CO2 Capture Project
Storage, Monitoring & Verification Team
"Building the SMV Family of Technology Providers"

SMV Workshop Summary by
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Potsdam, Germany
October 30 - November 2, 2001

Organization of Report **Page**

1.0 Executive Summary

1.1 Background to Worskhop

The workshop was organized primarily by the CO2 Capture Project's Sequestration, Monitoring and Verification (SMV) team leader, Craig Lewis of ChevronTexaco. Invited attendees included the SMV Team reps and we had 100% attendance from the SMV Team's 29 Technology Providers (TPs) contracted to work on the project.

Additionally, a number of non-CCP funded organisations working on related SMV areas were also invited to take part. Examples include Weyburn, SACS, GEODISC, GEOSEQ, NASCENT, etc. The objectives of the workshop were:

- **For the SMV to inform participants** on the status of the CCP in general, and information about the SMV Team and its vision for "The Way Forward".
- **For participants to share with others** work plans for the contracted work
- **To establish an open dialogue** where the technology challenges and issues of geologic storage can be discussed.
- **To explore opportunities to communicate and collaborate in the future.**

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The workshop was physically hosted by Dr. Gunter Borm of the Potsdam GeoForschungZentrum, one of the SMV Technology Providers.

1.2 Results of SMV Workshop

Many of the TPs funded by the SMV Team are working in similar or related areas. For example, there are several TPs working to develop HES (health, environment and safety) Risk Assessment Methodology and Tools. The SMV Team sees great value in encouraging teamwork, sharing, collaboration and leveraging the work across the TPs. Because this was the first CCP SMV Workshop

of its kind, the SMV Team did not have extensive expectations for tangible results from this workshop; in fact most of the TPs did not have executed contracts at the time to proceed with the work. However, some important tangible findings and results did come from the workshop as follows:

- There are a number of R&D organizations working on HES risk assessment methodologies, and use the FEPs Process (features, events and processes).
- It was recommended that CCP's SMV Team participate in a FEPs workshop planned for Rome in January, 2002. (Note: This actually occurred in May 2002 in Nottingham, England.).
- The SMV R&D portfolio was conspicuously missing work in the area of Leveraging Natural Gas Storage Lessons Learned. Some of this was captured in Sally Benson's (LBNL) HES Lit Search and Synthesis.
- It was felt that the portfolio could benefit by beefing up the work on long-term integrity of tubulars and cements.
- The SMV Team announced it would entertain new proposals involving Natural Gas Storage, and Long-Term Integrity of tubulars and cements.

There were also a number of significant intangible that came out of the workshop as follows:

- The entire first day was filled with excellent presentations from the 29 TPs as well as related non-CCP R&D organizations. Many commented on learning a lot from this excellent sharing process.
- Most of the TPs seemed quite keen on collaboration, particularly where they are working on related work. In fact, many PIs could be observed sharing contact information, planning meetings, collaborating in the hallways, etc.
- Most attendees were really impressed with the sharing, and the excitement about collaborating together.

1.3 Next Steps

- We will have a similar Workshop No. 2 to review the work completed over the past year, share lessons learned from collaboration, etc. This is planned for October 21-22, 2002, and the location is tentatively planned for Denver, Colorado, USA.
- The final Workshop No. 3 is anticipated to occur in 4Q 2003.
- Finally in late 2003, SMV Team intends to engage a professional editor to integrate the final reports from the 29 TPs, and to develop different version for different audiences (e.g. one for the technical community, one for public consumption, etc.)

2.0 Workshop Organization & Process

The workshop began with presentations providing an overview of the Carbon Capture Project (CCP) and SMV project. Day one (October 31) consisted of "blocks" of presentations from Technology Providers (TPs) on related research areas. The groupings of presentations for each block were as follows:

- HES Risk Assessment Methodology
- Sequestration Analogues & Characterization
- Reservoir Properties & Processes
- Monitoring & Verification

After each of the presentations for each block was completed, the participants at each round table had a breakout session to list comments and issues. This feedback is contained in the Appendix, in Section 4.1.

On Day 2 (November 1), there were several facilitated breakout sessions to brainstorm the following areas:

- Performance Requirements
- Monitoring & Verification
- Public Communications with Governments & Public
- Cross-Cutting Issues
- Demonstration Projects
- SMV Team Technology Integration

In these breakout-group sessions, participants identified issues, did some prioritization, identified gaps, overlaps, common ground and recommendations for action relating to that area of work. Feedback from these 6 breakout sessions can be found in the following Section 3.0.

Day 3 (November 2) consisted of parallel workshop sessions which aimed to identify issues to be considered in the way forward and make recommendations for action. The workshop ended with thanks from SMV and feedback from participants. Before leaving participants filled in an evaluation form.

The following notes are a direct transcription of points made by participants that were recorded onto flipcharts during the three days.

3.0 Technical Feedback from Day 2 Breakout Group Sessions

This Section 3.0 contains the raw comments, prioritization of ideas, gaps & overlaps, and suggestions from 6 breakout sessions for the following topical areas:

3.1 Performance Requirements
3.2 Monitoring & Verification
3.3 Communications with Governments & the Public
3.4 Demonstration Projects
3.5 Cross-Cutting Issues
3.6 SMV Technology Integration

3.1 Performance Requirements: leakage from reservoirs, surface and wells workshop (facilitated by Sally Benson)

The aim of this workshop was to look at
1. selecting sequestration sites
2. requirements for HSE risk assessment
3. developing a regulatory framework
4. setting monitoring targets

and to identify:
- what are the issues
- what are the R&D needs
- recommendations for action?

Feedback from Days 1-2 relevant to performance – and result of prioritisation

Issue	***Dots***
Caprock deformation – how important is it? Funding?	
Medium term predictiveness for geomechanics	***3Ω***

Co-ordinate caprock integrity work	*1*
Reactive transport issues	*1*
Cores from exploration wells	
Evaluate technology to bottom hole survey of physical properties	*1*
Confidence about monitoring and reservoir simulations	*2Ω*
Bore stability and completion technique definition	***5Ω***
Management of unconsolidated samples	
Model big changes in pressure	
Operational evidence for dissolution of rocks	
Link between lab results, analogues and simulation	*1*
Intermediate term data on reaction kinetics	*2Ω*
Effect of numerical dispersion and upscaling	*1*
Lack of samples for verification	
Info on gas reservoirs	
Info on caprock properties	*1*
Geomechanics of reservoirs	*1*
FEP common database	*2Ω*
1,000 year limit is arbitrary	
Risk to investment	
Common methodology to assess probabilities and certainties	***4Ω***
Difference between onshore and offshore physics and impacts	
Site by site dependence	
Learning from nuclear waste	
Split work into impact, methodology and probability	
Matrix for HSE risk assessment	
Case histories	
Use FEP workshop to co-ordinate work	*1*
Probabilistic conversion of deterministic models	
Identify FEPs for each analogue	
IFP work not related to others	
Soil sample analysis	
NASCENT project data	
Tie Utah data to effect on local environment and simulate it	
How much CO2 is dissolved in water and in mineralisation?	*2Ω*
Ball park figures for leakage rates	*Ω*
Remedial action after leakage	
Linking cause and effect	

Performance requirements

- Communication plan (P+5)
- Vision
- Leakage – small
- Size – big enough?
- Economic
- Injectivity
- Capability to monitor
- Resources (e.g. oil and gas)
- Surface deformation

Leakage has to be small – safety issues and climate issues
Leakage requirements driven by risk – insignificant but not = 0.0

- Other risks – Groundwater
- Performance based
  - Leakage levels
  - Pressures
  - Well abandonments
- Plume – move? Migration = leakage?
- Aquifer – do we need to know where it will go?
- Limits of exposure at surface
- How long – delays unacceptable?
- Catastrophic failure (how, why, mitigation)…Show how you can manage it
- Aquifer or reservoir
- "Probabilistically permanent"

1. Selecting Site

- Quantifiable leakage
- Traps that are effective
- Use regulations for natural gas, storage, waster disposal and produced waters
- Presence of population – possible damage to movement
- Presence of oil, gas etc – endanger resource recovery
- Assess caprock quality, pressures, reactivity (degradation over time)

2. Risk Assessment

- Movement in and out of storage container
- Quantitative – were to get probabilities
- Consistent set of FEPs – area oaf co-operation with other groups
- Hazards – what could happen, event risk, probability of occurrence, include money
- Liability
- Scenario planning especially for catastrophes with mitigation methods
- What is safe enough

Regulatory framework

- H_2S regs as analogue. Need geological models, flow simulation
- Leakage guidelines
- Monitoring guidelines
- Performance based criteria e.g. coalbed seal not so important
- Prescriptive – operational procedures and best practices
- Well programmes, D&A, monitoring etc – advantage to drilling early wells
- Baseline studies: pilot programmes
- Ownership, responsibility, timeframe

Monitoring requirements

- Monitor aquifers
- Prove CO2 is where you predict it will be
- Tracer needed for Co2 (?) Whose CO2 is it?

R & D needs

- Long terms forecasts $\prod$ flow, reactions $\prod$ experimental

- Geological, geochemical and hydrodynamic understanding
- Risk criteria – define and quantify
- Seal capacity of faults and caprock
- Geochemical understanding of caprocks
- Old wells
- Understanding, modelling chemical reactions
-]behaviour of systems on 1000 yr. system
- worst case scenarios esp. from 316 leaks
- develop cheap indirect methods for monitoring
- long terms integrity of abandoned wells
- understand and quantify what we do today

Plenary feedback comments

- Oil industry has experience of working with waste and regulators – what lessons?
- Properties of seal will lead to leakage rates. Will be different for different storage sites. Need to define parameters for each type
- Actions?
  - FEPS
  - Criteria for acceptable risk (use natural analogues)
- Work needed to define worst case scenarios
- at Mammoth lake people live with CO2 all the time
- Flow rate and cartography interaction is important – not just flow rate
- Timeframes: how long should it be monitored? (No conclusions)

3.2 Monitoring & Verification Workshop (facilitated by Mike Hoversten)

The aim of this workshop was to
- Explore issues and tools available for each different storage type or site
- Recommend approaches for monitoring

Feedback from Days 1-2 relevant to monitoring – and result of prioritisation

Issue	***Dots***
Involve service companies – new and innovative techniques for monitoring	
Linking cause and effect	*3*
Implications of monitoring	*2*
Pipelines	
Ability to pick up small leakage	*2*
Help regulators with regulation	*2*
Tie monitoring to process and risk assessment and then define monitoring goals	***6***
Limited offshore capability	
Using FACE to test equipment	
Migration of CO2 in subsoil	
Knowledge about CO2 addition in seismic field	
Soil sample analysis	
Co-ordinate monitoring and modelling groups	***6***

Reasons for monitoring (what, why, when)

- For performance in early stages (capacity, location, leakage, chemical reaction)
- Long term integrity

- Migration of CO2
- Improve prediction tools
- Management assurance (public acceptance, economic viability, operational effectiveness, meeting regulatory requirements, mass balance, self-assurance that technically sound)

Types of sites

1. Onshore
- oil reservoirs
- gas reservoirs
- brine filled aquifers
- coal beds

2. Offshore
- oil reservoirs
- gas reservoirs
- brine filled aquifers

3. Natural analogues

Performance Verification

Recommendation: have a test case with
- 4D seismic
- monitoring wells – chemical sampling
- flow simulation models
- surface sampling
- remote sensing (incl. Botanical response and surface defamation)

In industrial application have:
- 4D seismic
- remote sensing
- slim hole above seal (targeting based on flow and transport modelling)

Risk

- formation leakage
  - remote sensing (botanical degradation)
  - surface Co2 detectors
  - 4D seismic
  - slimhole
- well leakage
  - sampling
  - remote sensing

Conclusions
1. Relative cost of repeat seismic is low enough that it makes other geophysics questionable unless a specific non-seismic capability is demonstrated
2. Run remote sensing (botanical degradation and surface defamation) on existing EOR sites (Sleipener)
3. Choice of monitoring is site specific, cost dependent and regulator controlled
4. Cannot recommend approaches until we have the results of some of the CCP research
5. Need more time to address these issues

New points

1. Horizontal wells above seal would be good for monitoring leakage
2. Place surface sensors (CO2 detectors) on initial projects

Plenary feedback comments

- May be underestimating costs of remote sensing – there are different types and varying associated costs
- Should aim to have a permanent monitoring well in at least one test case
- What about using micro-seismics? – Only used where cracking rock. Ekofisk and Gaz de France use it.
- Need to identify uncertainties that can be closed down
- Target monitoring to greatest areas of uncertainty
- Self-potential technique
- Streaming potential
- Q. Will monitoring methods be able to measure CO2 saturation? A - there are some possible ways)
- What is the minimum CO2 saturation that can be detected seismically?

3.3 Communications with Governments and the Public (facilitated by John Gale, IEA)

The aim of this workshop was to identify

- relevant issues and focus
- the best approaches to get public acceptance
- recommendations for action

Feedback from Days 1-2 relevant to communication with the public – and comments

Issue	***Comments***
Bore stability and completion technique definition	*To be covered by other groups*
Management of unconsolidated samples	*Not relevant to this group*
pipelines and operational issues	*To be covered by other groups*
Positive aspects of impacts	*Communication strategy issue*
Separation and capture issues	*Not certain of relevance*
Leverage 3rd party experience in engaging public and NGOs	*Communication strategy issue*
Use natural analogues	*Tactical issue*
Using nuclear waste learning without being associated with it	*Need to distance CO_2 industry from nuclear*
Case histories	*Communication strategy issue*
Risks/rewards of involving NGOs	*Tactical issue*
FEP lists to public	*Dialogue required when lists developed*
Building research info	*Not relevant to this*

	group
Helping regulators form regulation	*Industry/regulatory dialogue required not dissemination issue*

First issue considered - What are we communicating about?

1 CCP SMV activities
2 CO2 sequestration policy in general
3 Energy policy in general

Decided to concentrate discussion on what needs to be communicated by CCP SMV team.

Second issue considered - Who are the stakeholders that we would want to communicate with.

Stakeholders include:

1 Public

Local	**Regional/National**	**International**
Demonstration site residents Individual rights holders Local technical people can act as influencers	Media - can exert high influence on public opinion	
ENGO's can influence local/regional, national & international public opinion		

2. NGOs

Local	**Reg./Nat**	**Int.**
Represent Local interest (RSPB, native orgs)	NGO (NRDC) Courts	International (Greenpeace/WWF). Public opinion

3. Government

Local	**Regional/National**	**International**
Local Councils	Regulators Res. Managers (DoE) (Funders) Policy Makers ∑independent experts (NAS, Royal Society)	EC, IEA/OECD, UN

4. Commercial

Local	**Regional/National**	**International**
	Reservoir rights holders (Business) ∑operators ∑royalty rights holders Sector lobbyists ∑Educational	

	∑political ∑ENGO	
Professional organisations can influence all regions		

Summary points agreed:

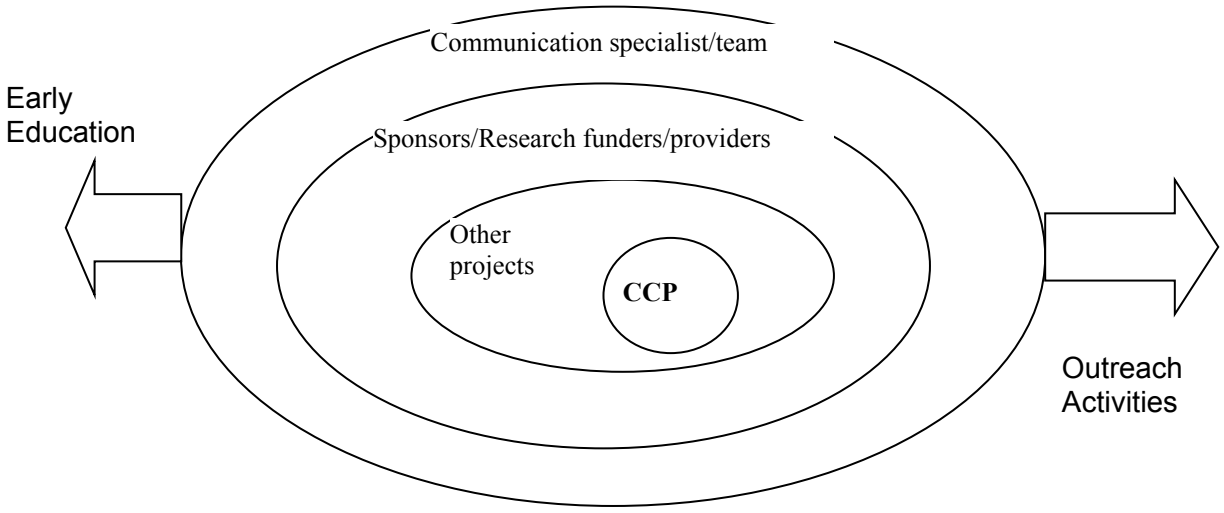
1. Take technology forward by communications
2. Central communications policy needed
3. Educational Programme
   - non-technical – lay people schools etc as early activity

Conclusions

1. Important topic – need to begin communication activities ASAP
2. When communicating there is a need to be focussed and do it well
3. Myriad of communication routes – local/ regional/international - important to recognise that each one has a different focus/need and method of communicating must be different
4. To move beyond our peers (technical community) engage communication specialists - CCP has communication team but CCP will be perceived as industry lobby group and communication via external independent experts could be considered.
5. In any strategy it will be important to focus on positive images
   - demonstration plants are good
   - analogues
6. Oil lobby/NGOs
   - Openness/behave responsibly
   - Scientific underpinning

Recommendations

1. CCP should not carry the whole CO_2 sequestratioin message alone
2. CCP to consider developing detailed communication strategy involving communication specialists – see diagram.
3. Education programme for scholls/colleges/universities should be considered as a high priority to develop knowledge base at public level.



Plenary feedback comments

- If communication is not right the whole project will not work
- Common language needed? May need to avoid certain words like waste?
- CO_2 can be a valuable commodity – issue of definition as waste vs by-product
- CCP needs to be documenting best practice – convince ourselves we are doing a good job
- Communicate to others like regulators
- Make sure messages from CCP not seen as lobbying
- CCP just one body that needs to communicate
- Technology needs to feed into policy
- Technology needs to be developed first
- Early education: broader points need to be communicated – e.g. renewables won't be the sole solution
- Public may not wait for us to come to conclusions. Already had media interest. CCP could say broadly what is being done
- Once research contracts are signed with universities etc it will be in the public domain
- CCP funded researchers need support in responding to media
- Information on projects will need to be explained to the public.
- Minds need to be kept open on CO_2 sequestration
- For credibility it is important not to oversell the benefits/the positive advantages

3.4 Demonstration Projects (facilitated by Andy Rigg)

- The aim of this workshop was to identify how to achieve integration/cooperation between CCP/SMV work and related non CCP funded activity.

Feedback from Days 1-2 relevant to this Workshop – and results of prioritisation

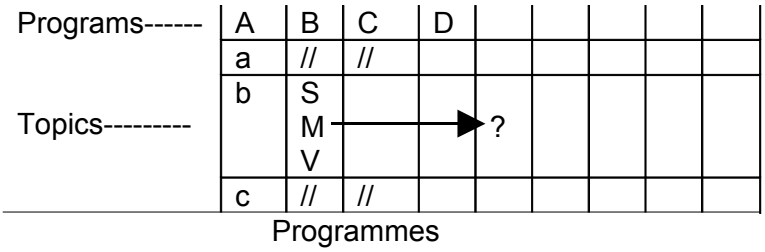
Issue	***No of dots***
Difference between institutes re pressure effects	
NASCENT/Weyburn etc could share cores	*2*
Co-ordinate with GESTCO gas fields work	*2*
Focus is too much on US reservoirs	
Checklist- sharing who is doing what, when	*1*
External projects: geochemistry, GEEODISC, geomechanics	*1*
Reservoir data needs to be more widely disseminated	
Gap in info on caprock properties	
The approach is numerical; need for experimental testing	
Confidentially issues	
Lessons learnt in Europe are globally needed too	*1*
How to manage world-wide integration (inc. funders)	*1*
External co-ordination needed with other parts of CCP	*Top line*
Need to work together re work scale and delivery timetables	
Need a network for all Technology Providers	*1*
FEP workshop should include abandonment assessment	
Need field trials for technologies (with funding and support)	*2*
Combine different remote sensing techniques (monitoring and verification)	
Get building research info (Erik)	*1*
Gap re pipeline monitoring	
Radioactive waste work has info on cement effects	***3***
Old statues could be used to provide info on atmospheric effects	***3***

CO_2 - brine system in relation to corrosion needs looking at	
Need probability based studies	
Gap re short term monitoring methods (link to new technologies)	
Find out what others (non CCP) are doing about monitoring	*1*
Use Weyburn pipeline as test for corrosion also Norwegian work	*2*
Get lists of CCP and non CCP funded projects	*1*
Corrosion and cement areas…get as much info as possible from non CCP projects	*3*
Involve service companies – do they have new/innovative techniques?	***3***

Website-to provide foundation for External Integration

- Access to range of programmes – design a layered matrix with links (see next section for layout)
  - Overview box for each programme – one line description plus contacts and timescale
  - Layers of specificity; each topic box to include contact to primary researcher
- Independent host and manager (e.g. IEA suggested-A Rigg to work with J Gale)
- Measure website activity to test usefulness of site
- Openness? Formal or informal? But needs to be read-only.

Virtual "centres of excellence" to emerge from website



- Centralised information enables exchange of info, problem solving
- Allows each researcher to see what others are doing
- Collaborative Model: GEO-SEQ participation by open invitation
- Initially populate with SMV type-projects ie SMV, GEODISC, Weyburn, SACS, GEOSEQ, GESTCO etc
- May later extend to Capture and Separation

Integration

- Ensure linkages are established and continue
- Recognise the existence of common funders between projects
-
- Demonstrate benefits of co-operation
- Look at more regular meetings?
  - Non-technical mtg.
  - All stakeholders?
  - Common/non-common sponsors?
  - Small meetings
    - Strategic level e.g. SMV/Weyburn/DOE?
    - And at higher level
  - Technical level integration

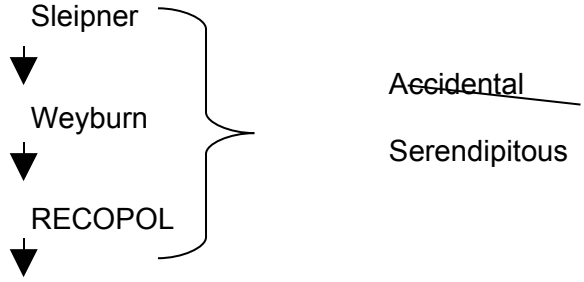
        - Success dependent on extensive dissemination, beneficial trades
        - Exchange agreements?
        - Literature surveys
        - Findings
    - Funders to be more involved in mtgs?
    - At higher level – project head with project head, national rep. with national rep.
- Look to share 'open file ' and published information
- Set up win/win scenarios
- Recognises that our set of problems that need joint solutions

Types of "Out of the Box" Questions

- Can someone help? -Go to website contacts
- Possibilities-go to website contacts
- How do we know what we don't know?
- Where is the elegance?
- What can cement tell us?
- How do you get out of the box?
- Advertise for radical ideas
- Synergies

Demonstration projects

- Recognition that types and timing of demonstration projects to date have been serendipitous



- Next ones should be? -more structured
    - Create a portfolio of projects
    - feasibility under different conditions/risks etc
    - (links to web idea)
    - selected using expertise from EOR companies systems/operational/modelling etc

Plenary feedback comments

- Oil companies are represented in SMV – they should consult more with their EOR people
- EOR people in companies are different to CCP representatives although some overlap
- Support in principle to "mine" the EOR business particularly for well abandonment, corrosion, monitoring experience
- Differentiate SMV from other areas within CCP because there will be fewer constraints of intellectual property rights, confidentiality etc. Therefore SMV can be more open
- Very important to integrate and share with existing projects – get better value and get results sooner, win-win

3.5 Cross-Cutting Issues Workshop (facilitated by Tony Espie)

The aim of this workshop was to address issues which had emerged as important during days 1-2 but which were not covered by another workshop. These were:

- Modelling
- Real world versus simulation
- Others including bugs/biodiversity and co-ordination of reservoir selection

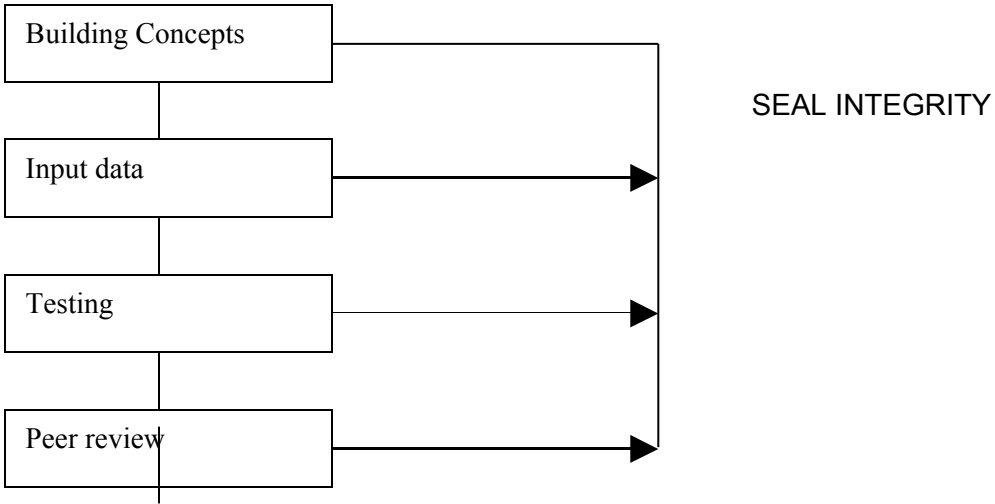
The aim was to identify

- What CCP needs to do about these issues
- recommendations for action

Feedback from Days 1-2 relevant to Cross-Cutting Issues – and result of prioritisation

Issue	***Dots***
Funds to develop monitoring technology outside an area of expertise – biotech/nanotech	*X*
Info from NASCENT project	*2*
Utah data on effect on local environment – use it for simulation	*2*
Performance and monitoring on natural analogue sites	
Include CO2 producing facilities in populated European areas	
Benchmark of existing software for modelling	*1*
Link between lab results, natural analogues and simulation results	*2*
Intermediate term data on reaction kinetics	
MMP studies missing Nox	
Impact of reactive components on MMP production	
Benchmarking software	*1*
Modelling workshop	*1*
Confidence about simulation and modelling work	
Equation of state	
Co-ordinate reactive transport	
Simulation of natural analogues	*2*
Cores from exploration wells	
Co-ordinate modelling/monitoring groups	
Use IEA website to draw info together	
Models for near-miscibility	
Challenge assumption that we are confident about short/long term effects	

Work Flow



Prediction

Interactions

Capture teams
- compositions
- rates data for modelling
- lab, natural analogues

Need
Boundary conditions for modelling
CCP | specific scenario modellers | specify need

Needs

Key issue is linkage between data sources and modellers
- specific scenarios
- contact points

Key system point is seal
- data on mechanical integrity
- geomechanics modelling
- gas storage experience

HSE assessment must consider full system

EOS for reactive systems

FEP database

Need to identify stakeholders in peer review process

Plenary feedback comments

- Will there be international standards on leakage? ∑ as technology matures, likely that standards will converge
  ∑ likely to be into next century before global standards exist
  ∑ will regionalise first
- Permanence issue
  ∑ work that could link into CCP
- Link to Kyoto in same ways
- Info on shales – seismic but also drilling and fractures

3.6 Internal SMV Integration Workshop (facilitated by Craig Lewis)

The aim of this workshop was to look at how to achieve integration between the activities of the TPs within the SMV project and propose recommendations for action.

Feedback from Days 1-2 relevant to this Breakout Group

Issue	***Comments and Dots (in brackets)***
RA – not dealing solely with CO2 – other gases	***Gap***

and contaminants	*Easy – tell them to include in analysis*
RA – methodology overlap – *is it beneficial,* – *how to manage it,* – *cost benefits*	*(11)* ***Integration*** *(now or later)* *TNO, Idaho, Berkely, Stenhouse, AEAT **FEP** NASCENT Quintessa support…concern about competition *Cons terminology, methodology* *RA workshop*
RA – what are the overall objectives?	***Integration*** *Issue to consider* *To get one!* *Divergent | converge* *RPs/methodology later* *Issue to engage*
RA – confidentiality	***Integration*** *External* *Encourage them to share* *Issues – SMV permission* *"mine is better than yours"*
RA – don't integrate too much at the beginning	*Comment*
RA – workshop/delivery timetables need to work together	*(1`)*
Treat gas storage at same level as natural gas analogues for CCP	***Gap*** *ENI*
Circulate email contacts *Website to share experience* *Workplace on the net*	*Quickplace* *IEA website* *CCP website*
RA - Projects seem ambitious	*True*
Sequestration (S) – unclear objectives	*Future*
S – IFP work is not related to others	*Basin modelling*
S - Analogues should be modelled	*(7)* ***Integration*** *They are motivated – make two lists* *Encourage and support* *GFZ to tie to lab work*
S- How do we gneralise from site specific results	*(1)* *See above*
S - What are the deliverables? *– link to objectives*	*Biorn pres. not clear on deliverables*
S- include geothermal and extensive litteratur survey	*Gap*
IFP and SACS project overlap with sequestration work	
Improve cooperation between New Mexico and ARI	*(2)* ***Integration*** *Quick kill* *May be others*

	Internal *EOR – CO2 analogue*
NASCENT project info	*(2)* ***Integration*** *External* *If NASCENT is lead*
Get more data from natural analogues	***Gap*** *NASCENT*
Tie Utah data to effect on local environment and simulate it	***Gap***
Minerology change – CO2 samples from EOR/caprock	*Link to analogues and simulation* Refinement – Action Luca
Confidentiality	
Select most relevant data from analogue studies	*Too broad – comment*
Also need analogues for leaky reservoirs	***Gap*** Not much to do 1 – broad range of options 2 – picked up by NASCENT
Funds to develop innovative technologies – eg biotech or nanotech	*New idea*
Monitoring pipelines – well bores, intelligent wells	***Gap*** *Broadening* *Reinertson refinement* *See below *****
Evaluate cement integrity	***Gap*** *May need expansion* *SINTEF*
CO2 brine system in relation to corrosion	***Gap***
Probability based studies in corrosion areas	*Comment* *Too deterministic*
Statistics on abandoned wells are insufficient	*(1)* ***Gap***
Learn from corrosion in geothermal plants	***Gap***
Fibreoptic technology in intelligent wells	*See above **
Chemical industry analogues for corrosion	*Covered*
Info from pre-computer times	***Historical gap***
Service companies – do they have new or innovative monitoring techniques	*Good Idea!* *Charles – Baker* *Craig – Schlumberger, Halliburton* *Cement integrity, intelligent wells*
Use solutions from west Texas CO2 EOR project	*Case study – good idea! – Jeff*
Combine different remote sensing techniques	*(2)* ***Integration*** *Geophysics* *Doing it now!* *Let us know if good ideas!*
Radioactive waste work has info on cement effects	*Lindeberg* *Refinement*
Old statues could provide info abot amospheric effects	*Lindeberg* *Refinement*

Gaps - action

1. Natural gas storage
   - go out for proposals
   - ENI – collect data and analyse for new project
   - P>Pi – Sergnano field , Italy onshore

2. West Texas EOR new project
   - Jeff to see status

3. Service Companies monitoring
   - Charles – Baker**
   - Craig – Schlum., Halliburn**

4. Cement integrity
   - SMV will consider expansion
   - As 3 above**

5. Leverage geothermal analogues
   - SMV to consider soliciting proposals

6. Link Utah state to simulations
   - SMV supports concept

1. Natural gas reservoirs
   - Limited – need demonstration

Integration – actions

- Support CCP involvement in FEP workshop
- Encourage consistent methodology and terminology
- Some SMV concern about potential competition
- Suggest FEP workshop in January could be part of broader RA workshop
- Diverse approaches near term objective – single consensus on methodology later
- Provide SMV permission , encourage to share

Plenary feedback comments

- depleted dry gas fields still not covered
  - underrepresented – natural gas fields
  - bring idea to demonstration (dry gas field)
- In NL there is a plan to have a dry gas field demonstration soon
- Caprock problems and reservoir issues will be similar
- Gas reservoirs are an important resource for capacity – they get nearly depleted – what effect on caprock?
- Injecting acid gas into reservoirs in Alberta
- If there are early successes it will be good for public acceptance -gas reservoirs are likely to produce early successes
- Focus on geochemical variation induced in caprock
- Good idea to co-ordinate risk assessment – how? Suggestion of a workshop…CCP to talk with Nick Riley about combining risk assessment workshop with FEP workshop

4.0 Appendix

4.1 Breakout Session Feedback

This Section 4.1 contains the raw feedback from the breakout sessions on Day 1 following the technical presentations for each one of the SMV Technology Providers.

4.1.1 HSE Risk assessment Technology Development – Breakout Feedback

Feedback Comments	**Gaps/overlaps/ commonground/ actions**
Not dealing solely with Co2 – other gases, contaminants	***Gaps***
Lack of common database	
1,000 year limit is arbitrary – it contains dialogue – how long is long enough?	
Risk to investment	
Common methodology to asses probabilities and certainties	
The approach is numerical – need experimental testing	
Confidentiality issues	
Communicating to the public	
Risk assessment – look at 'non-healthy' humans	
Bench mark existing modelling software	
Pipelines and operational issues	
Difference between onshore and offshore physics and impacts	
Look at positive aspects of impacts	
Look at lessons learnt in Europe/globally	
Separation and capture in operational and pipeline issues	
Site by site dependence	
Broaden beyond nuclear analogues to natural analogues	
Absence of integration here	
How to use nuclear waste experience…learning from it without being associated with it	
Difference between onshore and offshore physics and impacts	
Value in collaboration - corroborates outcomes - manage balances	
Matrix for HSE risk assessment – where are we going	
Case histories	
Common FEP databases	
World-wide integration – how to mange this e.g. funders are often the same	
Use facilitation and process management (professional decisioneers) to integrate	
Include shallow gas from north sea analogues	
Need overall objectives	
Methodology…do you want overlap - is it beneficial - how to manage - what cost benefits?	***Overlaps***
Split the work into three areas: - impact - methodology	

- probability	
External co-ordination with other parts of CCP	
Radon landfill gas, coalmines, methane…share work	***Common ground***
Don't integrate too much at the beginning	
workshop/delivery timetables need to work together	
Probabilistic conversion of deterministic models	
Use FEP workshop in January to co-ordinate	
Treat gas storage at same level as natural analogues for CCP	***Actions***
Compile master list of FEPs – separate from risk process	
Urgently need common data set for FEP parameters	
Circulate email contacts	
Need practical guidelines for all operations	
Website needed for looking at /sharing expertise (whole CCP)	
Workplace on the net	
Network for al TPs	
Caution – who would answer questions on the net? No-one yet	***Other comments***
Projects seem ambitious	
Be open minded	
Pass FEP list to general public etc – what do others think	
Need to consider risk/reward of including NGOs in this work	

4.1.2 Sequestration Analogs and Characterization - Breakout Feedback

Feedback Comments	**Gaps/overlaps/ Commonground/ Actions**
Unclear about objectives for this group	***Gaps***
Identify FEPs for each analogue	
IFP work not related to others	
Why seals are sealed or not?	
Tie this to work on natural analogues - which simulations specifically?	
Analogues should be modelled	***Action***
No performance and monitoring around these sites (natural analogue)	***Gaps***
Include natural analogues and CO2 producing facilities in populated European areas	
Natural analogues are unlikely first choice for injection	
Soil sample analysis	
How do we generalise from site specific results	
What are the deliverables? – link to objectives	
Include geothermal and extensive literature survey	
Info on total organic content in waters (Utah State)	
Influence of microbiology processes?	
Influence on microclimate?	
Influence on biodiversity	
Effect on microbiology in the 'store'	
IFP and SACS project overlap with sequestration work	***Overlaps***
Improve co-operation between New Mexico and ARI	***Actions***
NASCENT project addresses some of the info gaps	
Look in more detail at one of the fields (natural analogues or EOR) Get more data	
Tie Utah data to effect on local environment and simulate it	
Mineralogy change – chance of getting CO2 samples from EOR/caprock	

before/after (30-40 years after)	
Will be access to conclusions of other studies	
Loo at whole infrastructure in oilfields not just subsurface	
Is there something to learn from the discovery process of CO2 domes? (looking for gas)	
Scan all analogue studies to select most relevant data	
need analogues for leaky reservoirs in the study	

4.1.3 Reservoir Properties & Processes - Breakout Feedback

Feedback Comments	**Gaps/overlaps/ Commonground/ Actions**
Is there any operational evidence for dissolution of rocks in the field? (No evidence for it yet)	***Gaps***
Link between lab results, natural analogues and simulation results	
Intermediate term data on reaction kinetics	
Effect of numerical dispersion and upscaling	
Lack of samples for verification	
Gas reservoirs underrepresented – bring in Berkeley labs	
MMP studies missing Nox	
Reservoir data needs to be more widely disseminated	
Impact of reactive components on MMP production	
Gap in info on caprock properties	
Benchmarking software	***Action***
Geo-mechanics	
Co-ordination of selection of reservoirs	***Gap***
Modelling workshop	***Action***
Definition of boundary conditions of numerical models – realistic stress fields	***Gaps***
Focus is too much on US reservoirs	
Is reservoir simulation underestimated?	
Over confidence in modelling work?	
Checklist sharing who is doing what, when	
Bore stability and completion technique definition	
Management of unconsolidated samples	
Model big changes in pressure	
Overlap with monitoring groups work	***Overlaps***
External projects: geochemistry, GEEODISC, geomechanics	
Co-ordinate caprock integrity work	***Actions***
Better define if study should be only reservoir, or include caprock	
Co-ordinate reactive transport – Jim Johnson, Jan	
Simulation of natural analogues – Jim	
Get cores from exploration wells – Canada etc….where should cores go?	
NASCENT/Weyburn etc have cores - can share them	
Need better use of national core repositories	
Co-ordinate modelling/monitoring groups	
Loss of injectivity work needed to correlate with model	
Co-ordination – take care not to divide into EOR and sequestration camps	
Evaluate technology to bottom hole survey of physical properties	
Co-ordinate with gas fields with GESTCO work	
Models need near-miscibility work	***Gap***

- is covered in phase behaviour and modelling	
If sequestration becomes important in EOR need to look at different ways of injection	
IEA website could be used to draw info together - brief project descriptions - need to think about managing this (IEA)	***Action***
Caprock deformation – area of science that is less mature - How important is it? - If important seek funding	
Are we confident about medium term predictiveness of geomechanics - FEPs - Uncertainty here	
Differences between institutes re pressure effects!	
Challenge assumption that we are confident about short/long term effects	

4.1.4 Monitoring and Verification - Breakout Feedback

Feedback Comments	**Gaps/overlaps/ commonground/ actions**
Tie monitoring to process and risk assessment and then define monitoring goals	***Gaps***
Limited offshore capability	
Using FACE to test equipment	***Action***
Migration of CO2 in subsoil	***Gaps***
Assumption that we know seismic but not sure about CO2 addition	
How much CO2 is dissolved in water and mineralisation?	
Funds to develop innovative technologies – e.g. biotech or nanotech	
Monitoring pipelines – well bores, intelligent wells	
Ability to pick up small leakage	
Evaluate cement integrity over 1000 years	
CO2 brine system in relation to corrosion	
Probability based studies in corrosion areas	
Ball park figures for leakage rates	
Remedial action after leakage	
Ball park figures for leakage rates	
Remedial action after leakage	
Short-term direct monitoring methods? (links to new techs)	
Fibreoptic technology in intelligent wells	
Overlap with sequestration	***Overlap***
Find out what others (non CCP) are doing about monitoring	***Action***
Linking cause and effect	
What are the implications of monitoring?	
Use Weyburn pipeline as test for corrosion (Norwegian work)	***Action***
Get lists of CCP and non CCP funded projects	
Corrosion and cement areas…get as much info as possible from non CCP projects	***Overlap***
Chemical industry analogues for corrosion	***Action***
Info from pre-computer times	
Involve service companies – do they have new or innovative monitoring techniques. Excellent idea!	
Use solutions from west Texas CO2 EOR project	
FEP workshop should include abandonment	

Need field trials for technologies (with funding and support)	
Combine different remote sensing techniques	
Operating procedures will need to be rewritten (Later)	***Comment***
Get building research info (Erik)	***Action***
Help regulators form regulation – think of what regulators need	
Radioactive waste work has info on cement effects	
Old statues could be used to provide info on atmospheric effects	

1.2 Workshop Details

This portion of the Appendix contains the Workshop Agenda, a list of Workshop Participants, and Feedback on the Workshop itself.

4.2.1 Workshop Agenda

When	Topic	Discussion Organization	Discussion Leader	Desired Outcomes
Day 1				
October 31				
0830-0900	Registration	GFZ to manage		Registration; Continental Breakfast
0900-0925	Workshop Process & Orientation	Chevron	Craig Lewis	• Welcome; Safety moment: fire alarms, exit locations, assembly points • Workshop objectives • Workshop key messages • Encourage active & positive participation by all • Workshop Ground Rules
	CCP & SMV Team Overview			**Desired Outcomes**
0925-0935	Carbon Capture Project Overview	BP	Gardiner Hill	• Provide overview of the CCP JIP • Budgets & co-funding applications Timeline and work processes • Organization of the Technology Development Teams, Technology assurance process etc.
0935-0950	Sequestration, Monitoring & Verification (SMV) Team	Chevron	Craig Lewis	• Update since January SMV Team Workshop in Washington D.C. • Proposal Evaluation & Selection process • SMV Recommendations to the Board • The Way Forward • Future Workshops • YE 2003 Wrap-Up
0950-	Process for Group	Chevron	Craig Lewis	• List Desired Outcomes for the

1000	Presentations			Upcoming Presentations • Process for gathering the key points
1000-1015	**Break**			
	Group Session A: HSE Risk Assessment Technology Development			**(6 presenters sit on panel at front of the room)**
1015-1030	Comparative Evaluation of Risk Assessment, Management & Mitigation	Berkeley National Lab	Sally Benson	Each Technology Provider to summarize the work funded by the CCP
1030-1045	Human Health & Ecological Impacts	Berkeley National Lab	Sally Benson	Ditto
1045-1100	HSE Risk Assessment Methodology	TNO-NITG	Ton Wildenborg	Ditto
1100-1115	HSE Probablistic Risk Assessment Methodology for Coalbed Storage	Idaho National Lab	Jenn-Tai Liang	Ditto
1115-1130	Management, Risk Assessment, Monitoring & Migration	BP	Tony Espie	Ditto
1130-1145	Coupled Ground Leakage & Atmospheric Models; Prob. RA Methods	Berkeley National Lab	Sally Benson	Ditto
1145-1200	Leveraging Nuclear Storage Lessons Learned; Public Perception Issues	Scientific Monitor	Michael Stenhouse	Ditto
1200-1300	**Lunch**			Bio-Fuel
	Session A Wrap-Up			
1300-1335	**HSE Risk Assessment Methodology - 5 Concurrent Breakout Sessions**		5 Breakout Session Facilitators	• Identify Gaps & Overlaps between TPs • Areas of Common Ground • How a TP can help another on a Common Problem • Actions to be undertaken
1335-1340	No A-1 Table Recap	PanCanadian	Ken Brown	Quick Report Out
1340-1345	No A-2 Table Recap	Statoil	Bjorn Berger	Quick Report Out
1345-1350	No A-3 Table Recap	Shell International	Wolf Heidug	Quick Report Out
1350-	No A-4 Table Recap	BP	Charles	Quick Report Out

1355			Christopher	
1355-1400	No A-5 Table Recap	ENI-AGIP	Luca Madeddu	Quick Report Out
1400-1415	**Break**			
1415-1430	SACS Overview	Statoil	Tore Torp	• Quick Status Report • Links with other R&D
1430-1445	Weyburn Overview	Weyburn JIP	Roland Moberg	• Quick Status Report • Links with other R&D
	Group Session B: Sequestration Analogs and Characterization			**(6 presenters sit on panel at front of the room)**
1445-1500	Leveraging Natural Analogs - 4 Field Case Studies	ARI	Scott Stevens	Each Technology Provider to summarize the work funded by the CCP
1500-1515	Leveraging EOR Studies - 50-75 Field Studies	New Mexico Tech	Reid Grigg	Ditto
1515-1530	Leveraging Acid Gas Disposal - 31 Sites in Alberta	Alberta Geological Survey	Karsten Michael	Ditto
1530-1545	Reservoir Characterization; Fault Leakage Analysis & Leaky Systems	Utah State	Jim Evans	Ditto
1545-1600	Basin Modeling & Geochemistry	IFP	Yann Le Gallo	Ditto
1600-1615	**Basin Model Development**	**GEUS / GESTCO**	**???**	**Ditto**
	Session B Wrap-Up			
1615-1645	**Sequestration Analogs - 5 Concurrent Breakout Sessions**		5 Breakout Session Facilitators	• Identify Gaps & Overlaps between TPs • Areas of Common Ground • How a TP can help another on a Common Problem • Actions to be undertaken
1645-1650	No B-1 Table Recap	PanCanadian	Ken Brown	Quick Report Out
1650-1655	No B-2 Table Recap	Statoil	Bjorn Berger	Quick Report Out
1655-1700	No B-3 Table Recap	Shell International	Wolf Heidug	Quick Report Out
1700-1705	No B-4 Table Recap	BP	Charles Christopher	Quick Report Out
1705-1710	No B-5 Table Recap	ENI-AGIP	Luca Madeddu	Quick Report Out
1710-1830	**Break**			
6:30-8:30	CCP-Hosted Reception with			Networking

	Heavy Hor D'oeuvres			
Day 2				
November 1				
0830-0845	Day 2 Logistics	BP	Gardiner Hill	
	Group Session C: Reservoir Properties & Processes			**(4 presenters sit on panel at front of the room)**
0845-0900	Influence of Injection on Physical Properties of Reservoirs & Caprocks	GFZ Potsdam	Gunter Borm	Each Technology Provider to summarize the work funded by the CCP
0900-0915	Reactive Transport Modeling of Integrity of Caprocks & Faults; RA	Livermore National Lab	Jim Johnson	Ditto
0915-0930	Use of Depleted Gas Reservoirs for Storage; Increased Condensate Studies	Texas Tech	Scott Frailey	Ditto
0930-0945	Screening Tool for Miscibility Pressure Calculations; CO2 Purity Tradeoffs	Tie Line Technology	E. H. Stenby	Ditto
	Session C Wrap-Up			
0945-1015	**Reservoir Properties and Processes - 5 Concurrent Breakout Sessions**		5 breakout session facilitators	• Identify Gaps & Overlaps between TPs • Areas of Common Ground • How a TP can help another on a Common Problem • Actions to be undertaken
1015-1035	**Break**			
1035-1040	No C-1 Table Recap	PanCanadian	Ken Brown	Quick Report Out
1040-1045	No C-2 Table Recap	Statoil	Bjorn Berger	Quick Report Out
1045-1050	No C-3 Table Recap	Shell International	Wolf Heidug	Quick Report Out
1050-1055	No C-4 Table Recap	BP	Charles Christopher	Quick Report Out
1055-1100	No C-5 Table Recap	ENI-AGIP	Luca Madeddu	Quick Report Out
1100-1115	GEOSEQ Update	Berkeley National Lab	Sally Benson	• Quick Status Report • Links with other R&D

1115-1130	GEODISC Update	AGSO / CSIRO	Andy Rigg	• Quick Status Report • Links with other R&D
1130-1145	**GESTCO Overview**		**???**	• **Quick Status Report** • **Links with other R&D**
1145-1200	**NASCENT Overview**	**British Geological Society**	**???**	• **Quick Status Report** • **Links with other R&D**
1200-1300	**Lunch**			Bio-Fuel
1300-1315	IEA Greenhouse Gas Program	IEA	John Gale	• Quick Status Report • Links with other R&D
1315-1330	RECOPOL (Poland)	TNO-NITG	Henk Pagnier	• Quick Status Report • Links with other R&D
	Group Session D: Monitoring and Verification			**(6 presenters sit on panel at front of the room)**
1330-1345	CO2 Detection Technology Literature Search	Cal Tech University	Pat Shuler	Each Technology Provider to summarize the work funded by the CCP
1345-1400	White Paper on Optimum Monitoring Technologies	TNO-NITG	Rob Arts	Ditto
1400-1415	Novel Geophysical Techniques for Monitoring of CO2 Migration	Berkeley National Lab	Mike Hoversten	Ditto
1415-1445	Hyperspectral Geobotanical Remote Sensing	Livermore National Lab	Bill Pickles	Ditto
1445-1500	Noble Gas Isotopes for Screening & Long Term Monitoring	Livermore National Lab	Greg Nimz	Ditto
1500-1515	Satellite Radar Interferometry for Long-Term Monitoring & Verification	Stanford University	Howard Zebker	Ditto
	Session D Wrap-Up			
1515-1545	• **Monitoring & Verification and Processes - 5 Concurrent Breakout Sessions**		5 breakout session facilitators	• Identify Gaps & Overlaps between TPs • Areas of Common Ground • How a TP can help another on a Common Problem • Actions to be undertaken
1545-1600	**Break**			
1600-1605	No D-1 Table Recap	PanCanadian	Ken Brown	Quick Report Out

1605-1610	No D-2 Table Recap	Statoil	Bjorn Berger	Quick Report Out
1610-1615	No D-3 Table Recap	Shell International	Wolf Heidug	Quick Report Out
1615-1620	No D-4 Table Recap	BP	Charles Christopher	Quick Report Out
1620-1625	No D-5 Table Recap	Texaco	Jeff Woliver	Quick Report Out
	Group Session E: Engineering, Optimization & Tech Transfer			**(6 presenters sit on panel at front of the room)**
1625-1630	NGCAS Overview	BP	Tony Espie	Each Technology Provider to summarize the work funded by the CCP
1630-1640	Methodology for Assessment of Storage Options	British Geological Survey	Nick Riley	Ditto
1640-1650	Optimization of Storage & Risk Assessment Methodology	AEAT	Pete Naylor	Ditto
1650-1700	Long-Term Sealing Capacity of Steel Wellbore Tubulars & Cement	Sintef	Erik Lindeberg	Ditto
1700-1710	**Understanding Critical Phase Behavior at High Temperatures & Pressures**	**Reinertsen**	**Gro Eidsmo???**	**Ditto**
1710-1720	Understanding Materials & Corrosion Issues, Costs & Rules of Thumb	IFE	Marion Seiersten	Ditto
Day 3				
November 2				
0800-0815	Logistics for the Day 3		Pippa Hyam	Explanation of the process for the smaller-sized Break-Out Group Sessions
0815-0835	**Engineering & Optimization 4 Concurrent Breakout Sessions**		5 breakout session facilitators	• Identify Gaps & Overlaps between TPs • Areas of Common Ground • How a TP can help another on a Common Problem • Actions to be undertaken
0835-0840	No D-1 Table Recap	PanCanadian	Ken Brown	Quick Report Out
0840-0845	No D-2 Table Recap	Statoil	Bjorn Berger	Quick Report Out
0845-	No D-3 Table Recap	Shell	Wolf Heidug	Quick Report Out

0850		International		
0850-0855	No D-4 Table Recap	BP	Charles Christopher	Quick Report Out
0855-0900	No D-5 Table Recap	ENI-AGIP	Luca Madeddu	Quick Report Out
	Small Group Breakout Session No. 2 (Sessions 2A-2E run concurrently)	**Organization**	**Group Chair**	
0900-1000	2A Performance Requirements for Geologic Storage & Sequestration	Berkeley National Lab	Sally Benson	Performance requirements for geologic sequestration need to be developed to enable a rationale basis for selecting suitable sequestration sites, setting requirements for HSE risk assessment, developing a regulatory framework, and setting monitoring targets. Requirements will be established based on both the effectiveness of sequestration, as well as, HSE risks. Until such requirements are developed, site selection, performance assessment and monitoring requirements will be difficult to determine. This breakout session will explore these issues and identify R&D needs to address them.
0900-1000	**2B Monitoring Requirements for Geologic Storage & Sequestration**	**Berkeley National Lab**	**NEED REPLACEMENT**	**Once performance requirements for geologic storage are developed to enable a rational basis for selecting sites, Monitoring Requirements will need to be planned and executed for each site on a site-specific basis. This breakout session will explore the issues, the tools available for each different storage type, and recommended approaches for monitoring. For example, monitoring programs for offshore vs. onshore locations are likely to be different, as would depleted fields vs. deep saline aquifers.**
0900-1000	2C Gaining Public Acceptance of Geologic Storage; Listing Issues	IEA Greenhouse Gas Programme	John Gale	This breakout session will focus on issues associated with the public, government and the environmental NGOs. In particular, this group will be asked to list the key issues, and

				consider the best approaches on how to gain public acceptance of geologic storage.
0900-1000	2D Opportunities for Using Demonstration Projects for HSE RA	Sintef	Erik Lindeberg	The primary R&D goal of the CCP SMV Team is to focus on developing methodologies for health, safety and environmental (HSE) risk assessments (RA). The approach is to understand risk in probabalistic terms, develop approaches to mitigate risk, and tools and plans to rememdiate problems if and when they occur. The CCP intends to share the results of these new HSE RA methodologies and tools outside of the CCP. This breakout session will explore potential applications of the CCP-funded tools to other non-CCP projects, such as Weyburn, GEOSEQ, etc.
0900-1000	2E Cross-Cutting Issues and "What Have We Missed"	BP	Tony Espie	The objective for this breakout group will not be defined in advance. This breakout session will explore whether there are areas or issues not addressed in the above 4 described breakout sessions, and which such issues are key to developing the technology for geologic storage.
1000-1010	Session 2A Report Out	Berkeley National Lab	Sally Benson	Report out to the larger group
1010-1020	**Session 2B Report Out**	**Berkeley National Lab**	**NEED REPLACEMENT**	**Ditto**
1020-1030	Session 2C Report Out	IEA Greenhouse Gas Programme	John Gale	Report-out
1030-1045	**Break**			
1045-1055	Session 2D Report Out	Sintef	Erik Lindeberg	Ditto
1055-1105	Session 2E Report Out	BP	Tony Espie	Ditto
1105-1110	Process for the Rest of the Day			
	Small Group Breakout Session No. 3 (Sessions 3A-3D run concurrently)	**Organization**	**Group Chair**	**(Note: Each Session will need to have a strong facilitator pre-selected)**

1110-1130	Good Ideas on the Way Forward	Norsk Hydro	4 breakout session facilitators	• Generate possible ideas on how we can leverage the value of up to 30 Technology Providers working together • Possible ideas on how we can leverage non-CCP / SMV Technology Providers • How to best move to The Way Forward
1130-1135	Session 3A Report Out	Norsk Hydro	Lars Ingolf Eide	Report-out
1135-1140	Session 3B Report Out	Shell Canada	Rick Weidel	Ditto
1140-1145	Session 3C Report Out	ENI	Luca Madeddu	Ditto
1145-1150	Session 3D Report Out	Suncor Energy	Swapan Das	Ditto
1150-1205	Wrap Up, The Way Forward, from the SMV Team's Leader Perspective	Chevron	Craig Lewis	• Summarize Key Learnings • Review the Way Forward • Meeting Plus Delta
12:05-12:15	Wrap Up, The Way Forward, from the CCP Chairman's Perspective	BP	Gardiner Hill	Summarize Key Points
12:15-1:30	**Lunch (optional)**			Bio-break
1:30-3:00	Tour of GFZ Potsdam Lab Facilities (optional)	GFZ	Guenter Borm	

4.2.2 Workshop Participants

Name	Organization	Tel.	Fax	E-mail
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4.2.3 Feedback on the Workshop

Good things about the workshop:

- Non CCP people were here – brought a lot of knowledge
- Integrated, co-operated
- Learnt a lot, openness, taking a common approach
- Success depends on quality of people – good quality here
- Craig did a good job
- Facilitators did a good job

- Potsdam is a great place

Improvements:

- Let conversations run, don't be too strict with timetable
- Need feedback time to avoid mistakes
- Have more flexibility
- To have had more time would have sacrificed non CCP presentations
- Time for teams to work together
- Presentations could have been done as exhibitions

WRITTEN EVALUATION

1. **What is your overall evaluation of the workshop**

   Excellent = 23 Good = 12 Average = 0 Poor = 0

What would have improved your rating?

- More time for follow-up questions and statement of concerns
- More time for the CCP project – less time on the non-CCP projects
- Less rushed
- Ability to access emails in evening
- The presentations could have been 'sorted' a little more e.g. the corrosion issue was not of interest to everybody, nor the pledge for the pipeline contract
- Somehow a bit more time to network
- A somewhat more detailed workplan of the R&D projects in the CCP programme as a reference for co-operation
- Would have loved a cake in the afternoon
- Let hot discussions go on
- More time on teambuilding
- Allow more time for technical interactions; but try somehow to keep conversations to CCP topics..maybe a group dinner?
- Slightly more relaxation time!
- Nothing
- More time for TPs to interact
- More detailed introduction linking the various projects
- Room was not prefect for presentations. Objectives of group sessions not always clear enough
- Poster session

2. How effective was the workshop in meeting SMV teams objectives

1	*2*	*3*	*4*	*5*
		2	**20**	**12**

Not very effective Very effective

What would have improved your rating

- Exceeded expectations
- I am not a SMV team member so I can not rate this
- The focus on the types of reservoirs of interest is still not well defined (more specific)
- Insufficient time to meet all objectives
- Hard for me to judge – I think yes but not sure what SMV objectives were
- Obviously the SMV team feedback will be the definitive answer to this. Comments and 'body language' seemed to indicate most of the objectives were met

- Objectives should be emphasised at start and end
- Very good and necessary for network

3. How effective was the workshop process

1	*2*	*3*	*4*	*5*
		3	**20**	**12**

Not very effective Very effective

What would have improved your rating

- Not enough time to pursue concerns about the plans and their objectives for specific presentations
- Time set aside to discuss collaborative efforts between TPs (specific collaborations)
- Better idea of what each TP in NGCAS will do
- Maintaining timing worked well – not too strict
- Would a different format for the last breakout be better?
- Breakout sessions on days 1-2 had specific questions but final session on day 3 objectives sere not as clear
- The discussions resulted in a lot of good ideas. I would like to see a more transparent selection of the most important ideas
- More time for discussions after presentations (limit presentations to 10 minutes with 5 mins for discussion)
- More open discussion
- Meeting more often to establish a real working relationship
- More time to sit in interest groups to plan
- More time for collaborative discussions – should have summarised what our group action items are
- Poster session – more time
- Additional opportunities for follow-on discussion
- Very little. Very impressed with facilitator's approach. 'Tag-team' worked well – guidance in breakout session appreciated – process of highlighting gaps overlaps etc worked well
- Process effective in informing – not as effective in developing ideas beyond a superficial level
- More specific expectations from the CCP team to focus discussions

4. What will you do differently as a result?

- Improved co-operation with other larger projects – (NASCENT, SACS etc)
- Greater interaction with other TPs since new collaborative opportunities became apparent
- I have got specific ideas I will add to my project
- Have several action items
- More specific actions relating to specific co-operations between teams closest related
- Will seek some information from another TP in similar areas
- Structure of our consortium workshop will change
- Simultaneous sessions of topics relevant to each groups research plans
- Increasingly personal initiative to collaborate with colleague institutes
- More time for discussions
- Learning about the other projects helps focussing on our projects and lead to new ideas. It makes co-operation easier
- Look into gathering seal properties for distribution. Look into collaboration with a few other TPs
- Follow up on gaps and integration of projects/TPs
- Put more emphasis on co-operation with other groups. Collect more experience for others
- Communicate more with CCP/SMV individuals
- I have received and will ask or some other input on what I need to have as results on my project. I can better see how what I am doing will fit in the overall project
- Not start at 7.30 in the morning
- Take feedback to consider improvements next time
- Use the info in steering project

- Integrate my work with numerous groups; collaborate with several groups that I haven't interacted with previously
- Put more effort into integration and formulation of new projects
- Not necessarily differently but information from the meeting can be incorporated in though process and action s on this project and other related one (Weyburn)
- Work harder on removing possible duplication of effort in GEODISC with work being done by others – push hard for FEP workshop
- Initiate collaboration between TPs of CCP as well as outside projects
- Consult with other TPs
- Consider to fill gaps close to our expertise. Establish contact to new TPs
- Modify objectives to co-operate with other projects

5. Will you be co-operating will any other TPs as a result of the workshop

Yes – REPCOL, Utah State	Vello Kieuskroa
❑ Scott Stevens and Jim Evans – modelling natural analogues ❑ Mike Hoversten – combined reactive transport of seismic modelling ❑ Jim Evans and Gunter Borm – modelling rock mechanics experiments ❑ Greg Nimz – modelling noble gas isotope migration	James W Johnson
All	Charles Christopher
TNO, INEEL, Utah studies – re risk assessment	Sally Benson
Bill Pickle – more info on remote sensing techniques	Pat Shuler
Risk assessment workshop ion Rome in Jan 2002	
Sally Benson, Scott Stevens, Ehrling Stenby (EOSMMP work)	Scott M Frailey
❑ With LBNL, AET and all the others of safety assessment ❑ Contact data providers to make appointments (GFZ) ❑ Contact institutes delivering analogues (NASCENT etc)	Jon Widenborg
LBNL on geophysical monitoring and with other partners involved in reservoir properties and risk assessment	Rob Arts
Yes , many and probably more as time goes on	G Nimz
Jim Johnson, Mike Hoversten, Gunter Borm, Scott Stevens, maybe Sally Benson	Don Seeburger
Yes	Marion Seiersten
HVT	H. Pagnier
Tony Espie, Craig Lewis, Sally Benson, ENI	W. Jazrani
I will be asking all the modelling people about input data that would be useful to them	Reid Grigs
Yes several	W. C. Prilater (LLNL)
❑ GFZ experimental group ❑ LLNL – remote sensing ❑ LLNL – modelling group ❑ LBL - modelling group ❑ ARI group ❑ (BGS – NASCENT)	Jim Evans
Berkley labs	Nick Riley
I propose to circulate our draft report to those interested in a common framework for risk assessment, for comments/criticism	Mike Stenhouse
Hopefully so	Andy Rigg
The risk assessment TPs	Jenn-Tai Liang
❑ IFE on brine Co2 ❑ Perhaps LLNL on reactive modelling ❑ Perhaps Scott Frailey on CO2 – condensate PVT	Ehrling Stenby

TNO, Stanford, LBNL	

1. Do you feel you have enough data/info. (If not what more do you need)

- At next meeting would need more detail on project accomplishments and plans
- Should have enough data per collaborations with other CCP TPs
- Need to agree NGCAs work programme amongst TPs
- Yes
- No – will need follow-up one on one discussion
- At present yes, co-operation at later stage.
- No. Range of input parameters most likely of interest to end-users of research results
- The timeframe and the types of reservoirs for monitoring are still very 'free' and not necessarily coinciding with other disciplines
- For now, yes
- Need more info from the Capture group
- Almost enough. I will be asking a little more on specifics. I am looking to see how much they are needed for the modelling not just for me to assess volume potential.
- Yes for our own review work. Interested in work concerning caprock integrity and long-term well integrity and possible R&D work in latter area
- No – FEP database
- Overview of projects in writing

2. What would make you feel more part of the SMV family

- The welcome and 'care and feeding' were most gracious
- Get a contract
- Some email updates, perhaps website postings
- You could consider an SMV family only portion of any workshop
- Master plan with each TP shown
- Nothing – I feel ok now
- More info on all projects/TPs on the internet pages
- Contact from the SMV/CCP key leaders
- To have more input on how they visualise my work fitting into the whole – this will let me know if my vision is compatible
- I feel part of the family
- Some sort of email/website to keep in touch, get updates
- Be involved in more SMV projects
- Direct participation
- Regular communications between TPs
- It is coming. Clear rules/agreements on IPR and publications

8. Any meetings/dates we should know about

- Dec 10-11 2001 mtg. of Weyburn project in Calgary, Canada
- Note IOR mtg. in Tulsa April 2002 should include CO2 project discussion
- Annual CO2 conference in Midland/Odessa Tex. First week December
- IEA/Weyburn EC FEP meeting in Rome in Jan 2002. IEA Weyburn sponsors meeting on Dec 10-11 2001
- American Chemical Society sequestration section next spring. Society of Petroleum Engineers will have a SPE/DOE symposium on Improved Oil Recovery – April 2002 – some sequestration but a lot of gas injection for hydrocarbon production
- DOE Berkley workshop Dec 2001 on CO2
- April 2003 – Geological Society Climate change/mitigation – geological perspective (London)

9. Any other comments

- Thank-you very much. Great effort and results
- Great facilitation
- Great to be part of this group
- Go on!
- Focus on critical issues….drop issues that are well developed (e.g. CO2 water data) or not very relevant (measuring subsidence)
- Good meeting
- Excellent planning and execution of plan
- Rewarding experience
- I suggest Copenhagen for the next CCP SMV meeting an it should be in Aug 20002
- Thank-you for involving me in the workshop
- FEP database is being compiled as part of Weyburn work: also participation in FEP workshop in January: happy to share. Our report on assessment framework will be directly relevant to some of the action s/needs of this workshop. Expected by end of 2001!
- Well done. GEODISC very pleased to participate and would like to be involved in the future.
- Appreciate the firm time management and open discussion