Overall Modern2020 Conference

Some preliminary conclusions based on draft documents & presentations

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Closing Session

11 April 2019

Rapporteurs view: an overall judgement

- Are objectives of Modern2020 met?
  - A short qualification of results: *new developments, more insight & experience, no fundamental changes, an important step forward towards implementation of HLW repositories*
  - Are expectations met? *yes, work performed according to proposals*
- Expected impact of Modern2020: potential usefulness for end users?
  - *methodology to develop monitoring programme (incl. plans for action if needed) available → 'it can be done' (but: program-specific work needed)*
  - *technology to perform monitoring*
    - *on the short term (already now): a useful monitoring can be implemented*
    - *the very extensive experience in URL's is a very useful indicator*
    - *on the long term, new technologies may become available: first for RD+D, later as qualified instruments → importance of qualification*
    - *that means: monitoring programme may change over the years, based on new insights and new technologies*
  - *involvement of stakeholders: take their views serious; be clear about what the foreseeable future decisions involve, and what role monitoring does play (as one of several elements of stakeholder interaction)*

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… due to the significant progress made in Modern2020 and good basis provided by the results of earlier activities

- Modern2020 was able to build upon …
  - work that started more than 30 years ago: guidance by international organisations, several cooperative projects & work of national programs
  - resulting in a broad understanding of the role of monitoring in repository implementation
  - with considerable practical experience with monitoring in several areas
- Modern2020 thus could focus on very specific areas (as identified in MoDeRn in 2013)
  - develop specific guidance on how to develop monitoring program and comparison with ideas in specific programmes (consolidate 'approach')
  - bring technology forward and develop understanding on what can be expected for the future
  - take advantage of experience from 'real scale' demonstrators & tests
  - clarify possibilities of early stakeholder involvement / interaction as essential element for successful repository implementation

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… to be applied by the end users of Modern2020

- The end users:
  - policy makers
  - implementers
  - regulators & their support organizations
  - other stakeholders
  - the broad scientific & engineering community
- … with an expected impact on …
  - the member states of the EU that have to manage wastes to be disposed of in geological repositories
  - the project partners of Modern2020
  - the affiliated project partners of Modern2020
  - the broad society in countries with disposal projects
  - the interested organisations worldwide, incl. science & technology
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- Comments on work packages 2, 3, and 4 by Frank Hanson – also using his experience in the US program as a benchmark
- Comments on work package 5 and its relation to the other work packages by Peter Simmons
- Some broad comments on all the work packages by Piet Zuidema

Broad comments on the
work packages of Modern2020 & their context
(taking also the presentations into account)

Broad judgement: Develop monitoring program (WP2)

Monitoring programme, monitoring strategies, role of monitoring in decision-making related to post-closure safety

'consensus' available & documented; some evolution, no revolution

- Documents provide guidance on how to develop monitoring program
  - sufficient system understanding is a pre-requisite to develop & implement program (incl. identification deviations & in-depth assessment of their meaning)
  - document is also useful for stakeholder interaction for (project-specific) 'face-to-face' discussions (to arrive at a transparent & understandable basis)
- Acknowledge that information to support evaluation of safety comes in parallel also from several other sources (e.g. RD+D program)
- Monitoring strategy influenced by repository concept & national context
  - identification of elements important for safety & their sensitivity e.g. to sensors
  - accessibility of locations for monitoring within repository system (e.g. affected by requirements for reversibility / retrievability)
  - nation-specific requirements by policy maker ('stakeholder view') & regulator
- Importance of monitoring for other (safety-related) aspects, e.g.: environment, safeguards & security, operational safety, readiness of equipment for intervention, …
- P.S.: make it upfront very clear which questions (by whom) you want to address with operational monitoring (in combination with other activities)

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Research & development of relevant monitoring technologies

better understanding of potential of new technologies; take advantage of experience elsewhere; importance of qualification procedure

- Proven technology for planned applications not yet available, due to:
  - harsh in situ conditions (all components)
  - limitations on accessibility & role of induced perturbations by installed equipment
    - maintenance, replacement, connections for energy & data transmission (if used)
    - in case of wireless sensors: power supply & storage, data transfer
    - acknowledge (potential) advantage of non-intrusive nature of geophysical tomography (with all its difficulties: calibration, interference between parameters)
  - duration of measurements without direct access: x 10 years, up to 100 years (or more?)
- But: promising technologies identified & worthwhile to adapt / further develop
- Qualification (→ process) of new developments essential
  - develop process that can be performed within reasonable time to qualify equipment as 'proven technology'
  - get agreement on process; goal: formal acceptance for regulatory purposes
- P.S.: insist on guidance on what is most important; preserve momentum

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Broad judgement: Practical experience (WP4)

Demonstrate practical implementation of monitoring programme

practical experience on what can be done & where current difficulties are → useful for everybody, most useful for those that did the work

- Comparison of performance of different sensors (role / importance of 'mix' of technology) → importance redundancy & diversity
- Experience with longevity of sensors and other technology, incl. better understanding of reasons for failure
- Role of heterogeneity of system and its impact on technology requirements (e.g.: role of 'linear' measurements like fibre optics)
- Practical experience with installation of equipment, collecting data, data management, evaluation of data & drawing conclusions

  P.S.: often more extensive instrumentation than for repository monitoring
- But: only of limited testing of new technology within Modern2020
- Remember - value of visual inspection (e.g. when dismantling test experiment) to better see the unexpected → WP2?
- P.S.: careful use of term 'monitoring' (monitoring, testing, demonstrator, …) and: make it clear that all of them have their role (→ WP2)

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Broad judgement: Stakeholder interaction (WP5)

Stakeholder engagement in relation to WP2, WP3 & WP4

More insights on importance to involve society early in monitoring in appropriate manner, including adequate explanatory material

- Remember - for long-lived waste (HLW): Safety by 'passive barriers only' after end of 'oversight'. Before: surveillance of repository with possibility to retrieve the waste as extreme end of actions (after careful evaluation)
- Recognise differences between countries (repository concept, legal requirements, social dynamics (trust, constructive mistrust, etc.): allow stakeholders (meetings?) to get broader perspective & understand differences
- Governance as driver for stakeholder interaction: policy maker (end user?) to define & implement overall process to ensure good partnership

  And, stakeholder interaction to be seen in wider context: although monitoring is very important for stakeholders, looking at it in isolation is not sufficient
- 'Learn to work together': process, language, behaviour (vigilance & humbleness), information flow (incl. role of social media), start early, …
- P.S.: importance of understandable documentation on monitoring (& other issues) for external stakeholders & future generations

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What next?

- Discuss your views as long as Modern2020 platform still active
- Some messages heard during conference (from WP3):
  - *'say what you want*!' (sensors (which parameters), wireless data transmission (how many data? how often?) to maintain momentum
  - *'continue to use infrastructure to test technology'* (and compare it other technology)
- Continue to share experience (with demonstrators, tests, etc.)
- … other?
- … and also acknowledge where future activities have to be done at national level

- P.S.: and think about formal action needed to make knowledge more easily accessible (also to policy maker)

Thank you …

- to the authors and speakers for your thoughtful ideas, presentations, posters and papers
- to the conference attendees for their lively participation
- the conference organizers for their excellent work
- to the Modern2020 project management, Executive Board and WP leaders for their skills and energy to make it happen
- to the scientists & engineers for their contributions to the WPs
- to the EC to provide the platform, parts of the funding and the support to make collaborative projects possible
- the other funding organisations (WMO's, …) for their support

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  - nation-specific requirements by policy maker ('stakeholder view') & regulator
- Importance of monitoring for other (safety-related) aspects, e.g.: environment, safeguards & security, operational safety, readiness of equipment for intervention, …
- P.S.: make it upfront very clear which questions (by whom) you want to address with operational monitoring (in combination with other activities)

Broad judgement: Develop new technologies (WP3)

Research & development of relevant monitoring technologies

better understanding of potential of new technologies; take advantage of experience elsewhere; importance of qualification procedure

- Proven technology for planned applications not yet available, due to:
  - harsh in situ conditions (all components)
  - limitations on accessibility & role of induced perturbations by installed equipment
    - maintenance, replacement, connections for energy & data transmission (if used)
    - in case of wireless sensors: power supply & storage, data transfer
    - acknowledge (potential) advantage of non-intrusive nature of geophysical tomography (with all its difficulties: calibration, interference between parameters)
  - duration of measurements without direct access: x 10 years, up to 100 years (or more?)
- but: promising technologies identified & worthwhile to adapt / further develop
- Qualification (→ process) of new developments essential
  - develop process that can be performed within reasonable time to qualify equipment as 'proven technology'
  - get agreement on process; goal: formal acceptance for regulatory purposes
- P.S.: insist on guidance on what is most important; preserve momentum

Broad judgement: Practical experience (WP4)

Demonstrate practical implementation of monitoring programme

practical experience on what can be done & where current difficulties are → useful for everybody, most useful for those that did the work

- Comparison of performance of different sensors (role / importance of 'mix' of technology) → importance redundancy & diversity
- Experience with longevity of sensors and other technology, incl. better understanding of reasons for failure
- Role of heterogeneity of system and its impact on technology requirements (e.g.: role of 'linear' measurements like fibre optics)
- Practical experience with installation of equipment, collecting data, data management, evaluation of data & drawing conclusions

  P.S.: often more extensive instrumentation than for repository monitoring
- But: only of limited testing of new technology within Modern2020
- Remember - value of visual inspection (e.g. when dismantling test experiment) to better see the unexpected → WP2?
- P.S.: careful use of term 'monitoring' (monitoring, testing, demonstrator, _ …) and: make it clear that all of them have their role (→ WP2)

Broad judgement: Stakeholder interaction (WP5)

Stakeholder engagement in relation to WP2, WP3 & WP4

More insights on importance to involve society early in monitoring in appropriate manner, including adequate explanatory material

- Remember - for long-lived waste (HLW): Safety by 'passive barriers only' after end of 'oversight'. Before: surveillance of repository with possibility to retrieve the waste as extreme end of actions (after careful evaluation)
- Recognise differences between countries (repository concept, legal requirements, social dynamics (trust, constructive mistrust, etc.): allow stakeholders (meetings?) to get broader perspective & understand differences
- Governance essential for stakeholder interaction: policy maker (end user?) to define & implement overall process to ensure good partnership

  And, stakeholder interaction to be seen in wider context: although monitoring is very important for stakeholders, looking at it in isolation is not sufficient
- 'Learn to work together': process, language, behaviour (vigilance & humbleness), information flow (incl. role of social media), start early, …
- P.S.: importance of understandable documentation on monitoring (& other issues) for external stakeholders & future generations