

Provincial Standards for Compressed Air Energy Storage Applications and Operations

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PREFACE

The operating and application standards presented in these *Provincial Standards for Compressed Air Energy Storage Applications and Operations* (**Standards**) cover **works** used in association with compressed air energy storage (CAES) projects regulated under the *Oil, Gas and Salt Resources Act*.

CAES applicants and operators are required, by section 2.1 of *Ontario Regulation 245/97* under the *Oil, Gas and Salt Resources Act* (OGSRA), to comply with the content of these **Standards**, except where a departure has been approved by the Ministry of Natural Resources and Forestry (ministry) in accordance with that section of the regulation.

Applicants and operators preparing materials and information to meet the requirements of these **Standards** are reminded that it is an offence under the OGSRA to knowingly make a false statement or provide false information in a document or other form of communication required under the act or the regulation.

The technical operating standards set out in this document are the minimum requirements for the design, installation, operation, abandonment, decommissioning and safety of **works**. These technical standards are not intended for use as a design handbook; the exercise of competent engineering judgment and application of practical experience are necessary in conjunction with their use.

The requirements of the operating standards are adequate under conditions normally encountered in activities involving **works**. Requirements for abnormal or unusual conditions are not specifically provided for, nor are details of engineering or construction prescribed. It is intended that all work performed within the scope of these standards, including other standards that may be referenced, shall meet or exceed the safety standards expressed or implied herein.

The Canadian Standards Association's *CSA Z341.2-14 Storage of Hydrocarbons in Underground Formations – Salt Cavern Storage* (**CSA Z341.2**) is referenced within this standard. **CSA Z341.2** was not specifically designed for air storage facilities, and therefore modifications to some provisions of this standard will be required to address some air-specific technical matters, such as corrosion. These adaptations shall be addressed by applicants and operators on a project-by-project basis in accordance with section 2.1 of *Ontario Regulation 245/97*.

Within this document, terms that are shown in **bold** font are defined in the Glossary.

SCOPE

These **Standards** apply to **works** used in association with CAES projects, where those projects utilize solution-mined **salt caverns** to store compressed air for the purpose of producing electricity. This includes wells and **salt caverns**, as well as pipelines or other structures or equipment that are located between the wellhead and the emergency shutdown valves, or, if there is no emergency shutdown valve, between the wellhead and the first isolation valve. It also includes pipelines or other structures or equipment that are used in association with the drilling, completion, maintenance, servicing, overhauling, working over, abandonment or decommissioning of a well or **salt cavern**.

These **Standards** do not apply to the CAES compression and generator facilities, including their location, structures and associated piping and facilities. These components may be subject to other agency requirements and approvals.

The activity of solution-mining for the creation of a **salt cavern** to be used for CAES is not subject to these **Standards**, and shall follow the requirements set out in the *Oil, Gas and Salt Resources of Ontario Provincial Operating Standards (Oil, Gas and Salt Provincial Operating Standards)*. However, proponents that are seeking to create one or more solution-mined **salt cavern(s)** specifically for the purpose of CAES may concurrently apply for approval to conduct solution-mining activities and subsequent CAES activities.

Where the requirements of this **Standard** conflict with the requirements of other standards referenced herein (i.e., **CSA Z341.2** and the **Oil, Gas and Salt Provincial Operating Standards**), the standard that provides a higher level of protection to public safety and/or the environment takes precedence.

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PART 1: OPERATING STANDARDS FOR COMPRESSED AIR ENERGY STORAGE

1.1 General

- (a) The design of all **works** used shall be suitable for air.
- (b) Operators of CAES **works** shall comply with all of the following parts of the **Oil, Gas and Salt Provincial Operating Standards**:
 - Part 3: Well Drilling;
 - Part 4: Blowout Prevention;
 - Part 5: Works;
 - Part 8: Well Servicing;
 - Part 11: Well Plugging;
 - Part 12: Oil, Gas and Salt Resources Trust; and
 - Part 13: Reporting.
- (c) Any **work** used in association with a CAES project shall be designed, constructed, operated, maintained, abandoned and decommissioned in accordance with **CSA Z341.2**.
- (d) Despite (c), where **CSA Z341.2** makes reference to hydrocarbon(s) in the context of a storage facility or a substance that is, will be, or has been injected, stored or withdrawn from the cavern, CAES applicants and operators shall read and apply the requirement as though the term 'hydrocarbon' has been replaced with 'air' unless it would make the reading of that requirement clearly unreasonable or result in a lower standard of protection to public safety or the environment.
- (e) Paragraph (d), above, also applies to the Annexes of **CSA Z341.2**, and the definitions of blowdown, choke, communication, confining formation, migration, salt cavern and subsurface safety valve.

1.2 Property Setbacks

- (a) Wells shall be located at least 150 metres from the boundary of the property(ies) that the operator owns or has leased for the purpose of CAES; and

- (b) The boundaries of any **salt cavern** used for CAES shall be no closer than 50 metres from the boundary of the property(ies) that the operator owns or has leased for the purpose of CAES.

1.3 Reporting

In addition to the reporting requirements of Part 13 of the **Oil, Gas and Salt Provincial Operating Standards**, the ministry shall be notified:

- (a) of planned well overhauls and inspections and the results of such inspections including copies of all the sonar surveys, logs, test data and the interpretations of this data;
- (b) of suspected damage to a brine stringer;
- (c) of **fluid** leaks at the well head or **casings**; and
- (d) immediately when any emergencies occur, including spills, loss of well control, fire, explosion or other accident.

1.4 Well Bore Surveys

Operators shall conduct and submit well bore surveys in accordance with section 1.9.3 of the **Oil, Gas and Salt Provincial Operating Standards**.

1.5 Injection Pressure

Despite any requirement to the contrary in **CSA Z341.2**, the maximum injection pressure for operations and mechanical integrity testing shall not exceed 75% of the local **fracture gradient**.

1.6 Mechanical Integrity Test (MIT) Examinations

Where mechanical integrity testing is conducted on a cavern system, the operator shall provide for a Class IV Examiner to examine the test results and certify their validity.

1.7 Annual Examination

The operator shall provide for an annual examination of all surface **works** located on land and a Class IV Examiner to certify that these **works** meet Part 1 of these **Standards**.

1.8 Posting of Well Licences

The operator shall post a copy of the well licence at the well site during all well drilling, workover or service operations involving a drilling or service rig.

PART 2: APPLICATION STANDARDS FOR COMPRESSED AIR ENERGY STORAGE

A well licence application is required to establish a new well for the purpose of CAES or to convert an existing well to be used for the purpose of CAES. The application shall address all activities to be undertaken in or on the well in accordance with section 10 of the OGSRA.

An injection permit application is required to use one or more wells for the injection of any substance, including air, into an area in association with a CAES project, in accordance with section 11 of the OGSRA.

2.1, below, applies to both well licence applications and injection permit applications.

Well licence applications and injection permit applications may be submitted and consulted on concurrently.

2.1 Common Submission Requirements: All Well Licence and Permit Applications

2.1.1 Applications shall be submitted to:

Petroleum Operations Section,
Ministry of Natural Resources and Forestry
659 Exeter Road
London, Ontario N6E 1L3
email at: posrecords@ontario.ca

2.1.2 Format

- (a) All application documentation shall be submitted digitally in readable PDF format, with the exception of maps, figures or other diagrams which shall be submitted in readable PDF or JPEG format. Applicants may, at their discretion, provide an identical paper copy of the application in addition to the digital version.
- (b) All numerical data shall be submitted in the International System of Units (SI).
- (c) All geographic coordinates (north latitude and west longitude) shall be based on the North American Datum 83 (NAD 83).

2.1.3 Applicant information

The following information shall be provided with the application:

- (a) Applicant full name, permanent address, mailing address, phone number, and email address;
- (b) Primary contact information, including:
 - 1. Full name,
 - 2. position or title, and
 - 3. contact information, including mailing address, phone number and email address; and
- (c) If the applicant is a corporation, a current certified corporation profile report.

Note: The regulation refers to a 'person' applying for a licence or injection permit. Therefore the application must be in the name of an individual or a corporation.

2.1.4 Application Fees

- (a) At the time of application, applicants shall submit the applicable application fee, payable to the Minister of Finance, in the amount that has been established by the Minister of Natural Resources and Forestry.
- (b) The application fee shall be in the form of a money order, cash, cheque or preauthorized debit from an account or credit card, or credit or debit card payable to the Minister of Finance.

2.1.5 Well names

All well names shall conform to section 1.8 of the **Oil, Gas and Salt Provincial Operating Standards**

2.1.6 Land Ownership/Lease Arrangements

Applications shall include confirmation, to the ministry's satisfaction, that the applicant has the surface, mineral and compressed air storage rights, through ownership or lease, for all lands on which CAES **works** will be located.

2.1.7 Project description

A project description shall be prepared and submitted with the application that includes:

- (a) An overview of the proposed project and its purpose;
- (b) The location description, including local and upper tier municipalities, lot, concession, geographic township, and civic address;
- (c) A description of the proposed project **works** and activities that are the subject of the CAES application under the OGSRA;
- (d) A description of other components of the project that are not subject to the OGSRA, identifying other federal, provincial and municipal approvals that will be required for these components;
- (e) A list of all documents and information that are being submitted in support of the application, including: the title of the document, its general subject matter, the version number and date, the author's name, and the author's qualifications; and
- (f) One or more maps showing:
 - 1. The general location of the lands on which any **works** subject to the application are located,
 - 2. The location of all existing and proposed well(s), cavern(s) and other **works** that will be used for the project,
 - 3. existing surface uses, significant natural and human-made features, populated areas, and relevant land uses that have the potential to be impacted by the project and are located within 500 metres of any proposed well(s) and also 500 metres from the boundary of the storage cavern(s) when projected on the surface,
 - 4. existing subsurface uses, including existing wells or **abandoned wells** and currently or previously active subsurface operations within a 1 kilometre radius of the subsurface perimeter of the storage cavern(s), as well as any other subsurface activity required to be addressed in 2.3.1 or 2.3.5, below,
 - 5. a North arrow, and
 - 6. a scale.

2.1.8 Technical Information Plans, Programs, Studies and Reports

- (a) Applicants shall provide adequate information to demonstrate, to the ministry's satisfaction, that compressed air energy storage wells and systems will be designed, constructed, operated, maintained and abandoned to:
1. permanently isolate and protect all potable water **formations** from contamination,
 2. protect existing and potential hydrocarbon-bearing **formations** from cross-contamination,
 3. prevent the migration of **fluids** between permeable **formations**,
 4. ensure that the compressed air is compatible with the storage **formation**,
 5. ensure storage **fluids** are contained within the designed storage area, and
 6. ensure all necessary measures are taken to ensure public safety and environmental protection;
- (b) Applications shall demonstrate that:
1. the compressed air energy storage project and associated **works** will be designed, constructed, operated, maintained, abandoned and decommissioned in accordance with Part 1 of this Standard,
 2. the compressed air energy storage project and associated **works** have been designed for the site specific location and the geological conditions,
 3. all **works** have been designed with consideration of the expected compressed air conditions, and
 4. the mechanical integrity of the proposed well, the wellbore and the salt solution-mined cavern system has been confirmed, or will be confirmed prior to operation;
- (c) All documents submitted to address the requirements of 2.1.8 (a) and (b), 2.2.3, 2.2.4, 2.2.5, and all parts of 2.3 of this Standard shall:
1. identify the current version number and the date the version was prepared,
 2. include a section identifying any proposed departures from Part 1 of these **Standards** that are being proposed in the document, and
 3. identify the individual(s) responsible for their preparation, the individual's qualifications and relevant experience, and the individual's seal, stamp and/or signature; and

(d) All departures from Part 1 of this Standard that are being proposed for approval shall also be summarized in one document and submitted with the application. For each proposed departure, the summary shall include:

1. the rationale for the proposed departure, and
2. the name and affiliation of the qualified person who has certified the proposed departure in accordance with clause 2.1(5)(c) of *Ontario Regulation 245/97*.

Note: Section 2.1 of *Ontario Regulation 245/97* does not permit departures from the application requirements contained in Part 2 of this Standard.

2.2 Additional Submission Requirements: Well Licence Applications

2.2.1 Application Form

Well licence applicants shall submit a completed Application for a Well Licence (Form 1).

2.2.2 Well Security

Well security set out in section 16 of *Ontario Regulation 245/97* shall be established in accordance with that regulation at the time of application. All information on the well security that is required under section 9 on the Application for a Well Licence (Form 1) shall also be provided.

2.2.3 Well location plan

Well licence applications shall include a well location plan that meets the requirements of all parts of section 1.9, except 1.9.2(b)(iv) and 1.9.3, of the **Oil, Gas and Salt Provincial Operating Standards**.

2.2.4 Drilling Program

Any well licence application that proposes to drill a new well shall submit a drilling program that meets the requirements of clause 1.3(b) of the **Oil, Gas and Salt Provincial Operating Standards**.

2.2.5 Well/Cavern Conversion

Any well licence application that proposes to convert the use of an existing solution-mining well to CAES use shall also submit a conversion program that provides details on the following:

- (a) the age and history of the well(s), including its original construction, use, service and maintenance;
- (b) the condition of the well(s), with confirmation that the condition and construction of any well(s) to be used in the project meets, or will meet prior to operation, the requirements of the **CSA Z341.2** standard;
- (c) confirmation of, or plans to demonstrate prior to operation, the structural stability of any cavern(s) to be used in the project;
- (d) confirmation of, or plans to demonstrate prior to operation, the mechanical integrity of the cavern storage system in accordance with the requirements of **CSA Z341.2**;
- (e) pressure tests, casing evaluation logs and cement evaluation logs that were undertaken, or will be undertaken prior to operation, to demonstrate the mechanical integrity of the well(s) in accordance with **CSA Z341.2**; and
- (f) an evaluation of whether the well(s) meets, or will meet prior to operation, the requirements of Part 1 of these **Standards**.

2.3 Additional Submission Requirements: Injection Permit Applications

2.3.1 Project Suitability Assessment

Applications shall include a report assessing the suitability of the proposed compressed air energy storage project, including:

- (a) for all wells located within 1 kilometre of any well or cavern proposed to be used in association with the project, where such information is available:
 1. the location, identity, status, depth, and **formation** at total depth,
 2. the oil, gas, water and loss of circulation zones encountered, and
 3. for wells that penetrate bedrock, the **casing**, **cementing** and plugging details of the wells; and
- (b) the location and status of potable water wells within 1 kilometre of any well or cavern proposed to be used in association with the project;
- (c) a description of all uses of the subsurface that are required to be addressed in 2.3.5, below;

- (d) the volume, the flow rates, and the injection and withdrawal pressure for the proposed injection activities to be carried out in association with the project;
- (e) the properties and composition of any substance to be injected or stored, including air;
- (f) the source, chemical composition and specific gravity of any **brine**;
- (g) the drilling and completion record, including any stimulation and workover of the well(s);
- (h) a complete description of the installation and **cementing** of the surface, intermediate and production **casings** of the well(s);
- (i) a complete report on the installation of the injection tubing in the well(s);
- (j) records of the tests of the integrity of the various well **casings**;
- (k) the well history, if converting an existing well;
- (l) a detailed record and cross-sectional diagram of the method of well completion (well-bore diagram);
- (m) a description of the proposed **fluid** handling procedures; and
- (n) a site plan of the wellhead and associated facilities.

2.3.2 Geological Studies and Maps

Geological studies and maps shall be conducted and created in accordance with clause 7.3 of **CSA Z341.2** and submitted as a part of the application.

2.3.3 Risk Assessment

A risk assessment shall be conducted in accordance with clause 7.1 of **CSA Z341.2**, with specific reference to compressed air parameters, and submitted as a part of the application. The risk assessment shall consider the life-cycle of the proposed operation from start-up through decommissioning and abandonment.

2.3.4 Location of Compressed Air Energy Storage Facility

Applications shall demonstrate that clause 6 of **CSA Z341.2** has been addressed in the location, design, operational, maintenance, and emergency response requirements of the underground storage facility.

2.3.5 Assessment of Neighbouring Subsurface Activities

An evaluation of all current and former subsurface activities and their potential impact on the integrity of the storage facility shall be conducted as per clause 7.2 of **CSA Z341.2** and submitted as a part of the application. The evaluation shall also:

- (a) identify and evaluate the potential impact that the proposed storage facility may have on any identified neighbouring subsurface activities; and
- (b) address any planned mitigation, monitoring, record-keeping and reporting proposed to be undertaken in relation to subsurface impacts.

2.3.6 Assessment of Neighbouring Surface Uses and Users

The application shall include an assessment of potential impacts to surface users and uses that may result from the development, construction, operation, decommissioning and abandonment of the well(s) and cavern(s). The assessment shall include:

- (a) the identification and description of existing surface users and uses that may be impacted by the proposed development, construction, operation, abandonment and decommissioning of the well(s), cavern(s) and any other **works** used in association with the project;
- (b) the identification and evaluation of the nature and extent of any potential impacts;
- (c) plans to mitigate identified impacts; and
- (d) details regarding any planned monitoring, record-keeping and reporting requirements related to the management of impacts to surface users and uses.

2.3.7 Emergency Response Plan

An emergency response plan shall be prepared in accordance with clause 10.1.2 of the **CSA Z341.2** and submitted as a part of the application. The emergency response plan shall deal with accidental air and **brine** release, as well as any accidental hydrocarbon release where applicable, and shall be developed for the compressed air energy storage facility rather than a hydrocarbon storage facility.

2.3.8 Well and cavern plan(s)

The applicant shall prepare and submit detailed plan(s) addressing the design, development and construction, operation and maintenance, and the abandonment and decommissioning of well(s) and cavern(s), including final site restoration. These plans shall also include:

- (a) the identification of any required training programs and/or required expertise for personnel conducting any activity addressed in the plan(s); and
- (b) details regarding any proposed monitoring activities, record-keeping requirements and requirements to report to the ministry or other party related to the activities addressed in the plan(s).

2.4 Notification and Comments: All Well Licence and Permit Applications

The requirements of this part apply to all applications for well licences (new wells or conversions of existing wells) and all applications for injection permits associated with compressed air energy storage projects.

The requirements of this part may be conducted concurrently for multiple applications related to the same project.

2.4.1 Identification of Indigenous communities and additional parties to be notified

- (a) After the applicant has met all of the requirements of all parts of 2.1, 2.2, and 2.3, above, the ministry will advise the applicant, in writing, of the Indigenous communities and organizations that the applicant shall be required to notify of the application in accordance with 2.4.2(b), below, as well as any additional agencies and ministries to be notified in accordance with 2.4.2(g), below.
- (b) The ministry may also direct that the applicant provide a digital copy of the application documents submitted under all parts of 2.1, 2.2, and 2.3, above, to any municipality or party identified in (a), above, at the same time as the notice of application required by 2.4.2, below, rather than on request.

2.4.2 Notification

The applicant shall notify the following persons and parties of the application:

- (a) All landowners within 750 metres of any well used by the CAES project;

- (b) Indigenous communities and organizations, as directed by the ministry under 2.4.1, above;
- (c) Any local or upper tier municipality, where the boundary of the municipality is located within 750 metres of any well used by the project;
- (d) All holders of a well licence issued under the OGSRA, if the licence is issued in relation to **solution mining**, hydrocarbon storage, or CAES, within 1 kilometre of any well proposed to be used in association with the CAES project;
- (e) All operators of a natural gas storage area designated under *the Ontario Energy Board Act, 1998*, if the boundary of the designated gas storage area is within 1.6 kilometre of a well proposed to be used in association with the CAES project;
- (f) All utility corporations holding an easement for railways, high voltage transmission power lines, transmission or distribution pipelines, or other occupied utility right of ways within 750 metres of any well proposed to be used by the CAES project; and
- (g) Other agencies and ministries, as directed by the ministry under 2.4.1, above.

2.4.2.1 Content of Notice

The notice provided under 2.4.2, above, shall:

- (a) not commence until such time as the applicant has met all of the requirements of all parts of 2.1, 2.2, and 2.3, above;
- (b) be provided on a form, if any, approved by the ministry;
- (c) advise the recipient that comments may be provided to the applicant, with a copy to the ministry, on the application within 60 calendar days from the date the notice was provided;
- (d) provide contact information for the applicant, including name, title, mailing address and email address;
- (e) provide the name, title, mailing address and email address for copies of comments to be sent to the ministry, as supplied by the ministry;
- (f) include the project description required in 2.1.7, above; and
- (g) if the application documents submitted under all parts of 2.1, 2.2, and 2.3, above, are not being provided with the notice, advise the recipient that digital copies of that information may be obtained by:

1. requesting it from the applicant, or
2. if the applicant chooses to establish a website to distribute the information, through the website provided.

2.4.2.2 Delivery of Notice

Any notice provided under 2.4.2, above, shall be deemed to have been provided:

- (a) If the notice was sent by mail, 5 business days after the notice was mailed;
- (b) If the notice was sent by email or fax, or delivered in person, on the day the notice was delivered.

2.4.3 Submission of Comments

- (a) Any person or party wishing to comment on the application shall submit comments, in writing, to the applicant with a copy to the ministry within 60 calendar days from the date the notice was provided. Comments may be submitted by mail or email.
- (b) Any comments submitted under (a) are deemed to have been submitted on the day the comments are mailed, or if submitted by email, on the day the email was delivered.

2.4.4 Record of Comments

Until such a time as the ministry has made a decision on the application, and communicated the decision, in writing, to the applicant, the applicant shall maintain a record of all comments received regarding the application. The applicant shall provide a full copy of the comments it received to the ministry only upon ministry request.

2.4.5 Summary of Comments

- (a) After the 60 day comment period for all notified persons and parties has passed and the applicant has considered the comments received, the applicant shall summarize their notification activities, the responses to the application that were received, and the applicant's plans to address any concerns that were raised.
- (b) The documentation related to Indigenous communities and organizations shall be in a separate summary document that is organized by community/organization.
- (c) The summaries shall include:

1. A description of all persons or parties notified of the application,
2. A summary of comments received from notified persons or parties,
3. A summary of any comments received from other persons or parties that were not notified of the application,
4. Any changes made to the application in response to the comments or how the original application addresses the comments, and
5. The identification of any concerns raised within the comments that have not been addressed, including an explanation of why they have not been addressed.

Note: Copies of the summaries of comments provided by the applicant may be requested from the ministry. These summaries will be shared by the ministry, on request, subject to the provisions of the *Freedom of Information and Protection of Privacy Act*.

GLOSSARY

Abandoned well - a well whose use has been permanently discontinued and has been plugged.

Brine - saline water naturally occurring in porous sedimentary rock **formations**, or **fluid** resulting from the dissolution of salt **formations** with fresh water for the purpose of salt **solution mining**.

Casing - metallic or non-metallic pipe placed in the bore hole for the purpose of supporting the sides of the bore and to act as a barrier preventing subsurface migration of **fluids** out of or into the bore hole (e.g. protection of fresh water zones).

CSA Z341.2 means *Canadian Standards Association (CSA) Standard Z341.2-14: Storage of Hydrocarbons in Underground Formations – Salt Cavern Storage*.

Cementing - the operation whereby a cement slurry is pumped and circulated down a well through the centre of the **casing** and then upwards into the annular space behind the **casing** in order to firmly fix the **casing** in the hole and to buttress the **casing** string from **formation**, production or injection pressures and to protect the **casing** from corrosion due to exposure to **formation fluids**.

Fluid - any material or substance which flows or moves and which is in a semisolid, liquid, sludge, or gas state.

Formation - a body of rock characterized by a degree of homogeneous lithology that forms an identifiable geologic unit that can be mapped on the earth's surface or is traceable in the subsurface.

Fracture Gradient - the pressure gradient, that if applied to subsurface **formations**, will cause the formations to physically fracture.

Oil, Gas and Salt Provincial Operating Standards - means the standards set out in the document entitled “*Oil, Gas and Salt Resources of Ontario Provincial Operating Standards*”, published by the ministry and available on a website of the Government of Ontario, as that document is amended from time to time;

Salt Cavern - a cavern constructed within a soluble rock **formation**, commonly rock salt, by circulating fresh water in a controlled manner.

Solution Mining - means the extraction of salt from a geological **formation** by the injection of water and the recovery of the salt in solution through a well.

Standards – means the *Provincial Standards for Compressed Air Energy Storage Applications and Operations, Version 1.0*.

Work (or works) - as defined in section 1 of the OGSRA, means a well or any pipeline or other structure or equipment that is used in association with a well. In accordance with subsections 1(4) and 1(5) of *Ontario Regulation 245/97*, for CAES projects, **works** are limited to the underground storage area and well, up to and including the emergency shut down valves or first isolation valve, as well as all pipelines, equipment or surface structures used in association with the drilling, completion, maintenance, servicing, overhauling, working over, abandonment or decommissioning of a well or **salt cavern**.



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