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**NUCLEAR ENERGY AGENCY  
RADIOACTIVE WASTE MANAGEMENT COMMITTEE**

### **Integration Group for the Safety Case (IGSC)**

**SALT CLUB**

**Mandate of the Salt Club**

**Draft version**

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## 1. PREAMBLE

In the scientific community worldwide it is accepted that deep geological disposal is the appropriate way to dispose of spent/used fuel elements, high-level radioactive waste, and other, especially long-lived radioactive waste safely and securely for long times. The geological formations that can host deep geological repositories include argillaceous rocks, crystalline rocks, and rock salt.

An advanced scientific and geotechnical understanding of rock salt as an appropriate geological material to host repositories has been accumulated by the dedicated research carried out by a number of countries favoring this material in the latter half of the 20<sup>th</sup> century.

The area of repository development for long-lived waste is a strategic area in the work program of the NEA Radioactive Waste Management Committee (RWMC) and an area of traditional strength of this Committee.

In the 2011 annual meeting, the IGSC endorsed the foundation of the Salt Club and approved the proposed working approach and work topics. The Salt Club was officially created in April 2012 and similar to the Clay Club, the Salt Club aims at promoting the exchange of information and shared approaches and methods to develop and document an understanding of salt formations as a host rock for a high-level waste repository.

Between 2012 to 2014, the Salt Club successfully held several technical workshops and/or conferences to further their understanding of the behaviours of salt rocks. The Salt Club members effectively shared their new gained knowledge and experience through these scientific meetings and dialogues. In their 2014 annual meeting, the Salt Club revealed their accomplishments in the past two years and concluded the need to continue their research efforts. The Salt Club is now seeking an extension of their mandate for the period of May 2014 – December 2015 from the IGSC.

## 2. DESCRIPTION

An advanced scientific and geotechnical understanding of rock salt as an appropriate geological material to host repositories has been accumulated by the dedicated research carried out by a number of countries favoring this material in the latter half of the 20th century.

Moreover, a comprehensive suite of technologies and scientific expertise have been developed leading to an advanced state of knowledge concerning disposal in rock salt. There is also more than a century of modern experience in mining and the operation of salt mines, and also substantial know-how from underground disposal of chemotoxic waste, and the successful operation of the WIPP and Morsleben repositories.

Since many years, countries like the United States of America (U.S.), the Federal Republic of Germany (Germany), The Netherlands, and Poland consider rock salt as one of the favorable rock types to host a deep geological repository for different kinds of radioactive waste, including high-level waste and spent nuclear fuel.

The Salt Club serves as the international focal point and a catalyst for the following general objectives:

- The timely and cost-effective exchange of information on both favorable and challenging attributes of rock salt as a host rock formation for deep geological repositories (and underground research laboratories [URLs]) for long-lived and heat generating radioactive waste.
- The establishment and accomplishment of joint research activities on the characterization of rock salt formations, on the design, construction, operation and closure of repositories in rock salt, on thermal, hydraulic, mechanical, and chemical (THMC) processes crucial for their construction, operation, closure and safety, and on assessing the safety of repositories in rock salt.
- The establishment of a constructive international dialogue on rock salt science and engineering, including the distribution of the information being synthesized under the first objective to national and international radioactive waste management organizations and institutions.
- Knowledge transfer, including to nations with small programs or programs in their initial state and adequate rock salt deposits for a repository, by organizing conferences, workshops, seminars on scientific-technical issues regarding disposal in rock salt as well as on issues of general interest for deep geological disposal.
- Fostering education and training as first steps in knowledge management.

Several recommendations of national and international bodies paved the way for investigating rock salt with respect to its suitability as candidate host rock for deep geological disposal systems (repositories) for radioactive waste because of its favorable characteristics supporting the safe development of a repository and the long-term containment and isolation of waste.

The most important positive attributes of rock salt for use as a repository host rock are:

- extremely low permeability/hydraulic conductivity that isolates the waste from any near surface groundwaters;

- dry environment;
- high thermal conductivity;
- viscoplastic behavior that increases with temperature and pressure and which closes all void spaces;
- predictable geology.

Moreover:

- a vast store of knowledge and experience on excavation techniques, mine development, and safe operation is available, stemming from salt mining at great depth;
- rock salt is easy and inexpensive to excavate/mine;
- transparent conceptual and numerical models (enhances scientific and public acceptance) are at hand, and
- theoretical and operational waste experience bases are readily available (reduces the learning curve and cost for new projects).

A wealth of knowledge and experience has resulted from research and development (R&D) activities in fields like site investigations, in particular with regard to the application of geophysical techniques, geomechanics, geochemistry, modeling, and performance assessment for more than four decades, which included large-scale experiments in underground laboratories (URLs).

The behavior of rock salt under thermal and mechanical loads as well as under high doses of radiation is well understood; this knowledge is available and at hand in several countries. A large number of laboratory and in situ experiments were performed; demonstration activities were conducted; instruments and methods for safety assessments were substantially developed and are being applied. Substantial progress was made in technologies and equipment. Yet there is more work to be done to expand the potential use of salt as a repository host rock.

A key source of relevant information is the successful licensing and operation of the Waste Isolation Pilot Plant (WIPP) in the USA. The Safety/Performance Assessments (SA/PA) conducted for and in conjunction with the 1996 WIPP Compliance Certification Application (CCA) to demonstrate the safe long-term, i.e., 10,000-year, performance of the WIPP repository were intensely scrutinized by many stakeholders, including an international peer review group coordinated jointly by the OECD-NEA and the International Atomic Energy Agency (IAEA). The CCA was ultimately approved by the U.S. Environmental Protection Agency (EPA), the licensing authority for the WIPP. These SAs/PAs, which convincingly demonstrated the excellent long-term radionuclide containment and isolation characteristics of rock salt, took credit for only one barrier not yet constructed: the shaft seals. Furthermore, the WIPP certification by EPA confirmed the accuracy and credibility of the data and models used by the United States Department of Energy (DOE) Carlsbad Field Office (CBFO). Based upon the recertification decision the outcomes of the recertification performed in the years 2004 and 2009 confirmed the soundness of the safety assessment for the WIPP.

Similar experiences are available in Germany with respect to the Gorleben exploration mine and from the operation and licensing for closure of the Morsleben repository. A vast amount of experience and scientific-technical know-how was gained by RD&D performed in the Asse mine that served as a 1st generation URL for nearly two decades.

However, good science and engineering are only part of the many disciplines and issues involved in the successful development of deep geological URLs and repositories. Further fundamental issues of particular importance to the success of geological repository programs are:

- Safety
- Regulatory Acceptance
- Public Acceptance
- Political Acceptance
- Costs

Judging mainly on German and U.S. data, rock salt is a very promising geologic medium for the development and safe as well as cost-effective operation of URLs and repositories for long-lived and heat generating radioactive waste.

Concerning regulatory acceptance, considerable experience exists especially in the U.S. Public and political acceptance, however, are either continuing or future challenges for all waste management programs. Although these challenges should actually be addressed using socio-political approaches in the respective national context, there is a need for common strategies and approaches.

Experience and expertise are available in the countries having investigated the use of rock salt and their respective technical organizations (academia, national research centers, industry, research organizations, etc.). Consequently, an additional very important objective for a Salt Club is to make the current knowledge base on rock salt more readily available within the IGSC member nations and especially nations with adequate rock salt deposits for a repository.

**Proposed mission and objectives of the Salt Club:**

- Develop and exchange geologic-medium specific, i.e., rock salt, information among nations currently pursuing or considering rock salt as a candidate deep geological repository medium;
- Stimulate interest in nations around the world (especially NEA member countries) with appreciable rock salt deposits to seriously consider rock salt as a viable repository host rock/medium for the safe containment and isolation of long-lived radioactive waste;
- Communicate identified relevant topics of common interest;
- Perform fundamental joint research into areas where understanding is incomplete;
- Transfer methods and tools for the nation's salt disposal facilities and mining operations to analyze their operations to ensure safe, secure, long-term functionality of the underground structures.
- Characterize and qualify the information available;
- Promote the information exchange, approaches and methods and methodologies, technologies in order to understand the characteristics of rock salt and to use its advantages to host a repository;
- Get information from other salt related fields like disposing of chemical wastes (underground disposal, state-of-the-art in related fields);
- Afford technical experts access to and interchanges with the latest international developments in salt mechanics sciences;
- Provide advice on major and / or developing issues pertaining to the understanding and characterization of rock salt;



- Inform and provide advice on conceptual topics, performance descriptions and modeling;
- Discuss performance assessment, models, reliability and quality of data, evaluate national and international (i.e. European Commission) R&D activities;
- Exchange with other working groups (i.e. the Implementing Geological Disposal Technology Platform (IGD-TP)) on issues of common interest;
- Exchange with nations with "non-salt programs" on topics of common interest (e.g. geochemistry, SA/PA);
- Disseminate results at conferences, workshops, and on similar occasions, and for - transparency reasons - to the interested public;
- Develop a central library of acquired salt data, information, and knowledge with broad access provided via the Internet;
- Address the fundamental issue of knowledge management that exists because current experts and researchers for salt applications are aging and retiring, but the knowledge they possess will be needed more than ever. Hence, one focus of the proposed Salt Club is to reinvigorate the science (chemistry and physics) of rock salt through education and training and through encouraging the development of new researchers and students;
- Encourage research on regulatory aspects, public and political acceptance

### **Organizational structure and mode of operation and cooperation**

In principle the organizational structure and the way of the Salt Club would be similar to the IGSC's Clay Club that has worked very successfully over the years and has produced valuable products and acquired a significant scientific basis and documented technical know-how.

To accomplish the above mentioned objectives, the Salt Club include representatives from key organizations in the U.S., Germany, Poland, and The Netherlands directly involved in safe disposal of radioactive waste in rock salt, because the radioactive waste disposal programs of these countries currently possess the state-of-the-art knowledge, models, expertise, equipment, instruments, and facilities for deep geological disposal of long-lived radioactive waste in rock salt.

Further participants may include waste management nations with adequate rock salt deposits for safe disposal of long-lived radioactive waste as well as any other national and international organization expressing interest in obtaining/ receiving the information. They will be invited to participate in the Salt Club as members, or to receive the information developed by the Salt Club.

The Salt Club hold regular annual meetings at which its work program and individual projects will be established, updated, and reported about and organizational issues will be addressed.

The work of the Salt Club will be coordinated by a Steering Group. The Steering group and its chair will be elected at the annual meetings with the simple majorities of (i) the member organizations of the Salt Club (one organization = one vote) and (ii) the countries represented in the Salt Club (one country = one vote, if organizations from one and the same country cannot agree on their vote this counts as abstention). The terms of office for the Steering Group will be until December 2015.

At each annual meeting, a work program and budget (or their updates) will be proposed by the Steering Group and confirmed by the Salt Club-members. The Salt Club will report to IGSC at its annual meeting.

Projects may be proposed or recommended by members or other parties, like IGSC, and should be driven by common interest in the issue. This is also important against the background of national programs, schedules, human and financial resources. The mode of cooperation is by working group meetings and periodic general workshops and the use of electronic media.

More information of the Salt Club and their publications can be found at <http://www.oecd-nea.org/rwm/saltclub/>.

### **Areas of work**

In general, problems have to be addressed that refer to the long-term behavior of the repository system and its isolation functions. That means that scientific key issues are the main areas of interest and refer to:

- geomechanical issues (coupled processes, excavation-damaged-zone (EDZ)-behavior), rock mechanic issues, backfilling, sealing and plugging of rooms, drifts, shafts);
- brine and gas migration;
- actinide and brine chemistry;
- microbial activities in rock salt
- geochemical issues (radionuclide chemistry, modeling, natural analogs);
- technical /technological and engineering issues (construction, operation, closure);
- performance of geotechnical barriers; and
- contributions to the Safety Case (e.g. FEP catalog, scenarios, PA issues, uncertainties, use of natural analogues).

## **3 MEMBERSHIP**

The **Salt Club Steering Group (SC-SG)** is composed of delegates from participating NEA member countries, represented by responsible authorities who appoint the delegates to the Steering Group.

The **Salt Club Working Group (SC-WG)** forms the members of the Salt Club. The WG is composed of the SG members and of senior technical experts (STE) with experience in assembling or reviewing the understanding of salt formations as host rocks for deep geologic disposal projects. STE are representatives from waste management agencies, regulatory authorities, academic institutions, and research and development institutions. Salt Club members have a level of seniority in their organizations such that they can mobilize resources within their organizations to contribute to Salt Club initiatives.

#### **4. RESOURCES**

Members are expected to support their responsible elements of the Salt Club initiatives, and participating organizations will work on a quid-pro-quo basis.

Each participating organization will make available an amount to be agreed on to support administrative issues, conference arrangements, proceedings publication and management.

#### **5. DURATION OF THE MANDATE**

The duration of Salt Club is until December 2015. Given the nature of the Salt Club, an extension of the mandate is envisaged which is to be determined at the discretion of the IGSC.