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To: SMRI Membership

C/: SMRI 2014 Research Committee Members
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From: Gérard Durup, Research Coordinator

Date: 01 April 2015

Subject: SMRI's 2014 Research Priorities Survey & Research Plan

At the Fall 2014 meeting in Groningen, the SMRI performed its 4th research priorities survey, this time polling the SMRI members and industry representatives present at that meeting. Fifty responses to the questionnaire were collected, compared to 32 in 2009 and 25 in 2005. As usual, the large majority of the responses received were from SMRI member companies.

The purpose of this memorandum is to (1) summarize the 2014 questionnaire responses and (2) provide a tentative SMRI Research Plan aiming to adjust SMRI's current research funding direction to more closely respond to the membership's research preferences, as reflected by this survey.

1.0 - Summary of the 2014 Research Priorities Survey responses

1.1 Who responded to the questionnaire?

Most of the questionnaire responses were from SMRI members with some respondents involved in more than one line of business. Approximately 35% of the respondents were in the storage business, about 20% were involved with solution mining, and the remainder were engineering company employees (35%) or researchers (10%). Compared to the 2009 survey, the total percentage of respondents from the storage and solution-mining businesses decreased in 2014 by about 10%, while collectively the percentage from engineering and research increased.

Of the questionnaire respondents from storage or mining operations, approximately 50% had operations in bedded deposits and 50% had operations in salt domes. Some respondents had operations in both domes and bedded deposits. The number of respondents in each category is very consistent with the previous survey responses (50% each).

1.2 How did the questionnaire respondents feel the SMRI was performing?

Generally speaking, the respondents seem pleased with SMRI's research performance and management. The results of the 2014 survey, as well as that of the three previous surveys, are summarized in Figure 1. In most areas where the SMRI scored extremely well in 2009, the 2014 scores remained equally as high. In comparison to all previous surveys, the 2014 respondents expressed a much higher approval for "Topics are well balanced" while the respondents continue to give "SMRI does not issue too many RFPs" the lowest overall ranking relative to the other topics, consistent with survey results since 2003. This is quite encouraging considering the SMRI is currently funding and simultaneously managing an exceptional number of research projects (7 active research contracts totaling almost \$ 900,000).

The category "Research results are easy to access" did not increase in spite of the substantial efforts deployed recently by the SMRI to improve the SMRI website layout, facilitate keyword and author searches, and simplify access to SMRI's research reports and results. This might indicate that website usage has not increased or should be more aggressively promoted to inform members how to quickly and efficiently access research reports.

1.3 How did the respondents prioritize future research areas?

The ranking priority assigned by the 2014 questionnaire respondents is summarized in Figure 2. It is encouraging that the respondents still ranked abandonment as highest, as it is an area where we have been steadily spent our research funds over many years. The two other categories with greatest interest are (1) high frequency cycling in salt storage caverns, and (2) the use of salt caverns for storage in the developing renewable energy sector. Currently, the SMRI has active multi-year research programs in both of these fields.

Gas quality and metering remain, as in previous surveys, are less attractive fields for funding research.

1.4 What specific research projects were suggested by the questionnaire respondents?

Table 1 provides a categorized listing of the specific research topics noted by the questionnaire respondents. The respondents listed 36 specific research topics, compared to about 50 and 65 specific research interests noted in 2009 and 2005, respectively. This reduction in suggested topics seems quite coherent with the highest score obtained in the most current survey for "Topics are well balanced" (about 85% in Figure 1).

Some of the research topics have already been undertaken while a few of the topics are essentially duplicates or are quite similar to suggestions provided by another respondent. Typical examples of suggested research topics which have already been undertaken by the SMRI and which are ongoing include: cavern abandonment, high frequency cycling of gas storage caverns, and characterization of salt dome edges. New topics of interest for consideration by the Research Committee are provided in Ch. 2.3.

2.0 – Tentative “SMRI Research Plan”

2.1 Research Plan Objective

SMRI's ongoing research priorities are regularly reevaluated and updated to reflect the current research focus, taking into consideration the views and opinions expressed by the membership in Research Priorities Surveys. The Research Coordinator performs such updates under the supervision of the Research Committee and the SMRI Research Chairman. The major objective of this research plan is to reflect the current research interests of the SMRI membership provided at the Fall 2014 meeting in Groningen.

The objective of this SMRI Research Plan update is therefore twofold:

1. Identify those ongoing research efforts which need to be maintained/encouraged
2. Identify new research preferences, as reflected by the 2014 Research Priorities Survey.

2.2 Current research direction that needs to be maintained

As reflected in Figure 2, the respondents are clearly in favor of maintaining some SMRI ongoing research efforts including: (1) development of safe and reliable long term abandonment concepts for salt caverns, (2) investigating the effects of high frequency cycling in gas storage caverns, and (3) the use of salt storage caverns in the development of the renewable energy storage business. All three research topics have ongoing multi-year research contracts, and all three topics have RFPs which are still active.

As in previous surveys, “Gas quality” and “Gas metering” continue to receive the lowest scores of those topics identified. This signifies that new research proposals submitted in these fields should continue being considered, but should have a “lower priority level” for funding by the SMRI.

2.3 New research preferences (subject to Research Committee approval)

There appears to be three fields for which survey respondents expressed “special or renewed” interest for research efforts by the SMRI:

- (1) Develop a database or a comprehensive data analysis addressing past incidents in salt storage caverns
- (2) Promote improvements in the field of solution mining, for example, preferential leaching in salt domes, improving salt extraction ratios, horizontal leaching experiments in salt mines, and re-leaching of old caverns
- (3) Fund refinements of SMRI software (SALGAS for bedded salts, SUBSID with improved influence functions, TOOLBOX with additional functions).

The Research Committee will need to examine how best to define/finance/develop research efforts in these fields in response to the current research preferences of the SMRI membership.



Figure 1. Summary of 2014 Survey Respondents' Rating of SMRI Performance

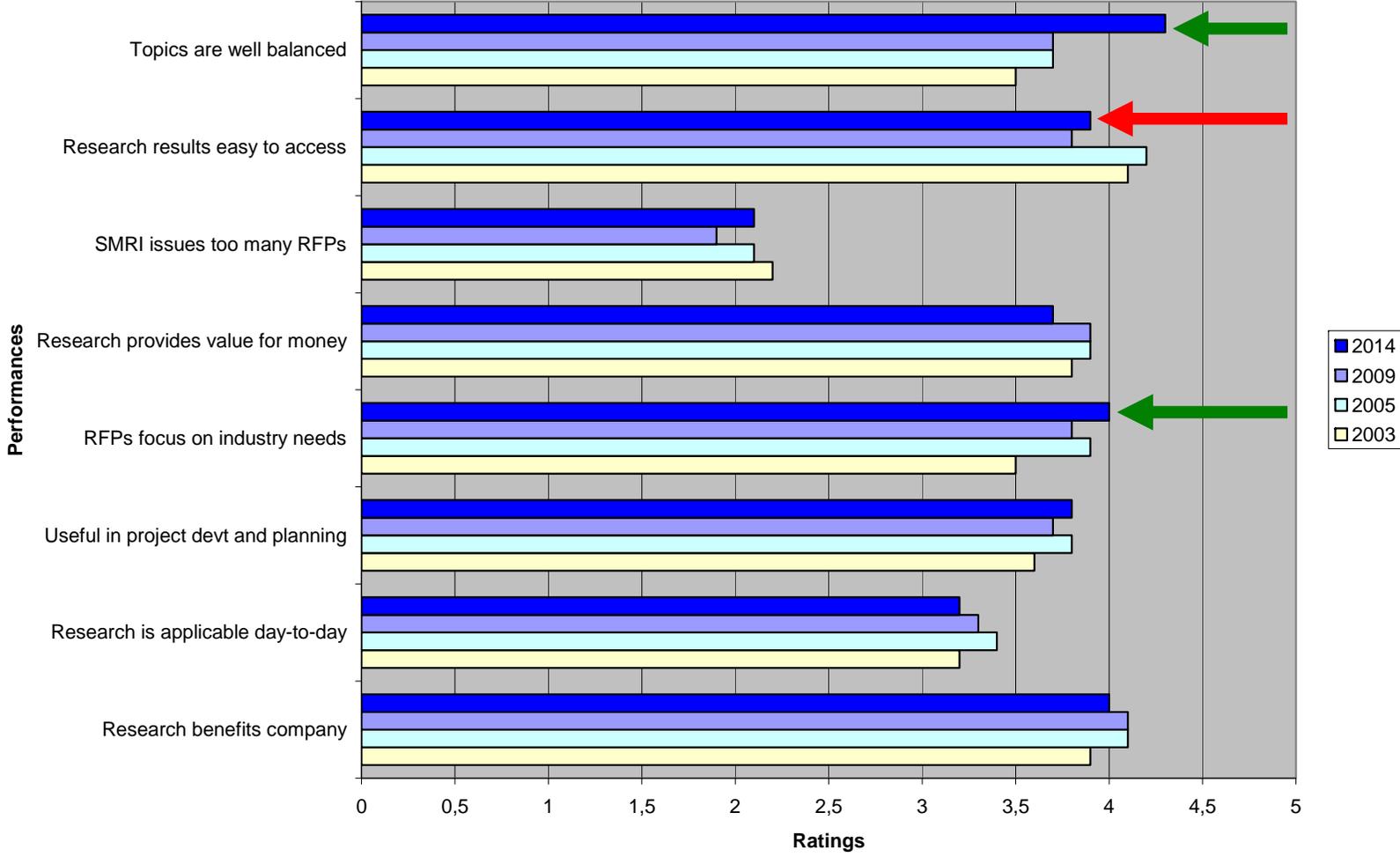


Figure 2. Summary of 2014 Survey Respondents' Ranking of Research Priorities

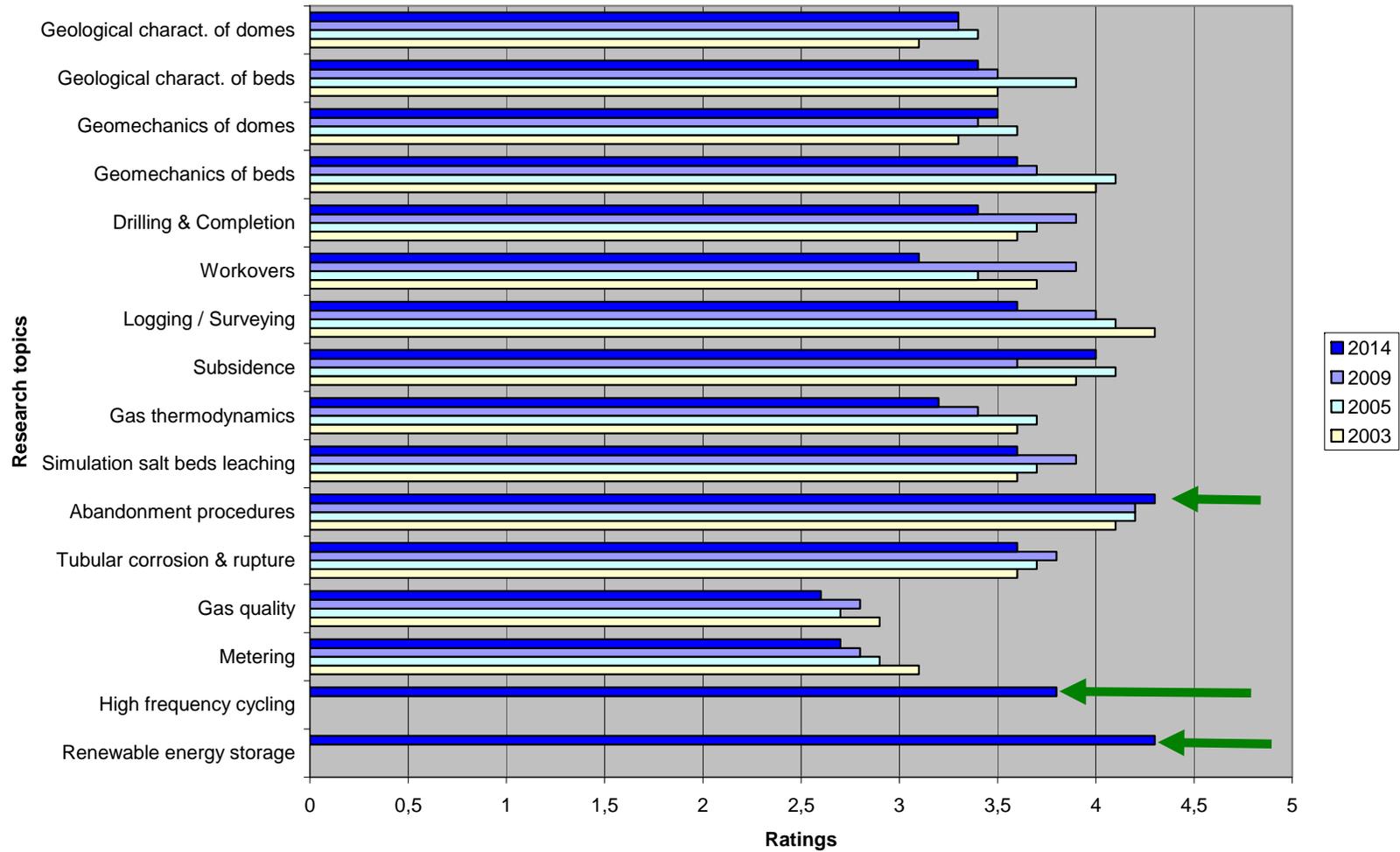


Table 1. Research Topics Suggested by Respondents to the 2014 SMRI Questionnaire

Topic Category	Suggested Topic
Logging	3-D seismic for salt caverns
	3-D cavern geometry
	Seismic and microseismicity (2x)
	Borehole seismic and radar
Salt Mechanics	Investigate stability issues related to old caverns (2x)
	Rock mechanical “wear” of storage caverns
	Investigate geomechanical issues related to bedded salt insolubles
Gas Storage	Investigate the negative effects of high frequency cycling of gas storage caverns
Cavern/Well Studies	Refine existing casing damage criteria
	Improve casing inspections methodologies
	Improve large diameter and directional drilling design
Standards	Develop an emergency plan for EU cavern operators
Safety and Risk Assessment	Perform a general analysis of gas completion incidents
	Develop an SMRI database of hydrocarbon cavern storage accidents
	Develop an SMRI database of salt cavern calamities
Site Characterization	Investigate issues related to overburden heterogeneity and anisotropy
	Improve salt dome characterization
	Investigate issues related to dome edge caverns
	Investigate issues related to internal salt structures
Practical	Investigate issues related to aging assets
	Refine SUBSID’s influence functions

Technologies	Refine the cavern abandonment concept in bedded salt formations
Solution Mining	Refine SALGAS for bedded salt
	Perform a market analysis of solution mining
	Synthesize existing horizontal leaching studies in mines
	Improve solution mining extraction ratios
	Investigate preferential leaching in salt domes
	Develop a model for “post-leaching” simulations