8. All injection wells shall have and maintain mechanical integrity (MI) consistent with the requirements of 40 CFR 146.8. An injection well has MI if there is:

a) No significant leak in casing, tubing, or packer (internal MI), and
b) No significant fluid movement into an USDW through vertical channels adjacent to the injection well bore (external MI).

2. Mechanical Integrity Testing (MIT) Methods

ACES I shall employ one or more of the approved testing methods set forth in 40 CFR 146.8 to demonstrate MI of the well / cavern system during cavern operations. The approved methods are described in the SCFOMRP.

3. Prohibition Without Demonstration

The permittee shall not commence injection operation of any new well without:

a) Prior demonstration of MI, and
b) Receipt of Director written approval of the MI demonstration.

4. Loss of Mechanical Integrity

If the permittee or the Director determines that a well fails to demonstrate MI the permittee shall:

a) Cease operation of the well immediately, and
b) Take steps to prevent losses of brine into USDWs, and
c) Within 90 days after loss of MI, restore MI or plug and abandon the well in accordance with a plugging and abandonment plan approved by the Director.
d) The permittee may resume operation of the well after demonstration of MI and receiving written approval from the Director.

5. Mechanical Integrity Demonstration Requests

With just cause, the Director may at any time require, by written notice, the permittee to demonstrate MI of a well. 7. Mechanical Integrity Demonstration Inspections The permittee shall allow the Director, or his representative, to observe any or all MI demonstrations. The permittee shall notify the Director, in writing, of its 34 UIC Permit No. UTU-27-AP-718D759 Final intent to demonstrate MI, no less than 14 days prior to the intended demonstration.

H. WELL AND CAVERN CLOSURE AND ABANDONMENT

(40 CFR 146.10 and R317-7-10.5)

1. Closure and Abandonment Requirements

   If a hydrogen injection/production well or well/cavern system operating under this UIC Class V Permit is required to be plugged and abandoned, ACES I shall execute the approved Well and Cavern Closure and Abandonment Plan (Attachment D). The document is informed by the "Cavern Well Abandonment Techniques Guidelines Manual" issued by the Solution Mining Research Institute (SMRI) provides guidance in the preparation of an appropriate Well and Cavern Closure Plan and at a minimum, the plan shall include monitoring of the cavern pressure and cavern volume during the waiting period required for the brine and cavern to reach static equilibrium before plugging and abandoning the well. The plan shall also include continued subsidence monitoring of the cavern for 10 years after the plugging and abandonment of the cavern well. The approved Well and Cavern Closure and Abandonment Plan shall become an enforceable attachment to this permit. The hydrogen storage cavern specific closure actions which must be performed by ACES I prior to release from this permit, including but not limited to financial assurance obligations are outlined in Attachment D. These and all other closure actions that pertain to both the Class III and V permits are specified in Attachment D.

I. FINANCIAL RESPONSIBILITY
(R317-7-9.1(24) and 40 CFR 144.52)

1. Demonstration of Financial Responsibility

   The permittee is required to maintain financial responsibility and resources to close, plug, and abandon all wells and well/cavern systems. This requirement is demonstrated by submission of financial assurance instrument(s) acceptable to the Director to implement the approved Well and Cavern Closure and Abandonment Plan (Attachment D) required by this permit. Evidence of adequate financial assurance has been provided in accordance with the requirements of the UIC Class III Permit and is also attached to this permit as an enforceable condition as Attachment F.

2. Renewal of Financial Responsibility

   Every five (5) years, the permittee shall demonstrate the adequacy of the financial assurance instrument to close, plug and abandon all well/cavern systems not permanently closed and abandoned by the permittee in compliance with the closure and abandonment requirements of this permit.

3. Alternate Financial Responsibility

   The permittee must submit an alternate demonstration of financial responsibility acceptable to the Director within 60 days after any of the following events occurs:

a) The institution issuing the financial assurance instrument files for bankruptcy; or

b) The authority of the institution issuing the financial assurance instrument is suspended or revoked; or

c) In the case a Certificate of Deposit (CD) is used to demonstrate financial responsibility, the CD is determined to be insufficient to cover well closure, plugging and abandonment; or

d) In the case a Certificate of Deposit (CD) is used to demonstrate financial responsibility, the CD is suspended or revoked.

J. ADDITIONAL CONDITIONS (40 CFR 144.52)

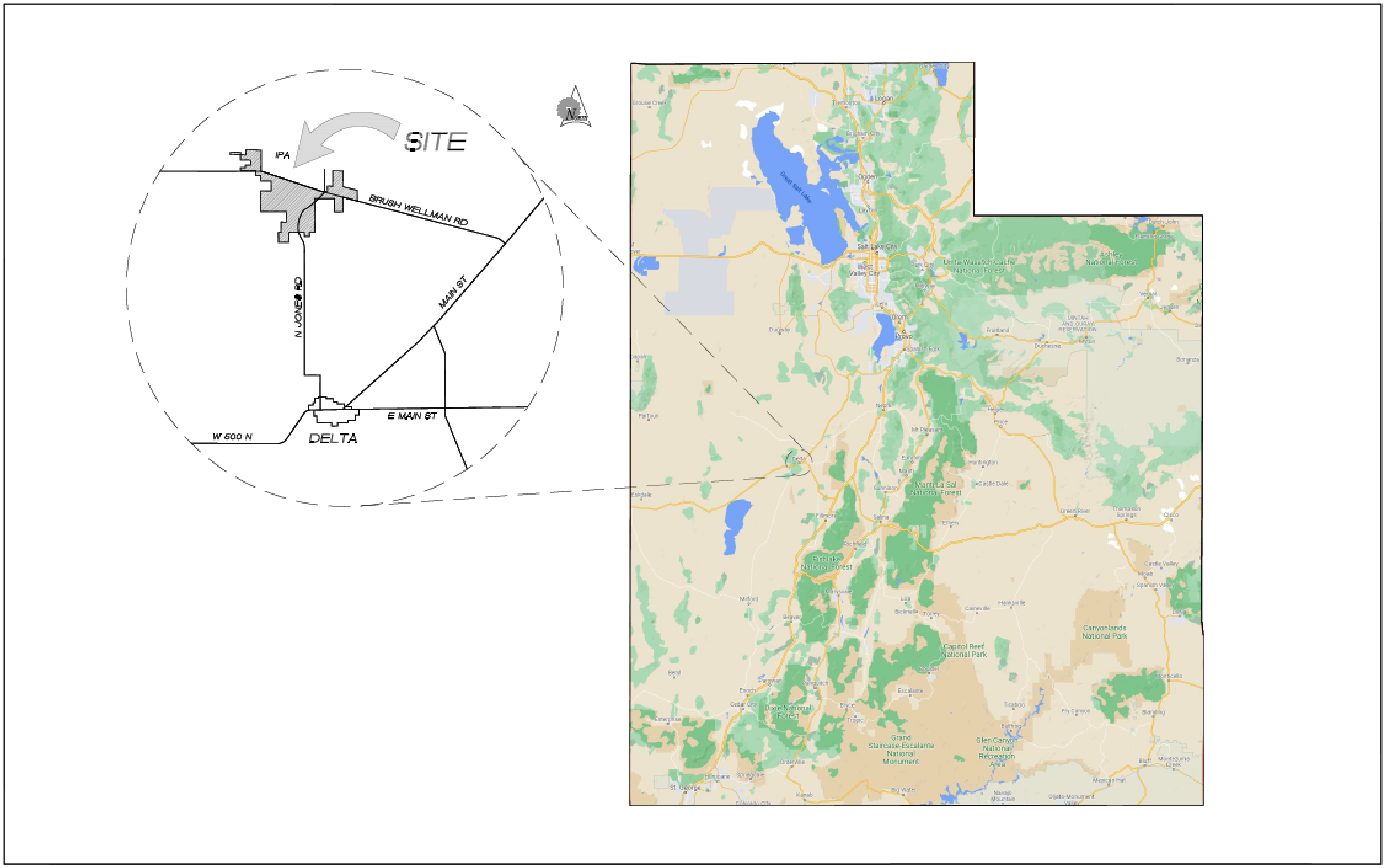
1. Geomechanical Analysis and Reassessment

Any geochemical processes that are detected during operations that may affect cavern stability during Class V operations requires additional analysis and reassessment of cavern stability as prescribed in the conditions of UIC Class III Permit Part III Section K and 40 CFR 144.52 and as set forth in the SCFOMRP.

DWQ-2022-001953

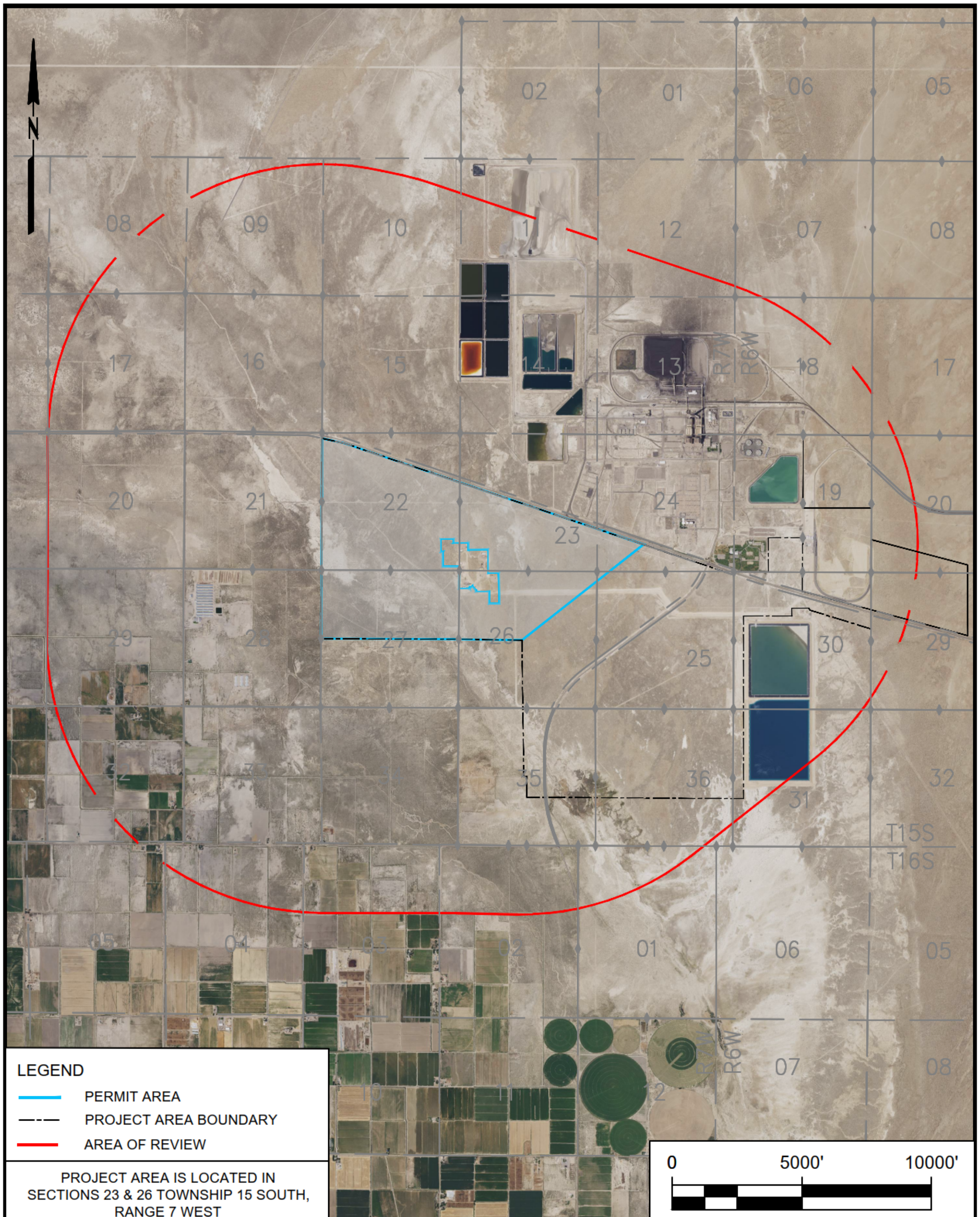
ATTACHMENT A

General Location Map of the Magnum Storage Project, Millard County.


SITE
IPA
BRUSH WELLMAN RD
N JONES RD
MAIN ST
E MAIN ST
W 500 N
DELTA

ATTACHMENT B

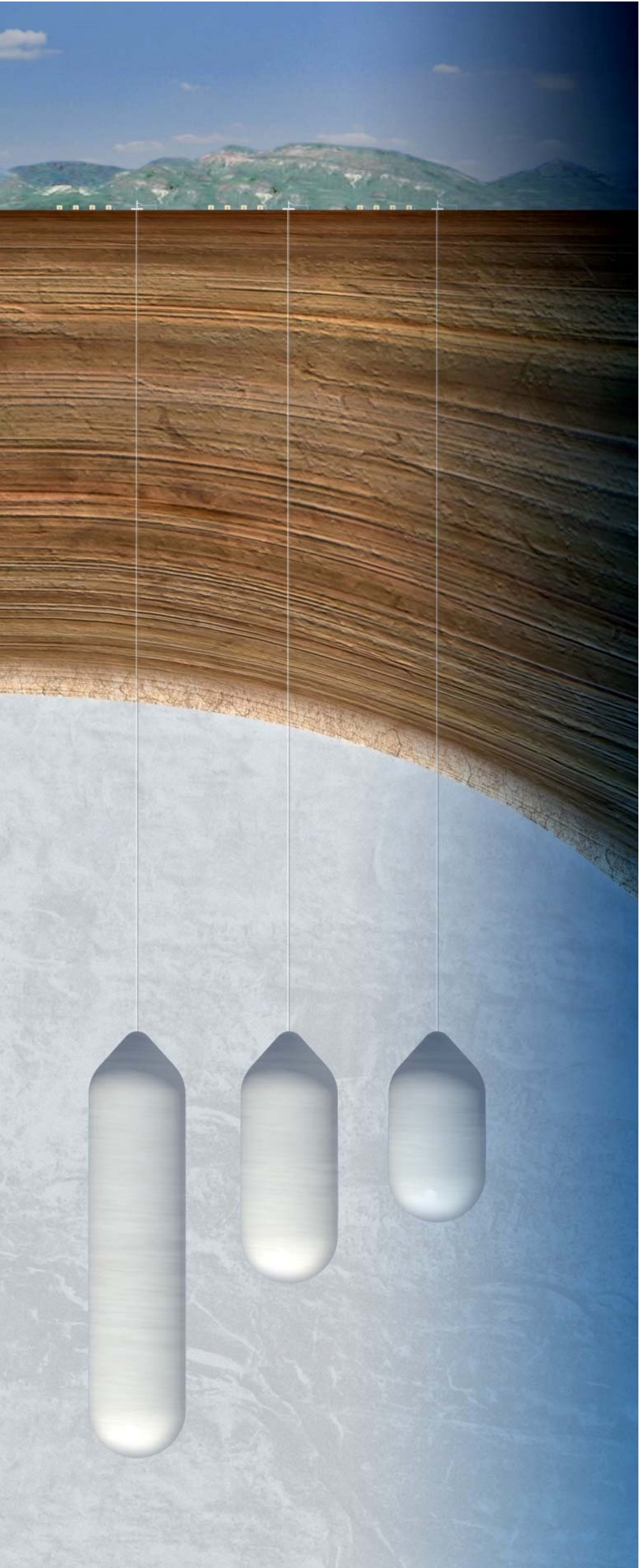
Map of the Magnum Storage Project Area of Review (AOR) including the Class V Hydrogen Injection and Withdrawal Wells and the Permit Area



MAGNUM	MAGNUM SOLUTION MINING, LLC	MAP OF PROJECT AREA OF REVIEW (AOR) INCLUDING THE CLASS V HYDROGEN INJECTION AND WITHDRAWAL WELLS AND THE PERMIT AREA	ATTACHMENT B

ATTACHMENT C

Hydrogen Storage Cavern Field Operating, Monitoring and Reporting Plan (Draft)



Hydrogen Storage Cavern Field Operating, Monitoring and Reporting Plan (Draft)

Class V Underground Injection Control Permit (UTU-27AP-BDCCF0C)

MAGNUM

Hydrogen Storage Cavern Field Operating, Monitoring, and Reporting Plan (Draft)

Class V Underground Injection Control Permit UTU-27AP-BDCCF0C

Magnum Solution Mining, LLC
(A Wholly Owned Subsidiary of Aces Delta, LLC)
Delta, Utah

December 2021

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Section 1

Introduction

1.1 Plan Purpose

This Plan has been developed to outline clear processes and procedures for the operation and maintenance, monitoring, testing and inspection, and agency reporting of the Hydrogen Storage Cavern Field at the Magnum Solution Mining, LLC (Company) Hydrogen Production and Storage facility (Facility). The operation of the Hydrogen Storage Cavern Field is under the jurisdiction of the Utah Department of Environmental Quality, Division of Water Quality (DWQ). The Company has created this enforceable Plan, to meet the requirements for the operation of salt storage caverns under DWQ Class V UIC Permit UTU-27AP-BDCCF0C and in accordance with the applicable methods identified in 40 CFR 146.33 and 40 CFR 146.8 and other acceptable industry standard methods. This Plan has been reviewed and approved by the DWQ. Any future modifications to this Plan requested by the Company are subject to approval by DWQ. DWQ may also modify the Plan after it receives new, previously unavailable information or after a review of the Plan. A copy of the Plan will be kept at the facility and on file with DWQ.

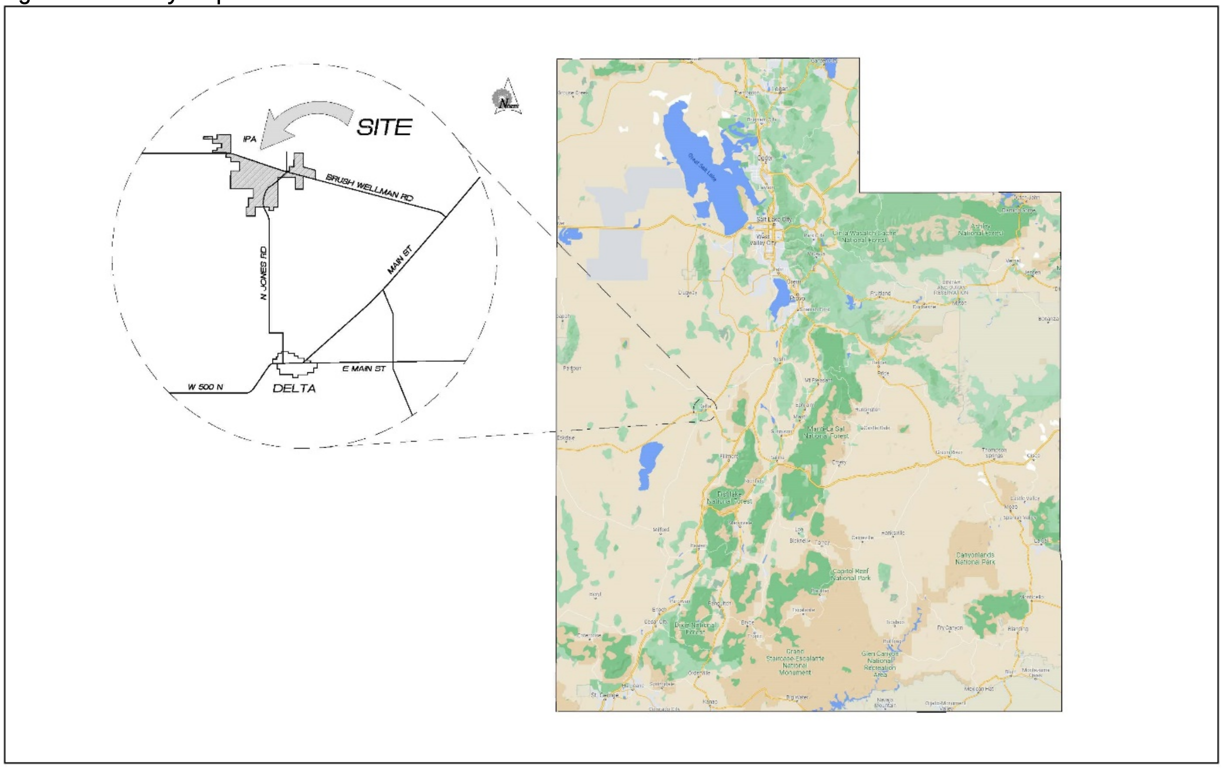
1.2 Facility Location

The Facility is located approximately eight miles north of Delta in Millard County and on lands leased from the Utah School and Institutional Trust Lands Administration (SITLA). As shown on Figure 1, it is situated west of Highway 6 near the intersection of Jones Road and Brush Wellman Road/SR-174.

1.3 Facility Description

The Facility is located above a salt dome that is approximately one mile thick, two miles in diameter and 3,000 feet below the ground surface. The Company will be solution mining storage caverns within the salt dome for the purpose of storing hydrogen gas. Figure 2 is a map depicting the storage facility layout as currently proposed. As shown, the facility components include a Storage Cavern Field with two caverns initially (H-1 and H-2), two brine evaporation ponds, a large-scale electrolyzer plant to produce hydrogen, and utilities interconnecting the components. The utilities interconnecting the components include brine, water, and hydrogen gas pumping and pipeline systems, and power and communications lines. Eventually the facility will be capable of storing up to 60 million kilograms of hydrogen gas in up to five approximately 21,000 metric tons (5.5 million barrels) caverns. The timing for the construction of each cavern will be solely dependent upon market demand.

Figure 1. Vicinity Map



1.4 Jurisdictional Oversight and Basis for Plan Parameters

The DWQ Class V UIC Permit is the principal approval for the operation of the storage caverns. This permit corresponds with the DWQ Class III UIC Permit (UTU-27-AP-718D759) that authorizes construction of the storage caverns. This Plan is enforceable under the Class V UIC Permit and there are two other enforceable plans that are associated with this Plan under the Class III UIC Permit: Hydrogen Cavern Construction and Development Plan (CCDP) and Hydrogen Monitoring, Reporting and Recording Plan (MMRP). The Company has completed an extensive regulatory process with the DWQ to support the issuance of the Class III and V UIC Permits. This regulatory process led to the development of the current parameters in all three enforceable plans and include: standards for the layout of the storage cavern field: siting criteria for caverns within the field; a typical engineering design for the individual caverns; and, construction, solution mining and operations and maintenance parameters.

This basis for these parameters includes a series of geomechanical analyses, cavern engineering design studies, and specific engineering designs for hydrogen storage that were completed by the Company from 2009 to 2020. The geomechanical analyses and cavern engineering design studies established the strength and suitability of the salt dome to support solution mined caverns, the range of cavern sizes that can be developed, the required cavern spacing and optimum cavern operating conditions and parameters. The specific engineering designs also outline parameters and procedures for:

- cavern well drilling and construction;
- cavern well casing design and installation;

- storage cavern solution mining;

- storage cavern operations and maintenance;

- monitoring, mechanical integrity, and other required testing (MIT) for both the cavern wells and storage caverns as an integrated system prior to and during operations; and,

- general plugging and abandonment procedures.

The Company has obtained the other required state and local permits authorizing the construction and operation of the brine evaporation pond and electrolyzer plant and the facility has been designed to meet all applicable federal, state and local engineering design and safety regulations and standards to include those required by the Occupational Safety and Health Act of 1970 (OSHA), Sections 4, 6, and 8; 29 CFR 1910.103 Subpart H - Hazardous Materials, National Fire Protection Association (NFPA) 2 Hydrogen Technologies Code, and other applicable NFPA and International Code Council (ICC) safety, fire, electrical and mechanical codes. These regulations and standards require specific engineering design criteria for all facility components, redundant safety features on handling and storage process related equipment, and offsets relative to the interior layout of the facility and existing buildings and infrastructure on adjacent properties.

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[redacted]

1.5 Storage Cavern Field Description and Design Parameters

The Company has designed the Facility in accordance with a larger Master Plan that has distinct use areas. The storage cavern field is a dedicated area within the Facility intended only for the construction and operations of storage caverns. Having a dedicated area allows the Company to develop standardized parameters for the siting, construction, operation and maintenance of all caverns in the field. As stated, figure 2 depicts the locations for the first two caverns to be constructed within the field as well as the broader Facility layout. Table 1 below provides the location and intended size of the first two caverns to be constructed. This table will be updated as each of the caverns are constructed.

Table 1. Hydrogen Storage Cavern Summary

Cavern Name	Surveyed Location (Lat/Long)	Cavern Capacity (total space)
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

Storage caverns within the field will be designed to ensure that the minimum required cavern spacing and depth is met when siting, constructing, operating and maintaining all caverns. The minimum spacing requirement is a condition of both the Class III and V UIC permits as defined by geomechanical studies completed for the Facility. The minimum required spacing between two adjacent solution mined caverns is required to be no less than a 2:1 P:D ratio, where *P* equals the distance between the two cavern boundaries and *D* equals the average of the maximum diameter of the two caverns. On the surface, this translates to cavern wells being no less than [redacted] The site-specific geological conditions within the salt body and the minimum pillar requirement will ultimately dictate the final dimensions of each individual cavern.

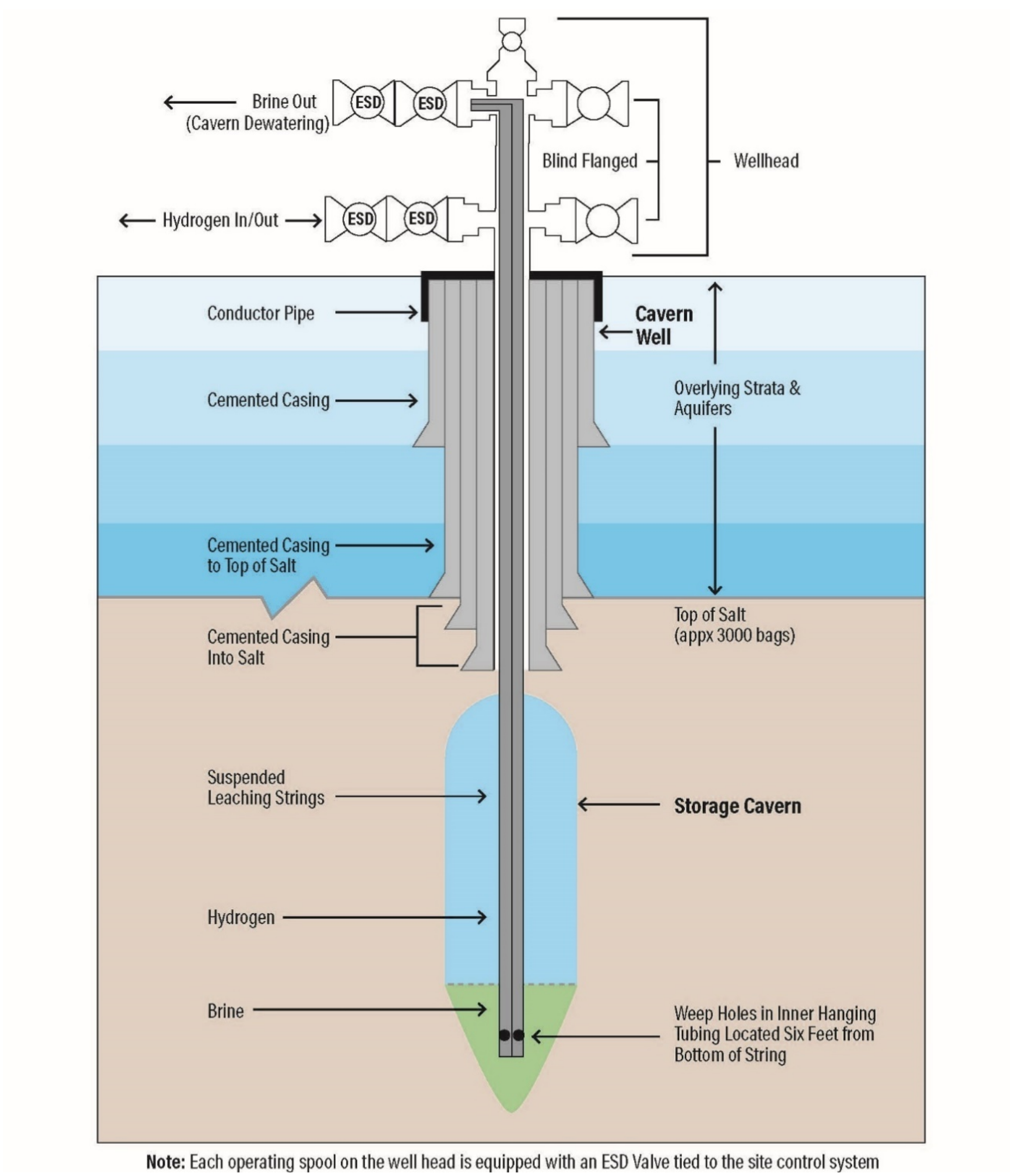
1.6 Storage Cavern and Cavern Well Description

Storage cavern construction begins with drilling and installation of the cavern well in accordance with the applicable federal and state rules (40 C.F.R. § 146.32, UAC R649-3-13 and UAC R649-3-7.4) and requirements of the DWQ Class III UIC Permit. The drilling and installation procedures for the cavern well are outlined in the CCDP. During the drilling and installation of the cavern well, each casing is set, cemented and pressured tested as outlined in the MMRP. The storage cavern design includes a well head and cavern well with five cemented casings and two hanging strings (Figure 3). The well head and hanging strings are used both during the solution mining process and hydrogen storage once the cavern is placed into operation. The cemented casing design also serves two purposes: 1) to provide long-term mechanical integrity of the cavern well and storage cavern; and 2) to protect groundwater contamination with the installation of one cemented casing to the top of the salt and two cemented casings into the salt.

Drilling and installation of the cavern well will also be completed in accordance with the Formation Testing Plan described in the CCDP in order to mitigate potential effects if an insoluble zone within the salt cavern stratigraphy is identified that would require a design change. If an insoluble zone is detected in the vicinity of the casing shoe, the shoe will be relocated to incorporate a 50 ft offset from the insoluble zone and 150 ft offset from the cavern roof. These offsets can be adjusted if an updated geomechanical study is completed by the Company to support the adjustment.

Once the wellhead, cemented casings and hanging strings for solution mining have been set, a final pressure test is conducted (with the exception of the interior of the inner 8 5/8" string) as described in the MMRP to verify the installation and integrity of all components on the cavern well prior to the commencement of solution mining. Appendix A includes the typical wellhead pressures during solution mining and hydrogen storage. As each storage cavern is constructed, Appendix A will be updated to include a wellhead schematic depicting the location of the pressure gauges.

Figure 3. Hydrogen Storage Cavern Component Diagram



After the cavern well is installed, the storage cavern will be constructed using conventional solution mining technology and freshwater displacement of hydrogen for purposes of cavern enlargement during operations. Depending upon the cavern size, solution mining can take between 18 and 24 months to complete. The solution mining process required by the Class III UIC Permit and outlined in the MMRP for individual caverns is provided below for reference:

- After the cavern well is constructed, a double string of hanging casing (an inner and outer hanging casing) will be placed into the open hole, and a wellhead is assembled.
- A nitrogen blanket is injected into the cavern well to a level about 200 feet below the final cemented casing shoe. The nitrogen blanket serves to keep solution mining activity below the final cemented casing shoe in order to maintain integrity and to control the shape and development rate of the cavern.
- Fresh water is injected at approximately 2,500 gallons per minute (gpm) through the inner or outer hanging casing and withdrawn through the annular space between the inner and outer casing or the inner string.
- Injected water is circulated in the well hole to dissolve salt and then transferred to the brine evaporation pond for storage and evaporation.
- The cavern shape is measured and monitored using sonar surveys during the solution mining process.
- Solution mining is stopped when the designed cavern volume is reached, the hanging strings used during solution mining are removed and a sonar survey and final MIT is completed.
- Hanging strings for use during cavern operation are installed in anticipation of the cavern being placed into commercial service.
- Only a successful MIT as determined by DWQ will allow the cavern to be placed into service.

Once the DWQ has determined a successful MIT has been completed, the jurisdictional requirements for the operations and maintenance of individual caverns will be transferred to the DWQ Class V UIC permit.

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Section 2

Operations Procedure

The Company will operate and maintain the storage cavern field components in accordance with the DWQ Class III and V UIC Permits and all other applicable permits and regulatory requirements. The operations and maintenance procedures described below were developed in cooperation with the respective jurisdictional agencies and are based on the requirements described in 40 CFR 146.33 and 40 CFR 146.8. The procedures also incorporate industry standards and practices that provide a foundation for the safe operations of the individual cavern well/storage cavern system and facility. The applicable regulations, codes and standards include requirements for the design, materials and equipment selection used during construction and also dictate the operations procedures of the storage cavern field and individual caverns. The procedures are therefore organized by the activities associated with these two components to ensure safe operations and mechanical integrity of the integrated system as a whole. Storage Cavern Field

2.1.1 Site Security and Emergency Planning and Response Plan

A Site Security and emergency planning and response plans will be established per the regulatory requirements of OSHA, NFPA, ICC, and Millard County. Copies of these plans will be placed on file with any relevant jurisdictional agencies and kept on file at the storage facility. The Site Security Plan will describe the design and establish procedures to control and maintain access to the site. The standard operating procedures and emergency planning and response plans will for the Facility will include the design for the facility-wide emergency shut-down system (ESD) that will initiate if a leak or loss in cavern pressure is detected. The ESD system is designed to contain any leak as well as isolate the affected equipment to protect other areas in the facility until a repair can be made. The standard operating procedures will provide the routine maintenance and testing procedures for the ESD system and the emergency planning and response plans will provide detailed procedures to ensure the safety of personnel and the community. These plans will also provide detailed procedures for the investigation, remediation, and reporting requirements following the management of a leak. A copy of these procedures and plans will be kept on file at the Facility.

2.1.2 Corrosion Control

A facility-wide cathodic protection system will be installed to protect the surface infrastructure, to include the cavern wellhead and facility piping. The system will be designed to continuously mitigate environmental factors that can induce corrosion on facility components. It will consist of deep anode groundbeds. The groundbeds will be installed at each of the operating storage caverns, on each of the hydrogen distribution lines, and other surface support equipment as necessary. The cathodic protection system will be expanded as additional storage caverns and support facilities are constructed and placed into operations. During operations, maintenance will include monthly inspections and an annual third-party survey as described in Section 3.

2.2 Storage Cavern and Cavern Well System

2.2.1 Operating Pressures

The operating pressure of each integrated storage cavern and cavern well system will be maintained at all times during cavern operations to ensure an exceedance of the allowable thresholds does not occur. The Class III UIC Permit established a minimum allowable operating pressure gradient (MinAOPG) of [redacted] to the last cemented casing shoe and a maximum allowable operating pressure gradient (MaxAOPG) of [redacted] to the last cemented casing based on the initial geomechanical analyses for the salt formation as a whole. To determine a safe operating envelope within these pressures' requirements, the Company completed additional geomechanical analyses that take into consideration hydrogen as the stored product type and the specific equipment designs to meet commercial delivery requirements. Based on these studies, the following MinAOPG, MaxAOPG and test pressure will be required at all times during operations and maintenance:

[redacted]

The pressure of each cavern will be maintained and monitored at the wellhead by a facility-wide control system that sets and monitors the pressure and temperature as well as continuously monitors hydrogen injection and withdrawal. To verify the actual pressure and temperature conditions within the cavern, a fiber optic interrogator will also be installed along the length of the hanging string with multiple gauges to obtain pressure and temperature profiles at various intervals. This information will be converted in pressure and temperature values that can then be used to verify the cavern inventory against the injection and withdrawal measurements monitored at the wellhead.

Both the wellhead control system and fiber optic interrogator will be integrated with the ESD system so that if a significant deviation in cavern pressure is detected, the ESD system will initiate and isolate that cavern from Facility until it can be assessed. To avoid unnecessary or false shut-downs, the Facility will use pressure calculations that are conservative during injection and withdrawal. In the event of pressure gradient reaching [redacted] at the casing shoe during the initial hydrogen fill or during normal operations, the injection compressors will be interlocked and will shut down. A copy of the ESD Valve system one line will be kept on file at the Facility.

2.2.2 Cavern Capacity and Geometry

The established geomechanical parameters for the cavern capacity and geometry of the individual hydrogen storage caverns and the cavern field will not be exceeded during operations. As described in the geomechanical studies on file with the DWQ, the parameters are the modeled or design criteria for a fully solution mined cavern to the designed [redacted] (capacity) and shape (geometry) within the salt formation (depth and spacing between caverns) that if maintained during operation will provide overall geomechanical integrity. The parameters include below:

- Salt thickness is a minimum of [redacted] above the cavern;
- The casing seat is a minimum of [redacted] cavern roof;
- The maximum cavern diameter is less than or equal to [redacted]
- The cavern height is less than or equal to [redacted]
- The cavern storage volume remains less than or equal to [redacted]
- The minimum pillar-to-diameter (P:D) ratio between caverns is no less than 2:1;

[1] Measured from the bottom hole depth of the well at start of solution mining. The bottom of the cavern will fill with water-insoluble material during solution mining and minor spalling of the cavern walls can be expected during storage operations preventing the sonar survey from imaging the solid rock wall of the cavern sump.

- The cavern shape remains similar to the proposed hydrogen storage cavern geometry evaluated by historical geomechanical studies with no evidence of major salt falls;
- Initial and periodic sonar surveys do not indicate failure of the insoluble interbed or preferential dissolution of highly soluble material beyond the periphery of the cavern envelop evaluated by historical geomechanical modeling; and,
- The distance from the outer cavern wall to the edge, or flanks, of the salt formation is a minimum of 500 ft.

If cavern capacity monitoring and mechanical integrity testing activities described in Section 3 indicate these geomechanical parameters have not been maintained during operations, then the Company will complete a new geomechanical report for the specific cavern that does not meet the criteria listed above[2] to ensure continued mechanical integrity. The Company will also track and verify the hydrogen inventory within the storage cavern as an additional means to verify both cavern capacity and mechanical integrity. The monitoring activities to verify cavern inventory are described in Section 3 and Appendix D.

2.2.3 Cavern Maintenance and Enlargement Activities

The Company may inject freshwater periodically as part of routine maintenance to recover cavern capacity that is lost due to salt creep and to desalinate the hanging strings. The Company may also want to inject freshwater to displace hydrogen product to enlarge the overall size of a cavern after it has been placed into operations if the cavern was not the planned [redacted] size. Cavern enlargement through freshwater displacement rather than saturated brine is authorized by the Class III UIC under specific conditions and if initiated will follow the procedures provided in the CCDP.

After any cavern reaches its planned capacity or the limits of the minimum cavern spacing requirement described in Section 1, the Company understands that any injection of freshwater injection will only be used for the purpose of routine maintenance only to recover space associated with salt creep unless a new geomechanical study is submitted and approved by the DWQ that would support an increase in the final cavern size.

2.2.4 Solution Mining Activities

The Company may also reinitiate solution mining to enlarge the overall size of a cavern after it has been placed into operations if the cavern was not the planned [redacted] size. Solution mining a cavern is a faster method than using freshwater displacement and is also authorized under the Class III UIC under specific conditions and if initiated will follow the procedures provided in the CCDP. After any cavern reaches its planned capacity or the limits of the minimum cavern spacing requirement, the Company understands additional growth through solution mining will no longer be allowed unless a new geomechanical study is submitted and approved by the DWQ to support an increase in the final cavern size.

[2] Company historically prepared a number of geomechanical studies using a facility-specific approach. The modeling criteria of those studies dictated the siting and development of all caverns within the field for both the storage of liquid and gaseous products. These facility-specific and product-specific criteria can also be modified in this Operating Plan if a new cavern specific or facility specific geomechanical study is provided as supporting evidence for DOGM to authorize the change.

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Section 3
Maintenance Procedures

The Company will maintain the mechanical integrity of the storage cavern field and storage cavern and cavern well systems during operations in accordance with the DWQ Class III and V UIC Permits, the operating, monitoring and reporting requirements of 40 CFR 146.33, the mechanical integrity requirements of 40 CFR 146.8, and procedures based on applicable industry standards such as API 1170. The purpose of these requirements is to ensure safe operations from both a mechanical integrity and groundwater protection perspective. Specifically, the maintenance procedures outlined below include monitoring, testing and inspection of the storage cavern field and the storage cavern and cavern well system (cavern well and wellhead). The procedures are designed to maintain the components as both discrete components and as an integrated system to ensure no significant leaks and no significant fluid movement into an underground source of drinking water will occur during operations.

3.1 Storage Cavern Field

3.1.1 <u>Monitoring</u>

3.1.1.1 *Ground Subsidence*

In accordance with federal and state regulations, a Subsidence Monitoring Plan has been developed to monitor for potential ground subsidence associated with the solution mining and/or operation of the storage caverns. Monitoring activities will be completed using a network of existing and new survey monuments, benchmarks, and wellhead survey points to establish a monitoring baseline and annual monitoring and reporting. A copy of the Subsidence Monitoring Plan, included as Appendix C, is on file at the storage facility. A short summary of the subsidence monitoring procedures is provided below:

- An initial baseline elevation survey will be completed prior to the start of solution mining activity at the Facility using network of survey monuments, benchmarks, and wellhead survey points that are either existing or will be installed.
- The monuments, benchmarks, and wellhead survey points are based on the following criteria:
  - Stable reference monuments are located more than 7000 feet beyond the expected subsidence radius to provide stable points that will not be influenced by the caverns.
  - Local subsidence monitoring points consisting of new and existing monuments, or points at wellheads, will be established. These points are located above the center of the cavern well field, and at approximately 480, 600, 750, 1500, 2500, 5000, 6000, 6350, 7000 feet out from the center of the cavern well field to provide good coverage for point monitoring as well as a network from which overall movement can be inferred.
- Elevation surveys will be conducted quarterly for the first year of operations and then annually thereafter.

- Surveys will be conducted with precise level surveys. The survey will be conducted in loops with the loops closed. This method provides for better accuracy (+/- 0.01 ft.) than other typically used survey methods.
- Level measurements will be accurate to 0.01 foot.
- If a benchmark is changed, the elevation change from the previous benchmark will be noted in the elevation survey report.
- If any wellhead work results in a change in the survey point at the wellhead, the Company will submit the elevation before and after the wellhead work.
- All elevation surveys will be conducted by a licensed professional land surveyor.

The Company will report significant elevation changes identified during monitoring as outlined in Section 5 below.

3.1.2 Testing and Inspection

3.1.2.1 *Corrosion Control*

Testing and inspection of the corrosion control system consists of both a monthly and annual activities. Monthly testing and inspection of the system includes the recording of ampacity readings at each rectifier station to ensure proper system function and the verification of voltage and current to test for proposer rectifier operation. If an ampacity reading at any rectifier demonstrates a deficiency in the system, the deficiency will be addressed within 30 days of identification where there is no risk posed to health, safety, or the environment. Annual testing and inspection of the system will entail a third-party survey of the system to test the integrity of the system. If a deficiency(s) with the system is identified during either a monthly or annual testing and inspection where there is a risk to health, safety, and environment, the deficiency(s) must be immediately addressed.

3.2 Storage Cavern and Cavern Well System

3.2.1 Monitoring

3.2.1.1 *Operating Pressures*

The operating pressure of all storage cavern and cavern well systems will be monitored and maintained as a system continuously at the wellhead and verified by a fiber optic interrogator installed within the cavern. Pressure measurements will be taken at the using pressure gauges and transmitters that are installed on the wellhead according to the following method:

- Pressure transmitters will be linked to the system programmable logic controller (PLC), which provides the capability of continuous pressure recording.
- Each of the pressure transmitters will record the maximum and minimum operating pressures during a 24-hour period.
- Each pressure transmitter detects operating pressures continuously with interlocks to the wellhead injection and facility ESD systems.

In addition to monitoring cavern conditions at the wellhead, temperature and pressure measurements will be collected by the fiber optic interrogator at various points within the cavern as a means of verifying in situ cavern conditions. This system will provide more accurate data that can be used for both maintaining cavern pressure and verification of hydrogen inventory in the cavern discussed in more detail below.

3.2.1.2 *Leak Detection*

LEL devices (gas detectors) will also be installed at each cavern wellheads to continuously monitor for gas leakage. These devices are all tied to the facility's control system and data historian. In the event any leak is detected at the wellhead, the facility ESD system will engage to both isolate the individual well and shut down operations of the entire facility until the cause of the leak and risk to other systems have been assessed.

3.2.1.3 *Cavern Capacity and Geometry*

The capacity and geometry of each individual cavern will be monitored periodically in accordance with permit requirements and industry standards. The periodic verification of cavern shape, size and roof thickness will be scheduled at the same time as the required mechanical integrity testing. The purpose of this monitoring is to ensure individual caverns meet the established geomechical parameters described in Section 2. The monitoring methods will include:

- To establish an accurate baseline of the cavern capacity and geometry, the first sonar survey will be completed with the hanging strings removed to allow for a full view of the roof.
- Subsequent sonar surveys will be completed using either a through-pipe method or a method that involves the removal or "snubbing up" of the hanging strings which can still provide a full view of the roof but does not involve a full workover of the cavern well.
- Surveys will be completed at the following times during operations at a minimum:
  - before placing the storage cavern into operations;
  - every five years thereafter;
  - as necessary during operations to determine the stability of the cavern and the overburden if the salt roof thickness and cavern geometry indicate that the stability of the cavern or overburden is at risk; and,
  - before plugging and abandoning the well if a sonar survey has not been run in the past five (5) years.

The Company will also monitor the thickness for each storage cavern roof using a combination of the sonar survey data, gamma ray log and/or a density log. The cavern roof thickness will be no less than 200 feet between the final cemented casing shoe and cavern roof in accordance permit requirements or meet the geomechanical recommendation of a thickness that is equivalent to a 2:1 pillar to cavern diameter measurement. This monitoring will be scheduled at the same time as the required mechanical integrity testing to include:

- every five years after the start of operations; and,
- as necessary if the Company or DWQ has concerns of cavern integrity.

The Company may elect to monitor cavern capacity and geometry with an alternative method as allowed by regulation. In this event, the Company will submit the following information for DWQ's consideration:

- a description of the proposed method and the theory for its operation;
- a description of the storage well and cavern conditions under which the log can be used;
- the procedure for interpreting the survey results; and,
- an assessment of the capacity and stability of the cavern upon completion of the survey.

3.2.1.4 *Hydrogen Inventory Verification*

Routine inventory verification will be conducted by the Company as a secondary risk mitigation measure to both prevent an overfilling event from occurring and/or detect an inventory loss that could indicate a mechanical integrity issue with the storage cavern. Inventory verification will be completed using a combination of industry accepted methods that will be applied based on operational applicability:

- monitoring of gas injections and withdrawals;
- indirect/model-based monitoring method using temperature and pressures measurements at the wellhead; and,
- direct/real-time measurement monitoring method using temperature and pressure using a fiber optic system installed within the cavern.

The monitoring of gas injections and withdrawals and indirect/model-based monitoring of temperature and pressure measurements at the wellhead is the current industry standard for monitoring cavern inventory. The direct/real-time measurement method using downhole equipment is an alternative method that is also used by the industry but is often paired with the other standard methods to mitigate any equipment reliability and maintenance challenges that are known to be frequently encountered when employing downhole systems. The use of all three monitoring methods will therefore provide redundancy and optionality to meet the Class III and V Permit and other regulatory monitoring requirements without risking unnecessary operational shutdowns. The Company will also maintain an open line of communication with the DWQ about the performance of the downhole fiber optic system to be able to adjust the use and configuration of the equipment as necessary.

Using the indirect/model-based method, the stored gas volume for each cavern will be initially calculated using the temperature profile, physical cavern volume, and physical properties of the gas. The temperature profile for each cavern will be based on the data from the continuous cavern pressure and temperature log and core data collected at the time of cavern well drilling. This is the same profile that is used for geomechancial models run by RESPEC to develop the design operating parameters. The physical cavern volume will be based on the initial sonar survey completed just prior to operational start up. The total gas volume stored is then calculated using rigorous equations of state that have been determined empirically for the specific gas that is being stored. The gas properties data, which are used in these equations of state are obtained from an industry database. It is anticipated that the Peng-Robinson equation of state will be used or another widely-accepted equations of state that is applicable to the specific facility storage operations. The Peng-Robinson equation of state has the basic form: `p = (R*T)/(V_m - b) - (a*alpha)/ (V_m^2 + 2 * b * V_m - b^2) ` to describe the state of the gas under given conditions, relating pressure, temperature and volume of the constituent matter. A detailed methodology for inventory verification and a proposed quarterly report is included in Appendix D.

The measurements derived from the indirect/model-based method and injection and withdrawal monitoring will be verified periodically using measurements of the actual pressure and temperature conditions within the cavern. These measurements will be collected using a fiber optic interrogator installed along the length of the hanging string with multiple gauges to obtain pressure and temperature profiles at various intervals. This information will be converted in pressure and temperature values that can then be used to verify the cavern inventory against the injection and withdrawal measurements monitored at the wellhead. Appendix D provides the inventory verification methodology in greater detail as well as the proposed fiber optic monitoring system.

3.2.1.5 *Off-Schedule Monitoring Activities*

The Company may also conduct periodic monitoring activities that fall outside of the monitoring required by the permits and regulations. Notice of any additional monitoring activity will be given to DWQ 48 hours prior to the start of the monitoring.

- The notice will describe measures to ensure the protection of public health, safety, and the environment.
- The measures will include the use of appropriate blowout prevention equipment, depressuring of well as needed, and spill containment material.

Results of any such monitoring activity will be reported to the DWQ as described in Section 4 below.

3.2.1.6 *Solution Mining Activities*

In the event solution mining is conducted during operations, the Company will monitor salinity and temperature of the injected fluid daily as stipulated in the Class III UIC Permit and outlined in the approved MMRP. This monitoring will be completed as follows:

- Specific gravity and temperature will be measured using calibrated hydrometers and thermometers;
- Hydrometers will be calibrated and maintained in accordance with American Society for Testing and Materials (ASTM) standard A126-05a; and,
- Thermometers will be calibrated and maintained in accordance with ASTM E77-07.

3.2.2 Testing and Inspection

3.2.2.1 *Mechanical Integrity Testing*

During storage operations, the Company will complete routine Mechanical Integrity Testing (MIT) of all storage cavern and cavern well systems in accordance with 40 CFR 146.33 and 40 CFR 146.8. MITs are completed to ensure no significant leaks and no significant fluid movement into an underground source of drinking water through vertical channels adjacent to the injection well bore. Per the regulation an injection well will be deemed to have has mechanical integrity if:

- There is no significant leak in the casing, tubing or packer; and,
- There is no significant fluid movement into an underground source of drinking water through vertical channels adjacent to the injection well bore.

The Company will conduct the required MITs periodically at the following times:

- after the solution mining of a storage cavern is completed and the cavern is ready to be placed into operations;

- every five years after a cavern has been placed into operations;
- after a cavern has a workover that involves physical changes to any cemented casing suspended string; and,
- before a cavern and cavern well system is plugged with the intention of abandonment, unless and MIT has been performed in the last five (5) years.

To evaluate the absence of significant leaks, the Company will complete MIT requirements in accordance with the following methods listed under the regulations:

- Following an initial pressure test, monitoring of the tubing-casing annulus pressure with sufficient frequency to be representative, while maintaining an annulus pressure different from atmospheric pressure measured at the surface; and
- Pressure test with liquid or gas; or
- Records of monitoring showing the absence of significant changes in the relationship between injection pressure and injection flow rate for the following Class II enhanced recovery wells:

To evaluate the absence of significant fluid movement, the Company will also complete the following tests listed under the regulations:

- The results of a temperature or noise log; or
- For Class III wells where the nature of the casing precludes the use of temperature or noise logs, cementing records demonstrating the presence of adequate cement to prevent such migration; and,
- For Class III wells where the agency has elected to rely on cementing records to demonstrate the absence of significant fluid movement, the Company has designed the monitoring program in accordance with CFR 146.33(b) to verify the absence of significant fluid movement.

It should be noted that the initial MIT completed prior to placing the storage cavern will include a pressure test using the nitrogen/brine interface test method and brine hydrostatic test. This test is an industry standard test designed to evaluate the internal (cavern well) mechanical integrity and/or the external (storage cavern) mechanical integrity at the start-up of operations. The procedures for the MIT consist of filling the cavern with water or brine and then injecting nitrogen into the well and establishing an interface at a depth appropriate for either a cavern well or storage cavern test. The nitrogen test pressure should be equal to the MATP gradient based on the casing seat. The interface, temperature and pressure data are used to calculate the pre-test and post-test nitrogen volumes. Comparison of the pre-test and post-test nitrogen volumes and movement of the nitrogen/brine interface are then used to evaluate the well/cavern integrity.

After the initial MIT is completed, the pressure test methods will alternate every five years between a gas filled method and brine/nitrogen interface method as appropriate to reduce the need for unnecessary operational shut-downs while ensure cavern integrity is maintained. Further, all MITs at the Facility will be conducted by an industry expert with experience in conducting this type of testing due to the complexity of the test and associated safety requirements. The test contractor will be required to have knowledge of:

- the pressure rating of the well and wellhead components;
- the use of dead-weight tests or calibrated data loggers to verify brine and nitrogen pressure;
- methods to track the volume of nitrogen injected before and during the test;
- differential pressure monitoring to prevent collapse of the tubing; and,
- a working knowledge of other procedural tasks that ensure a viable and safe test.

In accordance with the 40 CFR 146.8, the Company can also elect to use an alternative mechanical integrity test method by submitting the following information for DWQ's consideration:

- description of the test method and the theory of operation, including the test sensitivities, a justification for the test parameters, and the pass and fail criteria for the test;
- description of the cavern well and storage cavern conditions under which the test can be conducted; and,
- a procedure for interpreting and reporting the test results.

The Company also acknowledges that the agency can require additional or alternative tests if the results presented under the requirements of 40 CFR 146.8(e) are not satisfactory to demonstrate that there is no movement of fluid into or between USDWs. Further, in the event an MIT is determined unsuccessful, the storage cavern that did not pass the MIT will be taken out of storage service until an evaluation can be completed.

3.2.2.2 *Casing Evaluation*

The Company will complete a casing evaluation of all storage cavern and cavern well systems at 10-year intervals in conjunction with the required MIT schedule. The methods that will be used include magnetic flux, ultrasonic imaging, or a multi-finger caliper. The evaluation will be to identify the following conditions:

- the presence of any metal loss due to either of the following:
- internal or external corrosion and internal wear;
- the degree of penetration of the corrosion or the casing defect; and,
- the circumferential extent of the corrosion or the casing defect.

The Company can also elect to use an alternative casing evaluation method by submitting the following information for DWQ's consideration:

- a description of the logging method, including the theory of operation and the cavern well conditions suitable for log use;
- specifications for the logging tool, including tool dimensions, maximum temperature and pressure rating, recommended logging speed, approximate image resolution, and hole size range;
- The Company will describe the capabilities of the log for determining the conditions listed above.

3.2.3 <u>Hydrogen Embrittlement Management</u>

The Company is aware that hydrogen embrittlement of certain cavern well system components and the hydrogen pipeline delivery system have the potential to occur from the interaction of the component materials with the stored hydrogen. Given that hydrogen embrittlement is most commonly a result of poor welding practices and materials selection, the Company developed an engineering design that contains several key criteria and industry practices to mitigate potential risks. The main design element that has been incorporated includes the selection of hydrogen-resistant, low-carbon steel and stainless steel, and the installation of a cathodic protection system. Minimizing carbon in the steel chemistry results in material that is less susceptible to the impacts of hydrogen. In addition, welding procedures have been developed that involve weld pre-heating and post-heating to facilitate carbon dispersing evenly thereby preventing a harmful concentration of carbon in and around the weld. Other design elements include reducing the range of operating pressures and the presence of chlorides, solids, and water in any withdrawn hydrogen gas. At this time, the Company believes that the incorporation of these design elements and operating procedures will sufficiently mitigate embrittlement risks but will incorporate any new industry standards that are established during operations.

Section 4

Agency Reporting and Notification

The Company will complete reporting and notifications to the DWQ in accordance with the requirements of the Class III and V UIC Permits per 40 CFR 146.33.

4.1 Storage Cavern Field

- An annual report will be submitted to the DWQ on or before June 1 of each year for the preceding period of April 1 through March 31. The annual report will include:
  - description of any incident of uncontrolled or unanticipated hydrogen loss;
  - well number and date of any logs or sonar surveys conducted;
  - estimated storage capacity for all unplugged caverns;
  - list of any caverns being enlarged under the Class III UIC permit;
  - list of the volume of hydrogen injected and withdrawn for each well; and,
  - list, by well number, of the maximum and minimum hydrogen storage pressures encountered during the report year with the average and standard deviation noted.
- The Company will notify DWQ at least five (5) days before conducting any MIT.
- The Company will follow the notification requirements in the facility's Emergency, Health and Safety Plan and provide oral notification to DWQ within two hours and submit written notification to DWQ within one week if any of the following events occurs:
  - over-pressuring or the overfilling of a storage cavern;
  - loss of integrity of a cavern well or storage cavern;
  - release of brine, hydrogen, or any other chemical parameter that poses a threat to public health, safety, or the environment;
  - any uncontrolled or unanticipated loss of hydrogen or brine that is detectable by any monitoring or testing;
  - any other condition that could endanger underground drinking water source, public health, safety, or the environment;
  - the establishment of communication between storage caverns;
  - the triggering of critical alarms verifying that safety requirements have been exceeded; and/or,
  - any equipment malfunction or failure that could result in potential harm to public health, safety, or the environment.
- A summary of any monitoring or testing activities conducted on components of the storage cavern field will be submitted to DWQ within 45 days after completing the test. The summary will include:

- a chronology of the test;
- copies of all logs;
- storage well completion information;
- pressure readings;
- volume measurements; and,
- an explanation of the test results.

- Subsidence monitoring survey results, including certified and stamped field notes, will be reported to the DWQ on a quarterly moving to annual basis. The report will be submitted within 30 days after the completion of the annual elevation survey.
  - In the event a surface elevation change is detected that is in excess of 0.50 foot since the previous survey, DWQ, SITLA and Millard County will be notified within 24 hours.

4.2 Storage Cavern and Cavern Well System

- An inventory verification report will also be submitted on a monthly basis the first year of operations and then quarterly thereafter. The report will track any inventory that is injected and withdrawn to confirm an inventory balance. Appendix D provides the methodology and the inventory report form. If a discrepancy over 5% is identified by the inventory verification, an internal evaluation will be initiated to determine the cause. If a discrepancy of 8% or more larger is identified by the inventory verification, an internal evaluation will be initiated to determine the cause and the discrepancy will be reported to DWQ within 30 days.
- An annual summary report will be submitted to DWQ of any cavern enlargement under the DWQ Class III UIC permit completed during operations that will include the estimated growth and tabulation of the pillar thickness (P) between adjacent caverns and between caverns and the permit boundary areas at 200-foot depth intervals beginning at the depth of the last cemented casing.
- If an individual cavern is no longer eligible for enlargement under the Class III UIC Permit, the Company will submit a notice to DWQ within 30 days if any method of cavern monitoring indicates that cavern has experienced a 5% growth in the cavern volume after the planned size has been reached (either [redacted] or a size that maintains the minimum required pillar).
- A summary report and the results of any storage cavern monitoring activity will be submitted to DWQ within 30 days after completion of the monitoring activity. A casing evaluation report will be submitted to DWQ per the following requirements:
  - 10 years after the cavern well is placed into operation and every five years thereafter;
  - after any workover involving the cemented casing; and,
  - if a determination is made by DWQ that the integrity of the suspended string casing could be adversely affected by any naturally occurring condition or man-made activity.

Section 5

Records Retention

The Company will maintain records associated with the operations of the storage cavern field and individual storage caverns and cavern well systems as outlined below:

- A period of five years, for:
  - The maximum and minimum operating pressures for each well; and,
  - The periodic inspections conducted by DWQ that will be quarterly moving to annual during operations.
- The life of the cavern well, for:
  - The casing records for each well;
  - The cementing records for each well;
  - The workover records;
  - The water or brine injection records for each well;
  - Monitoring information, including calibration and maintenance records; and,
  - Continuous monitoring data.
- The life of the facility, for:
  - All logging events;
  - All mechanical integrity tests and other testing;
  - All groundwater monitoring data; and,
  - All correspondence relating to the operating plan, including electronic mail.
- Surface elevation surveys will be maintained and retained for the life of facility plus 10 years after the facility's closure.
- In the event of new ownership of the facility, all required facility records, reports, and documents must be transferred to the new owner.

The Company will conduct an annual inspection of facility records to ensure that the required records are being properly maintained. These records will be maintained at the facility and the records will be available to DWQ upon request.

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Appendix A

Storage Cavern Wellhead Gauge Summary Tables

Typical Wellhead Pressures for Solution Mining and Hydrogen Storage

Operation	Casing (inches)	Fluid	Pressure Loss (psi)	Casing (inches)	Fluid	Pressure Loss (psi)	Static Head (psi)	Water/Product Line Pressure Loss (psi)	Brine/Water Line Pressure Loss (psi)	Surface Pressure (psi)
Direct Mining	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Appendix B

Cavern Inventory Verification Methodology (Indirect/Model-Based and Direct/Real-Time Measurement

Hydrogen Cavern Integrity and Inventory Verification
Indirect/Model-Based Methodology

I. Introduction

WSP USA Inc. (WSP) is the leading engineering services firm for underground storage cavern development in North America. WSP (FKA, PB Energy Storage Services and PB-KBB) also provides cavern testing and maintenance services for the majority of, North American storage operators and is very familiar with the methods used for verification of cavern integrity and storage inventory. The following methodologies have been adopted by various state regulators, e.g. Texas Railroad Commission, and have been adopted as an API recommended practice (see API RP 1170). When directed to be used per the field operating plan, detailed procedures will be prepared and approved by the operations team and management, prior to implementing.

II. Cavern Integrity Verification

Prior to placing a newly developed salt cavern into service, and subsequently at specified time intervals thereafter, a mechanical integrity test (MIT) is performed. During a mechanical integrity test, the cavern is pressured to an authorized level just slightly above its maximum allowable operating pressure (MAOP) and is monitored for a specific period of time. The MIT is performed in one of two commonly followed methods, noted below.

1. **Brine-Filled Cavern**
   Upon completion of cavern leaching or after a well workover, the cavern is pressured with nitrogen in the space above the brine and the position of the brine-nitrogen gas interface is monitored for movement using a wireline log. The starting quantity of nitrogen is calculated and compared with the calculated amount remaining toward end of the test.

   The difference between the beginning and ending nitrogen quantities is the calculated leak rate (CLR) which, is compared with a predetermined amount, i.e. Minimum Detectable Leak Rate (MDLR). If CLR is less than MDLR, the cavern is considered as having satisfactory integrity.

2. **Gas-Filled Cavern**
   When a gas storage cavern does not contain brine such as, after it has been in operation, it is tested by pressuring the cavern to the MAOP then, running an initial pressure and temperature log. After 72 hours a second pressure and temperature log are run. The gas volumes from the initial and second logging runs are calculated and the difference

determined. If the calculated difference does not exceed a predetermined quantity, then the cavern is deemed to have sufficient integrity for gas storage.

III. Cavern Inventory Verification/Monitoring

Cavern inventory verification is a holistic set of ongoing processes that occur at different operating levels and differing frequencies, depending upon the process. Those frequencies are dictated by the field operating plan. They start with the previously mentioned MIT to verify containment integrity of the cavern system. All of these processes are cross-checked against each other to enhance cavern inventory verification and provide confidence of cavern integrity. Significant variances between inventories based upon different methods shall be investigated.

The gas contained in the cavern is based on the volume of the cavern, the composition and physical properties of the stored gas, and the pressure and temperature of the gas in the cavern. After completion of the cavern leaching process, the cavern volume is first gauged using an ultrasonic imaging tool, i.e. a "sonar" and, as brine is displaced from the cavern upon the initial gas fill, the volume of displaced brine is determined. The sonar volume is less precise than the displaced volume, however, the sonar provides a useful three-dimensional rendering of the cavern. This three-dimensional rendering allows for comparison with future sonar surveys to determine changes in cavern shape thereby validating modelled creep estimates which in turn benchmarks the cavern volume that is used for inventory calculations. It also that may indicate potential integrity problems prior to them happening. The techniques for inventory verification and monitoring are given below.

1. **Physical (Measured) Parameters Method**
   The stored gas volume is initially calculated with data from a cavern pressure and temperature log, the physical cavern volume (sonar/measured displaced brine volume), and physical properties of the gas. The total gas volume stored is calculated using rigorous equations of state that have been determined empirically for the specific gas that is being stored. The gas properties data, which are used in these equations of state are obtained from an industry database (see: Design Institute of Physical Properties, www.aiche.org/dippr). It is anticipated that the Peng-Robinson equation of state will be used or another widely-accepted equations of state that is applicable to the specific facility storage operations. The Peng-Robinson equation of state has the basic form: `p = (R*T)/(V_m - b) - (a*alpha)/(V_m^2 + 2 * b * V_m - b^2) ` to describe the state of the gas under given conditions, relating pressure, temperature and volume of the constituent matter.

   This method can also be augmented, as opportunities present themselves, by the use of a calculation technique known as a two-point analysis method. This technique benchmarks against metered quantities of gas over a certain time period, enhancing confidence in inventory results.

Table 1 lists the measured parameters including data, which is maintained in the facility data historian and available for audit.

Table 1. Cavern Inventory Management – Measured Parameters

Parameter	Measurement Method(s)	Typical Units and/or Data Available for Audit	Notes
1. Cavern Physical Dimensions/Volume	Ultrasound (Sonar) & Volume of Brine Displaced	Cavern volume as established by sonar is calculated using software that is specific to the sonar imaging tool. The sonar data is converted into **API barrels**, which is then used as a basis for determining cavern inventory. The metered brine volume (**API barrels and/or US Gallons**) is recorded by the facility data historian and is also a basis for inventory calculation. The cavern volume and hydrogen inventory are maintained in the data historian and is available for audit.	The cavern volume is determined with an ultrasonic imaging tool and the amount of brine displaced during the initial cavern fill provides the volume occupied by the hydrogen. The sonar is run periodically to determine changes in physical cavern volume. The brine displaced from the cavern during initial fill and after the cavern is de-watered is measured by a magnetic or other type of flow meter.
2. Injected Hydrogen Volume	Multi-Path Ultrasonic or Other Type of Flow Meter	The flow of hydrogen into or out of the cavern is measured and recorded by the facility data historian. The volumetric units may be reported as millions of standard cubic feet (**MMSCF**). This information is available for audit.	The meter is installed in the flow line that connects to the wellhead. The meter is designed to measure flow going into or coming out of the storage well (bi-directional flow meter). The metering takes into account pressure and temperature of the flowing gas to ensure accurate flow measurement.
3. Wellhead Pressure	Pressure Transmitter Located on the Flow Line near the Wellhead. A second pressure transmitter will be placed between a wellhead wing valve and ESD valve to detect pressure when the storage cavern is shut in.	The pressure is recorded in pounds per square inch gauge, i.e. **psig.** The pressure is continuously monitored and is recorded at a predetermined interval (usually once per minute) in the facility data historian. The recorded pressure data is maintained in the data historian and is available for audit.	Pressure measurement is used to calculate cavern inventory independently of the flow meter. The pressure measurement may also be used in conjunction with certain types of flow meters to compute hydrogen flow.
4. Wellhead Temperature	Temperature Transmitter Located on the Flow Line near the Wellhead.	The temperature is recorded in degrees Fahrenheit, i.e. **°F.** The temperature is continuously monitored and is recorded at a predetermined interval (usually once per minute) in the facility data historian. The recorded temperature data is maintained in the data historian and is available for audit.	Temperature measurement is used to calculate cavern inventory independently of the flow meter. The temperature measurement may also be used in conjunction with certain types of flow meters to compute hydrogen flow. Temperature is most accurate when hydrogen is flowing. A wellhead pressure and flowing (not static) wellhead temperature may then be used as inputs to the gas correlation (Peng-Robinson) to calculate the gas inventory at any given point.

Parameter	Measurement Method(s)	Typical Units and/or Data Available for Audit	Notes
5. Cavern Hydrogen Flows	Use of Flow Meter	The flow may be presented in millions of standard cubic feet per day, i.e. **MMscfd.** The flow data are recorded by the facility data historian and are available for audit.	Cumulative volumes injected and withdrawn from storage are determined through measurement with the flow meter.

2. Gas Accounting Method

Gas volumes injected to and withdrawn from the cavern are continuously metered at the cavern wellhead and are used for calculating the cavern inventory status in real time. The types of meters that may be used include, ultrasonic, turbine or orifice-type meters, some of which require periodic calibration to assure measurement accuracy. The incoming or outgoing gas temperatures are factored into the flow measurement for achieving the proper level of accuracy, and all data is stored in the plant historian, accessible for audit purposes.

Due to small inaccuracies in measurement, the cumulative measurement error may add up and/or cancel out over time and may or may not result in an increasing discrepancy between the actual and calculated cavern inventory over time. The influence of salt creep, whereby the volume of the cavern decreases over a period of time, will to a small degree, impact cavern inventory measurement. The direct logging of the gas pressure and temperature in the cavern, as well as a sonar[3] volume calculation is performed periodically to resolve any discrepancy.

Table 2, below, is an example of the Gas Accounting Method where, a monthly report form is presented. The form shows the beginning cavern inventory, which is the ending cavern inventory of the preceding month (or calculated initial inventory when the cavern is first placed in operation). The daily metered injection and withdrawal volumes are added to (injections) and subtracted from (withdrawals) the beginning inventory through the end of the month. Daily static wellhead pressures readings are shown and are adjusted to mid-cavern pressures to allow for a volume calculation that is used to compare with metered volumes in order to detect possible irregularities. Flowing wellhead temperatures during injection and withdrawal are also used in the gas volume calculations and adjusted to cavern conditions. The metered gas volumes, wellhead pressures and temperatures, and inventory calculations are recorded and maintained by the facility data historian and are available for audit.

[3] Periodic sonar surveys detect changes in cavern volume, which may indicate cavern salt creep.

TABLE 2. Gas Accounting Method					
Cavern/Storage Well No.	#				
Reporting Month/Year	MM/YYYY	Day	Day	.....	Day
Sonar Volume	__,____,____BBLs	1	2		30
Beginning Wellhead Pressure	____ psig				
Beginning Wellhead Temperature (Flowing)	___°F				
Beginning Inventory (Calculated)	___._ MMSCF				
Beginning Inventory (Metered)	___._ MMSCF				
Withdrawals	___._MMSCF				
Injections	___._MMSCF				
Ending Inventory (Metered)	___._ MMSCF				
Ending Wellhead Pressure	____ psig				
Ending Wellhead Temperature (Flowing)	___°F				
Ending Inventory (Calculated)	___._ MMSCF				

Note: Calculated Beginning Inventory is calculated from sonar volume and wellhead pressure and temperature, adjusted to reflect cavern conditions.
Beginning Inventory (Metered) is the ending metered inventory from the previous month.

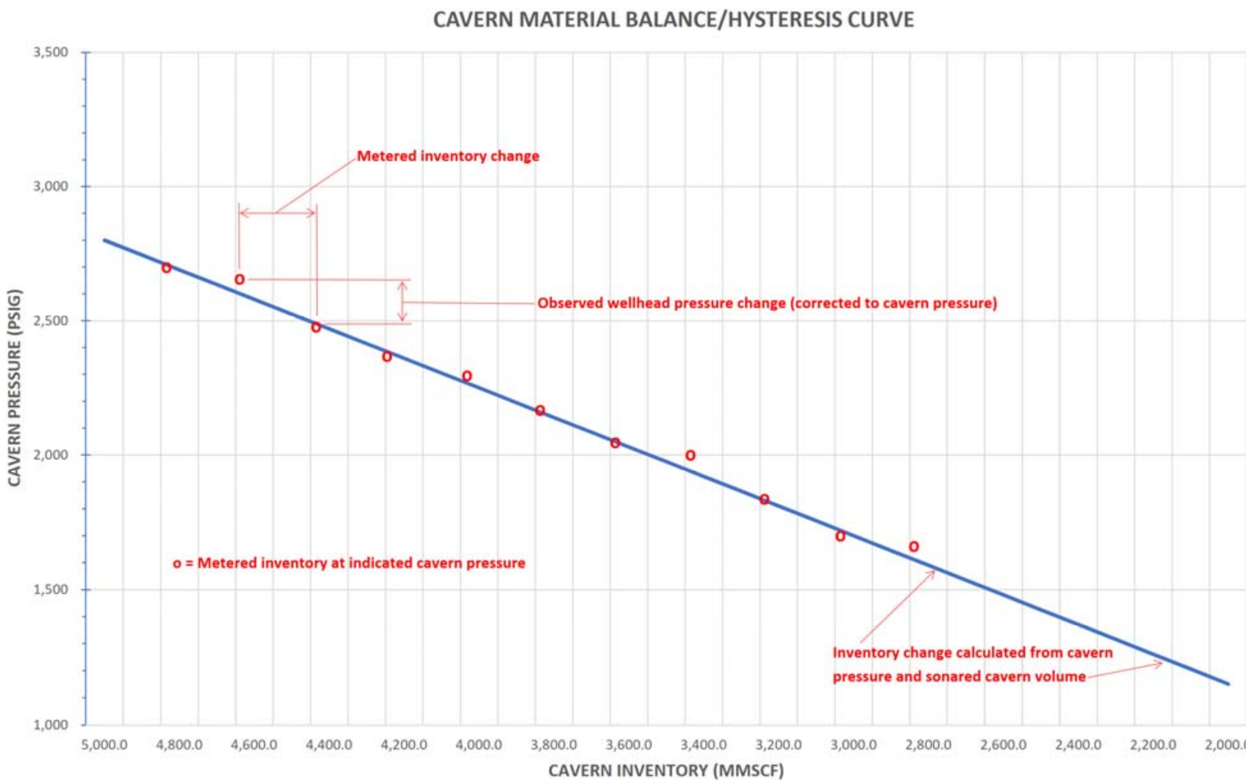
3. Material Balance/Hysteresis Curves

For Hysteresis Curves, the mid-cavern pressure (wellhead pressure plus the gas column pressure to mid-cavern) versus gas inventory is plotted. The plot shows the cavern pressure – inventory relationship. Metered gas volume deviations from the plot may indicate an issue either with containment or gas measurement error. The daily static wellhead pressure readings (corrected to mid-cavern pressure) and corresponding inventory calculations based on metered gas injections and withdrawals (see Gas Accounting Method, above) are compared with pressure versus inventory curve.

Figure 1 is presented as an example and shows the relationship of wellhead pressure (corrected to reflect mid-cavern pressure) and cavern inventory. Metered hydrogen injection and withdrawal volumes are added or subtracted, respectively, from the starting cavern inventory and the corresponding measured wellhead pressure (corrected to mid-cavern pressure) is plotted along with the material balance/hysteresis curve. Significant deviations (trends) between calculated and metered cavern inventories may require further analysis to determine if there is a cavern containment problem or measurement error.

As with the Gas Accounting Method, the cavern inventory will be re-verified, periodically and this measurement technique fine-tuned with a sonar survey and cavern pressure and temperature log.

Figure 1



4. **Other (Thermal Simulation)**

   Another method that may be performed should more investigation be required, is thermal simulation using SCTS® (Salt Cavern Thermal Simulator) or other similar methods. SCTS® considers salt properties; cavern geometry, dimensions and depth; well configuration; gas properties; operating pressures and temperatures; and, frequency, duration, and flow rates into and out of the cavern. The accuracy of SCTS® is as good as the data that is input to the program.

   SCTS® using, the latest cavern sonar survey and pressure and temperature logs and considering the past injection and withdrawal volumes and durations, can produce a reasonably accurate depiction of how the cavern storage pressures and temperatures should behave over time. The simulation results may be compared with past operations to identify possible irregularities, if any, and provide clues as to possible underlying causes.

Hydrogen Cavern Integrity and Inventory Verification
Indirect/Model-Based Methodology

ACES will install inside the hydrogen storage caverns Distributed Temperature Sensing or DTS equipment. This technology is used to measure temperature distribution along a fiber optic line. The optic fiber uses a short laser light pulse that travels along the fiber. As the light travels, it collides with the lattice structure and atoms of the fiber, causing them to emit small bursts of light at slightly shifted frequencies which travel back to the beginning of the fiber. This returning "backscattered" light is analyzed by a detector to determine the temperature at a particular location with a spatial resolution between 0.5 m and 1 m (refer to Figure 1). With a DTS fiber, it is possible to measure temperature along the entire length of the fiber simultaneously with a temperature accuracy of ±0.3°C to ±1°C.

In Figure 2, a DTS fiber installed on the outer diameter of a hanging casing is shown. Along the entire length of the fiber, temperature is measured providing a continuous-distributed temperature profile throughout the vertical profile of a cavern. An example of such distributed data is shown in Figure 3. The recorded temperatures are measured at defined time intervals that can be updated on the order of seconds, which truly provides real-time data. Single-point pressure gauges may also be incorporated and installed to measure pressure at the mid-cavern height and bottom of the cavern.

Continuous temperature distribution data along with single-point pressure data allow for real-time integrity monitoring of the entire cavern interval. Measured cavern pressures and temperatures may be used to accurately verify cavern inventory at any point in time. Additionally, the continuous temperature profile of the cavern interval may be analyzed for temperature anomalies and detect hydrogen leaks.

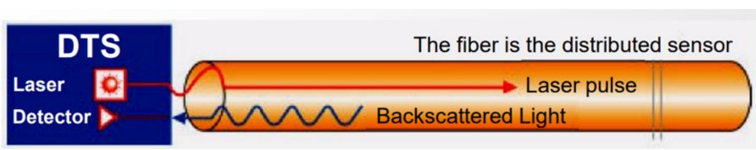


Figure 1 DTS fiber

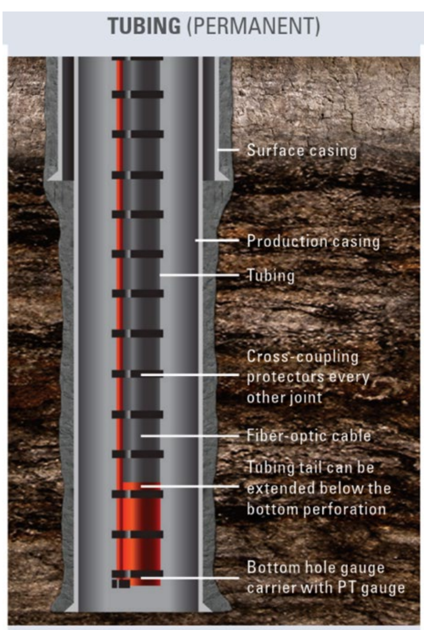


Figure 2 DTS fiber installed on hanging casing.

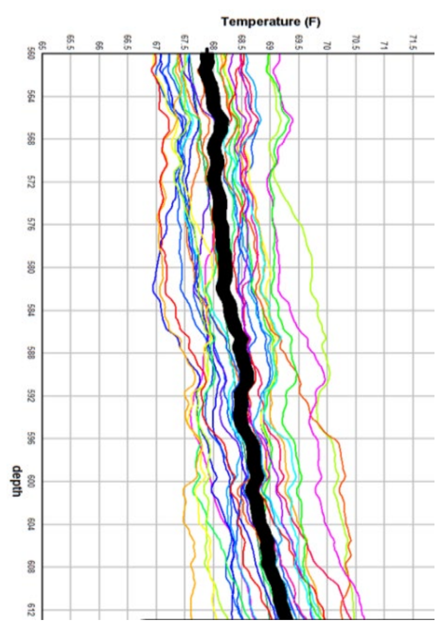
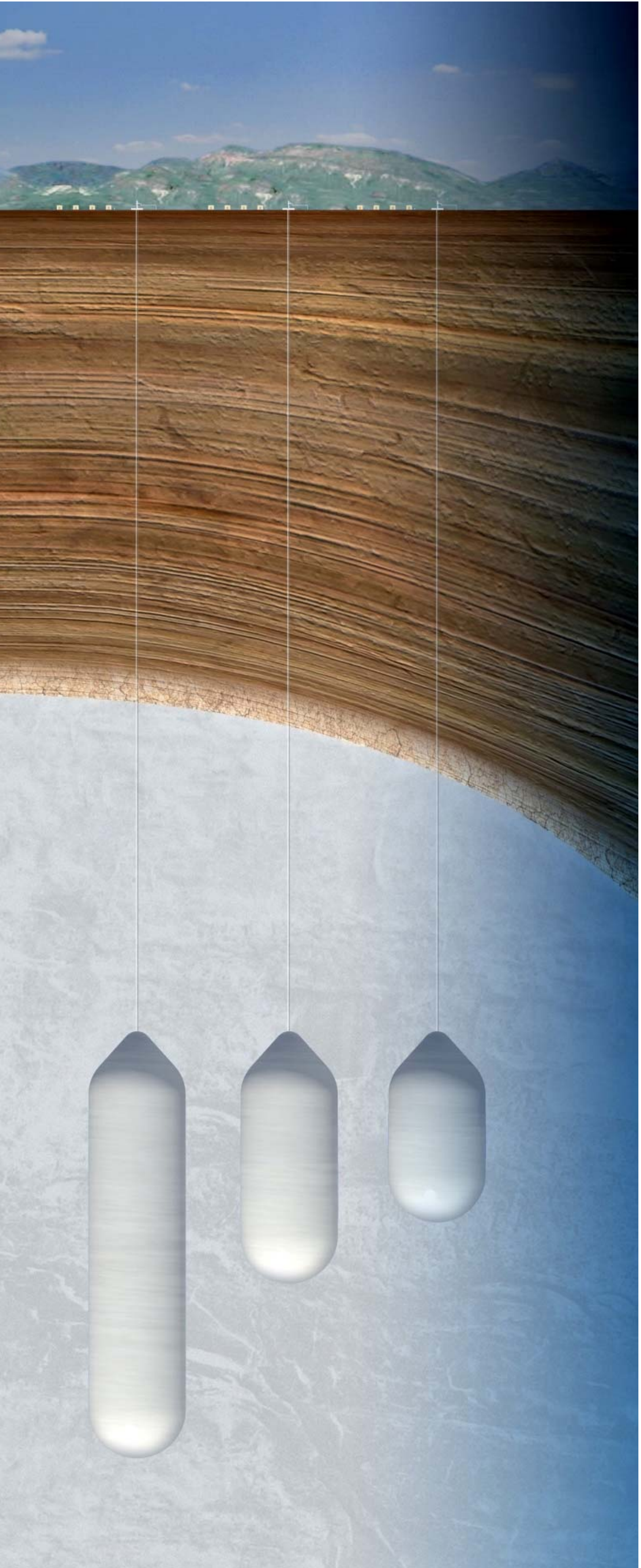


Figure 3 Example distributed temperature profile.

Appendix C

Subsidence Monitoring Plan



Subsidence Monitoring Plan

MAGNUM

Subsidence Monitoring Plan

Magnum Solution Mining, LLC
Hydrogen Production and Storage Facility
Delta, Utah

April 2021

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Figures

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Section 1

Introduction

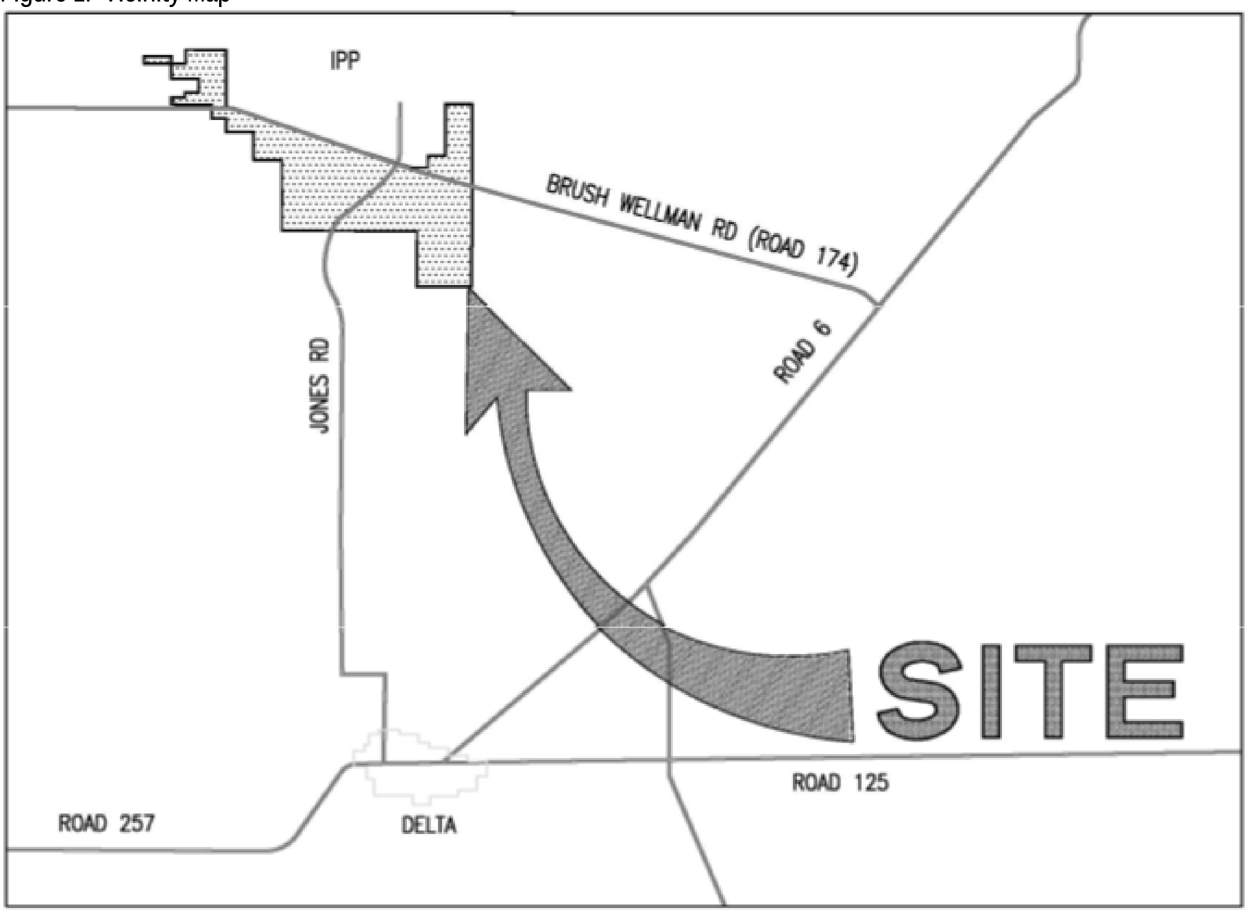
1.1 Purpose of the Plan

The purpose of this Subsidence Monitoring Plan (Plan) is to document regulatory compliance procedures for the monitoring of potential ground subsidence in the vicinity of the Storage Cavern Field at the Magnum Solution Mining, LLC (Company) Hydrogen Production and Storage Facility (Facility). Specifically, the Plan outlines the subsidence monument network, monitoring methods and frequency, agency reporting and notification requirements, and record retention policies.

1.2 Facility Location

The Facility is located approximately eight miles north of Delta in Millard County, Utah, on lands leased from the School and Institutional Trust Lands Administration (SITLA). As shown on Figure 1, the Facility is situated west of Highway 6 near the intersection of Jones Road and Brush Wellman Road/SR-174.

Figure 1. Vicinity Map



1.3 Facility Description

The Facility is comprised of three main components: a Storage Cavern Field, a 168-acre brine evaporation pond, and an electrolyzer facility to produce hydrogen with an associated evaporation pond. The Facility will also contain utilities interconnecting those components, including brine, water, hydrogen gas pumping and pipeline systems, power and communications lines, and a smaller evaporation pond. As stated, the monitoring procedures in this Plan pertain only to the monitoring of potential subsidence in relation to the Storage Cavern Field.

1.4 Storage Cavern Field Description

The Storage Cavern Field currently includes up to five storage caverns that are each [redacted] These caverns will be constructed in a salt formation located approximately [redacted] below ground surface (bgs) using standard solution mining technology. While cavern depths within the salt formation are dependent upon the individual cavern locations relative to the below ground elevation of the top of the salt, the tops of caverns will likely range in depth between [redacted] bgs and the base of caverns will range in depth between [redacted] bgs. The timing of construction of each cavern within the Storage Cavern Field will be dependent upon market demand.

Figure 2 depicts the Subsidence Monument Network and the major Facility components, including the location of the Storage Cavern Field along with the approximate locations and numbers of the first two planned storage caverns and cavern wells, Hydrogen Cavern Well 1 (H-1) and Hydrogen Cavern Well 2 (H-2). Company plans to develop and operate up to five hydrogen storage caverns within the Storage Cavern Field.

1.5 Potential Subsidence

Subsidence, or the downward change in surface elevation, in association with solution mined storage caverns is directly related to cavern "creep". Cavern creep, or closure, is a term used to describe the process by which cavern walls close shut over time due to the malleable or "self healing" property of salt at depth and pressure. Subsidence above a solution mined storage cavern is a direct result of cavern creep. The subsidence is caused by the change in the below ground elevation of the salt formation as it creeps shut to fill in the cavern void.

The rate at which this type of subsidence occurs is very slow, typically over a period of months or years. Surface manifestation of subsidence tends to be minimal and restricted to the area directly above, or in immediate proximity to, the subsurface cavern. There are instances, however, where the total affected area at the surface is greater than the immediate subsurface cavern diameter. Consequently, Company will use a radial network of subsidence monuments that extend between 5,000 and 7,400 feet away from the Storage Cavern Field. Company has committed to use this network to monitor for potential surface subsidence associated with the solution mining and operation of storage caverns.

Section 2

Subsidence Monitoring System

2.1 Subsidence Monitoring Network

The Subsidence Monitoring Network for the Facility will be comprised of 20 new and existing monitoring and stable reference monuments: six new monitoring monuments installed by the Company, 11 subsidence monuments from an existing radial network and three existing stable reference monuments. The radial network and stable reference monuments were previously installed by Sawtooth Caverns, LLC (Sawtooth) for the purpose of monitoring potential subsidence associated with an adjacent storage caverns facility. Company has entered into a cooperative agreement with Sawtooth to allow it to use the existing network of monitoring points and monuments.

Figure 2 depicts the major Facility components and the Subsidence Monument Network. The density and distribution of the subsidence monuments are based on: the surface and subsurface geology of the planned Storage Cavern Field; the individual storage cavern locations, sizes and calculated creep rates; and the potential radial influence of subsidence at the surface. As shown on Figure 2, the Subsidence Monument Network monitoring monuments include:

<u>Existing Deep Surface Monuments</u>

- one central subsidence monument installed in the center of the Storage Cavern Field;
- two subsidence monuments installed at 1,500’ radius;
- three subsidence monuments installed at 2,500’ radius;
- three subsidence monuments installed at 5,000’ radius;
- two observation wellhead subsidence monuments (DA-1 at 6,000’ and DA-2 at 7,000’);

<u>Existing Stable Reference Points</u>

- three existing stable reference point monuments (SR-1 at 7,100’, SR-2 at 6,350’, and the main control point monument at 6,000’);

<u>New Deep Surface Monuments</u>

- one subsidence monument installed at 1,500’ radius outside the Sawtooth storage cavern field fence line;

<u>New Bedrock Well Monuments</u>

- two storage cavern wellhead subsidence monuments (H-1 and H-2); and

- three fresh water wellhead subsidence monuments (GRN-MH-1, GRN-MH-2, and GRN-MH-3).

Of the 20 monitoring monuments, 12 are local deep surface subsidence monuments (all but H-1, H-2, GRN-MH-1, GRN-MH-2, GRN-MH-3, SR-1, SR-2 and the main control point monument) installed to provide representative geospatial coverage across the area of interest. These local monuments are based on a central monument (see Figure 2) situated near the center of the proposed extent of the Storage Cavern Field. From this central monument, nine additional deep surface local monuments are situated at radial intervals of 1,500 feet; 2,500 feet; and 5,000 feet. In addition to this array of local monuments, five subsidence monuments will function as bedrock monuments via the installed well casings for water wells GRN-MH-1, GRN-MH-2, and GRN-MH-3, and storage cavern wells H-1 and H-2, which extend into the bedrock. As the Facility is expanded, Company will install new monuments on each additional cavern and water well when constructed and may add monuments to the radial network if necessary.

There are three stable reference points that are also part of the subsidence monument network: two existing stable reference point monuments to provide coverage up to 7,400 feet beyond the center of the Storage Cavern Field, and an existing main control point monument located approximately 6,000 feet from the center of the Storage Cavern Field. These points will serve through time as stable reference points for the entire subsidence monitoring network as the monuments are located beyond the potentially affected surface area.

The horizontal position of all monuments was established by GPS survey and defined in both the State Plane Coordinate System and the Company's local coordinate system of northings and eastings on an X and Y coordinate based on true north. The main control point monument is located at a horizontal distance of approximately 6,000' from the center of the Storage Cavern Field. This monument was installed June 1, 2010, to create a stable and permanent benchmark and control point for all Magnum projects. It is a stainless-steel rod driven to refusal, isolated from surface frost by a greased sleeve, and protected within a concrete monument box, and was constructed to the Class A Rod Mark standard in accordance with guidance promulgated by the United States National Oceanic and Atmospheric Administration (NOAA).

[redacted]

Section 3

Monitoring Procedures

3.1 Monitoring Methods

Company will complete precise elevation or "level" surveys of the Storage Cavern Field and potentially affected area to monitor for subsidence at the Storage Cavern Field. Level surveys will be completed under the direct supervision of a licensed surveyor using a transit and graduated rod. Surveys will be capable of detecting elevation changes to within 0.01 foot. Surveys will include points taken at and between the monuments in the subsidence monitoring network and points taken across and beyond the potentially affected area. Surveys will be completed according to best practices including:

- perform peg test at the beginning of each survey to verify that the instrument is in good adjustment; additional tests should be performed whenever the instrument is suspected to have been put out-of adjustment by mishandling;
- standard field note recording techniques will be followed including recording of temperature and weather conditions;
- balance backsight and foresight distances within the tolerances specified by the accuracy requirement;
- monuments have been distributed so that no turning points are needed in the execution of the field leveling (if turning points are needed to complete the level survey, either metal turning pins or turning plates should be used to minimize the errors caused by rod displacement);
- instruments will be shaded from direct sunlight for second-order leveling; and
- closure check will be performed at the completion of each loop or line segment on the field (if the closure exceeds tolerance the loop or line should be rerun).

3.2 Monitoring Frequency

As described above, most of the monuments in the subsidence monitoring network are currently in place and the remaining monuments will be installed during Facility construction. Before commencement of solution mining for the first hydrogen cavern, a baseline elevation survey will be completed. Subsidence monitoring will be initiated the first month after storage operations commence. During the first year of storage operations, monitoring events will be completed on a quarterly basis. After the first year of operations, monitoring events will be completed on an annual basis. If monitoring results indicate subsidence in excess of the reportable amount described in Section 4, Company will consult with the Division of Water Quality (DWQ) to determine if a change in monitoring frequency is necessary.

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Section 4

Agency Reporting and Notification

4.1 Reporting

Company will prepare and file an annual report with DWQ and Millard County. The report will be submitted by March 1 of each year after storage operations has commenced. The report will include the certified and stamped survey results and a summary that identifies any subsidence that has occurred since the last monitoring event and a cumulative subsidence total since the initiation of storage operations.

4.2 Notification

Company will report surface elevation changes in excess of 0.5 feet within 24 hours of the monitoring event to DWQ and Millard County.

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Section 5

Record Retention

5.1 Records

Company will retain copies at the Facility of this Plan, the initial baseline survey, any annual subsidence monitoring reports, and any level surveys completed for the purposes of subsidence monitoring or the addition, repair, or replacement of monuments in the subsidence monitoring network. The record of each level survey will include the following items:

- original copy of the field notes, certified and stamped by the licensed surveyor.
- listing of the adjusted elevations and their root mean square (RMS) error.
- listing of corrected horizontal distances and their RMS errors (if distance measurements were made).
- listing of adjusted horizontal coordinates and their RMS errors, if available; and
- any associated cross-section profile plots, subsidence contour maps, strain computation, and statistical analysis of changes in elevation, strain and horizontal coordinates.

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ATTACHMENT D

Well and Cavern Closure and Abandonment Plan

Attachment D
Well and Cavern Closure and Abandonment Plan

The plugging and abandonment (P&A) of a storage cavern may be necessary during Facility operations if the continued operation or maintenance of the cavern presents a risk to public safety or the environment. DWQ may also require the P&A of a cavern if the Company is unable or unwilling to maintain proper oversight and management of the cavern consistent with these requirements of the Class III and V Underground Injection Control (UIC) Permits and other applicable regulations. In the event a cavern P&A must be completed, the Company will develop and submit to the DWQ for approval a detailed P&A Plan to address the specific circumstances of the individual storage cavern.

1.1 General Plugging and Abandonment Conditions and Assumptions and Duration

The typical P&A process is based on the following general conditions and assumptions for the facility and cavern prior to the initiation of a cavern P&A. The estimated duration to complete the typical P&A process of a storage cavern is approximately fifteen weeks. This duration will allow enough time to complete the necessary steps from displacing all the hydrogen from the cavern with brine to completing any necessary sonar and MIT testing and placing the appropriate cement plugs in the cavern well. This duration does not include Post P&A monitoring that may be needed to completed. In addition, these baseline conditions and assumptions may vary due to the specific circumstances of the facility and cavern when a detailed P&A Plan is developed for the actual closure of a cavern.

- the hydrogen production plant will be functioning so that the storage cavern can be emptied of hydrogen and filled with brine to create the static interior pressure conditions required for abandonment;
- the storage cavern will be approximately [redacted]
- the cavern well will have a 16" final cemented casing set at about 3,800 feet below ground level (note: the depth and diameter of the casing greatly influences the amount of cement and bentonite required);
- a Mechanical Integrity Test (MIT) and sonar survey will need to be completed in advance of the P&A (note: this step may not be necessary if an approved MIT and sonar survey of the storage cavern has been completed within five years of the P&A);
- the plugging technique will be to install three cement plugs in the cavern well - at the surface, top and bottom (note: there are alternative plugging techniques that can be used such as filling the entire wellbore with cement); and,
- the bradenhead (flange on the last cemented casing) will be left in place at the completion of the plugging work to allow continued post-P&A subsidence monitoring.

1.2 Typical Plugging and Abandonment Process Conditions and Assumptions and Duration

1.2.1 Cavern Preparation:

- All stored hydrogen will be removed and the cavern will be filled with saturated brine water until a 0 psi reading is achieved at the wellhead.
- This process should take approximately [redacted] based on an estimated two weeks to displace [redacted] of cavern space with brine.
- This involves bleeding the hydrogen back to the hydrogen production plant by displacing the hydrogen with brine.
- The hydrogen pipeline between the Facility storage caverns and hydrogen production plant will be used to convey gas back to the plant either for use or disposal.
- The brine transfer and pipeline system between the Facility brine evaporation ponds and storage caverns will be used to pump brine into the cavern.
- The process of injecting brine to remove hydrogen will continue until brine is seen in the hydrogen stream.
- A portable separator and flare system will be set up at the well to finish removing the gas.

1.2.2 Cavern MIT:

- A MIT will be completed of the storage cavern/cavern well system in accordance with the requirements of the Class V UIC Permit as outlined in the Operations Plan.
- Cavern P&A Mobilization, Set-Up and De-Mobilization:
- A well rig will be transported and set up at the cavern well head to first complete a sonar survey and then P&A of the cavern well.
- After P&A of the cavern well is complete, the well rig will be broken down and transported off site.
- Cavern Sonar Survey:
- A sonar survey of the storage cavern will be completed of the storage cavern in accordance with the requirements of the Class V UIC Permit as outlined in the Operations Plan.
- Cavern Well Plugging:
- Remove all free hanging tubing from the well (if a sonar survey is necessary, this will be completed prior to the sonar survey).
- Run wire line log to determine the exact depth to the bottom of the cemented production casing.
- If casing conditions warrant, a scraper will be run from surface to bottom of the cemented casing to remove scale or hydrogen from the casing.
- A drillable plug capable of supporting a cement plug will be installed below the cemented casing with the bottom of the plug at least 10 feet below the end of the casing.

- The casing will be circulated clean utilizing brine or freshwater to remove any contaminant from the stored hydrogen string that may adversely react with the cement plugs (step 6).
- The following plugs will then be placed using Class G cement with no additives and the slurry weight will be 14.5 pounds per gallon or more per DOGM regulations:
- Bottom plug: A 300-foot plug from the plug at the bottom of the production casing upward.
- Surface casing plug: A 150-foot plug from 75 feet below the bottom of the surface casing upward.
- Top plug: A 75-foot plug from 75 feet below surface grade upward to surface.
- The casing between each of the plugs shall be filled with a non-corrosive mud slurry of at least 10 pounds per gallon weight.
- Cavern P&A Reporting:
- All required reports will be filed in accordance with DWQ rules and Class V UIC Permit conditions as applicable.

1.2.3 Post Cavern P&A Monitoring:

- Post P&A monitoring will consist of continued annual subsidence surveys for three years.
- The survey should include monuments on the cavern that was plugged and abandoned as well as other storage caverns in the vicinity.
- The following table provides the estimated and duration and cost to complete each step in the P&A process described above. Note that the estimate does not include the cost of electricity or manpower to remove the bulk of the hydrogen to the surface facility or contingency

1.3 Plugging and Abandonment Bonding

In accordance with the requirements of the Class III and V UIC Permits, the Company will secure and maintain a bond of a sufficient amount to plug and abandon caverns at the Facility with the DWQ as a named insured party.

ATTACHMENT E

Financial Assurance

Memo – Revised Estimated Cost to Plug and Abandon Hydrogen Storage Caverns at Delta, Utah

June 27, 2021

To: Division of Water Quality and ACES I, LLC
From: T. Eyermann
Subject: Revised Estimated Cost to Plug and Abandon Hydrogen Storage Caverns at Delta, Utah

[redacted]

[redacted]

[redacted]

		Total	$477,200