

ADMLC Seminar 12 March 2020

Challenges in modelling for emergency planning and response to contaminant releases – Seminar Q&A Discussion Sessions

1. Introduction

This document provides a record of the discussions at the ADMLC seminar that took place at PHE (Chilton) on 12 March 2020, shortly before travel restrictions came into force in response to the coronavirus pandemic. The morning session was focused on Emergency Response and the afternoon on Emergency Planning and Preparedness. Each session involved several 20 minute presentations, followed by a Q&A session. Topics raised in the Q&A sessions are recorded below.

In addition, participants at the seminar were invited to respond to questions posed by the organising committee under four topic headings:

1. Current practice in modelling approaches
2. Current practice in policies for planning and response
3. Emergency preparedness and exercises
4. Improving collaboration across the UK and internationally

The format for participants' responses was to use post-it notes that were pinned onto four notice boards in the atrium at the venue. In the final afternoon session of the seminar, the responses posted were summarised by a topic leader (Simon Gant, Steven Herring, Peter Bedwell and Justin Smith) and there was an open discussion of the issues raised, chaired by Professor Robin Grimes. Details of the issues raised and the ensuing discussion are recorded here.

This document reflects a range of views of attendees of the seminar; these views do not necessarily reflect the views of the Committee or the views of the organisations which sit on the Committee.

If you have any questions about the seminar or the issues raised here, or would like to know more about the work of the ADMLC, please do not hesitate to get in touch with us through our contact email address: admlc@phe.gov.uk, or our website: www.admlc.com.

2. Discussion: Emergency Response Session

Members of the audience noted that data are often held in inconvenient formats that are difficult to share, e.g. data may be held in the incident response log which is typically a Word file.

Dispersion simulations of unit releases are useful in that they often provide a starting point to predict the dispersion pattern and can be scaled at a later date if/when the source term is known. Waiting for the source term before any modelling is done may result in no modelling being carried out. Also unit releases can indicate areas of importance because they can show that a source term must be unfeasibly large for a hazard to exist at a particular location.

It was asked if JAM (Joint Agency Modelling¹) is missing information on 'ground truth' or 'event truth', and whether there should be a means to assimilate real event data into the modelling. It was noted

¹ See https://admlc.files.wordpress.com/2020/03/04-phe_rad_emergency_response_v1.0.pdf for details.

that JAM needs to be adaptable. It is important to make sure that the modelling outputs are useful and mean something to the recipients – a key aim of the JAM tool.

It must be recognised that modelling is just a part of the response, usually carried out early on in a response to get an initial prognosis of the impact. Monitoring gradually becomes more important as time progresses.

Communication problems can arise through the use of different technologies e.g. PHE use Resilience Direct² but not all participants have access to this. To help with communication, expertise from other disciplines, such as scientific journalism, should be sought. Use of consistent terminology across disciplines would be a good start. PHE (EHE) have recently employed a behavioural scientist to help in this area.

Several attendees at the seminar noted that staff turn-over can also cause problems (particularly of end users, who are then unfamiliar with the process). Adequate training must be provided and must be available on an ongoing basis for new staff. It is important that Fire Brigade and Police understand the information provided as they are having to make balanced decisions. PHE (EHE) have developed some guides to help explain (to fire crews) what their advice means. Knowledge management for the future is very important.

Practicing is important. SAGE needs diversity in what it practices e.g. what if a fire occurred at a brachytherapy unit? Also, more joint exercises across disciplines are required.

A sensible approach is to anticipate questions that are likely to be raised in emergency response, to help prepare answers.

3. Discussion: Emergency Planning and Preparedness Session

Some concerns were expressed that only Reasonable Worst Case (RWC) scenarios are considered in planning. The RWC is a useful place to start, but other scenarios can and should be considered. In REPPIR³, a range of potential accident fault sequences are considered.

The Government is the customer for the National Security Risk Assessment (NSRA). The NSRA exists to enable the Government to understand the main events that are likely to be particularly stretching in terms of response, so considering a RWC is helpful.

The purpose of planning is multifaceted. For example, HSE require chemical plants⁴ to carry out modelling to identify the extent and level of risk and hazard to the public around a site and to support the local authority in determining the level of emergency preparedness that is required.

² Resilience Direct is an online private 'network' which enables civil protection practitioners to work together – across geographical and organisational boundaries – during the preparation, response and recovery phases of an event or emergency.

³ Radiation (Emergency Preparedness and Public Information) Regulations.

⁴ The Control of Major Accident Hazards Regulations 2015 - <https://www.hse.gov.uk/pubns/books/l111.htm>

4. General Discussion

Four topics were considered in the final session. Four or five questions were posed to seminar attendees under each topic. Seminar attendees were asked to answer at least some of these questions anonymously using post-it notes. The answers to the questions and the subsequent discussions are summarised below.

4.1 Current practice in modelling approaches (Topic 1)

There was a strong desire to bring together emergency response and planning communities on a more routine (e.g. annual) basis, to discuss relevant topics in the field and improve awareness and understanding, but a mechanism for achieving this was unclear. However, for progress to be made it is likely that the impetus must come from government departments and agencies.

Secondly, it is recognised that whilst improvements in modelling approaches for both emergency planning and response are required, there exists more significant room for improvement within the broader process of the provision of advice (which models only form a part of).

- 4.1.1. Are you aware of the differences in modelling approaches (e.g. dispersion modelling) for different contaminants across UK government agencies?

The general consensus was that people understood the differences in modelling approaches within their sector (e.g. nuclear), but they have limited awareness of modelling approaches across different sectors (i.e. between nuclear and chemical).

- 4.1.2. Does understanding of these differences/consistencies between agencies need to be improved?

Yes, attendees thought it would be useful to improve awareness and understanding.

- 4.1.3. Do you have any suggestions of how to do this?

Attendees suggested running the ADMLC seminar annually to help bring together stakeholders from different government agencies, industry and academia. There was also a suggestion to have an annual conference on the topic of modelling in emergency planning and response.

However, there was feedback from attendees that whilst the ADMLC provides a useful function in organising seminars every 2-3 years and commissioning small research projects, it is a relatively small organisation run by its membership on a largely voluntary basis and its remit is wider than just emergency planning and response. It was noted that to coordinate knowledge-sharing across government on modelling in emergency planning and response, the action should be centrally funded and coordinated through government, perhaps through Cabinet Office or GO Science.

A further suggestion was to have UK government designations as “dispersion experts” like “government statisticians” and arrange formal meetings of these dispersion experts at intervals throughout the year to coordinate activities across government – similar to the (relatively informal) ADMLC but organised and funded centrally by government.

Another suggestion was to coordinate efforts using post-exercise reviews that would involve subject-matter experts from across government.

- 4.1.4. In your discipline, are there differences between models used for planning and models used for response, and are these appropriate/necessary/important?

Yes, attendees saw the need for different types of modelling approaches for planning and response. Also, it was recognised that there is a need for different models at different stages in the response process. In the initial response, a simple model might be used (R91 or the US PHMSA Emergency Response Guidebook). At the same time, a more complex model like NAME could start to be run. When the NAME results become available, a short while later (when there is more data and more time), they could be used to provide more specific results, based on more accurate meteorology. In general, there is value in a nested/hierarchical set of models. It was also recognised that model improvements are required.

- 4.1.5. Are improvements necessary in the modelling approaches for (A) planning and (B) response and if so what weaknesses should be addressed?

- For (B) response:
 - *Communication needs to improve and models are required to achieve the best inputs*
 - *PACRAM/NAME output should be used earlier in response*
 - *Use-ability of models for response should be improved*
- For both (A) planning and (B) response
 - *More support/help should be provided for PACE⁵/NAME users, as it is demanding for new users*
 - *Modelling of dispersion in very low wind speeds needs to be improved*
 - *A comment from the audience considered an exercise run by MOD in nil wind conditions. This proved challenging when it came to setting downwind monitoring locations, since there was no clear downwind direction.*
- As part of the ADMLC Chair's address at the start of the seminar, four topics were raised as requiring improvements:
 - *Deposition modelling*
 - *Modelling of sources in an emergency, when there is limited information available*
 - *Fire source terms and plume rise*
 - *Understanding the impact of meteorological uncertainties*

4.2 Current practice in policies for emergency planning and response (Topic 2)

The emphasis here was placed on a need to better understand 'modelling' limitations (across the broader framework of the modelling process) within the policy making context, and the key message was for more dialogue between the scientific community and policy advisers. However, the question remains as to how this can best be achieved.

- 4.2.1. Are you aware of any differences in the *policies* for emergency planning and response across different contaminants?

It was recognised that there exist significant differences in the policies for response to different contaminants across the different lead Government departments (BEIS⁶, MOD⁷ and CCS⁸) for

⁵ See <https://www.phe-protectionservices.org.uk/pace> for a description of PACE.

⁶ Department of Business, Energy and Industrial Strategy

⁷ Ministry of Defence

⁸ Civil Contingencies Secretariat

emergency planning and response to civilian, military and malicious radiation incidents. But it was also raised that even within one contaminant (radiation/nuclear) there are significant differences in tools and approaches across agencies and organisations, and this is not desirable.

- 4.2.2. Does understanding of modelling approaches and their limitations within the policy context need to be improved?

There was unequivocal agreement that there was a need to improve the understanding of modelling approaches, model output and model limitations within the policy making context.

- 4.2.3. Do you have any suggestions of how to do this?

It was suggested that there should be more discussions between scientists (model developers and model users) and policy advisers to enable scientists to explain the limitations and uncertainties in model outputs, but in addition it was believed that such discussions were necessary to determine policies for capturing uncertainties in model outputs and how the contextual information required by decision makers when using modelling outputs should be provided. A specific issue identified in relation to radiation incidents was that there were many different risk levels which needed to be considered, making the task of providing decision makers with clear information more difficult. The need for a more joined-up approach to determining policy was identified, with a specific suggestion that the formulation of policy for radiation emergencies should involve the Nuclear Resilience Coordination Committee.

- 4.2.4. Is there appropriate consistency across scenarios/contaminants in terms of the overall aims for public health protection or should there be more? For example, do some disciplines focus more on low probability and high consequence events and others on higher probability and lower consequence events?

It was suggested that peer review of different approaches within and across organisations would be of value and that it would be beneficial to have joint exercises which would allow comparison of approaches to training as well as the approach to response, although recognised that such events might be difficult to arrange in practice. There should be more consistency in the usage of the terms risk/harm across different contaminants.

4.3 Emergency preparedness and exercises (Topic 3)

A common view was that there exists a lack of breadth of exercising (including roles not fully tested, a tendency for incomplete organisational play at all levels in most exercises, a need for more challenging scenarios and issues with scenarios not reflecting the real world / reality). It was noted that there is a need to exercise scenarios including composite hazards.

The use of real weather in exercises is a major omission. It means that models used in exercises differ from the ones which would be used in reality, because not all exercise participants can handle the more complex modelling that would be applied in a real response. This is linked to some exercises being more like a 'tick box' exercise for some participants rather than being an accurate reflection of (and training for) real events.

It was recognised that too little time is allocated and devoted to exercising. There is insufficient exercising of the response at a national level, of the relationship between STAC⁹ and SAGE¹⁰, and of the recovery phase (where exercises would benefit from starting midway through the emergency response timeline). Furthermore, the handover between the management (by the police and fire and rescue service) of the local response in the early phase of the emergency to the recovery phase managed by the Local Authority is challenging and should also be exercised (more). Certainly, for those aspects relating to the national response, there is scope for improvement if agencies that form part of the response can liaise with (and share the burden with) GO Science. Exercises can be made more challenging if staff from each agency are able to input into the planning stage, as they are best placed to understand the greatest challenges faced by their colleagues (e.g. injecting different/'wrong' met and applying different models in the planning of the exercise compared to the response in the exercise). There would be benefits in attaining a better understanding of the implications of opting for different approaches to the response for a single scenario (for example what would be the implications of not doing anything; there is significant value in recognising that on occasion no action may be the optimum decision). MOD have recently exercised scenarios which include significant wind direction uncertainty and calm conditions; this was deemed to be of great value.

A further common theme was that the consideration of uncertainty in both exercises and response is limited and tends to focus only on the reasonable worst case, but because of time constraints, this was rarely discussed. An interesting point made on the post-it notes was the concept of inviting members of the public to play in exercises, briefing them of the unfolding events and (potential) protective actions, and responders addressing their evolving concerns.

- 4.3.1 In your discipline, is there any disconnect between emergency preparedness/planning and emergency response? For example, do emergency exercises consider an appropriate and/or full range of scenarios?

Exercises do not consider a wide enough range of scenarios (establishments and different scales of release, including low probability events). There is a need to cover confounding factors e.g. flooding / radiological release / chemical release. There is also a need to cover issues/concerns/challenges for 'national' agencies. Exercises consider sanitised scenarios and data that do not reflect the real world. Typically, scenarios do not consider realistic weather, data transfer, uncertainties and lack of knowledge; this means that the modelling capabilities are never fully tested (in fact barely tested at all) but equally the staff with the expertise to interpret them don't get the practice either. Nuclear exercises tend to use models which would not be used in real events – real weather data (pre-prepared) needs to be provided so all players can participate with their tools. In real accidents, all kinds of questions pop-up that normally are not considered in preparedness; these questions mostly relate to concerns, not immediate hazards.

- 4.3.2 Are current modelling approaches for (a) planning and (b) response adequate for the full range of scenarios?

There were mixed responses. Some thought that current modelling approaches are mostly adequate, though highlighting that fire/explosions tend to be challenging and the modelling here tends to be very simplistic. Conversely other attendees felt that current modelling

⁹ Scientific and Technical Advice Cell

¹⁰ Scientific Advisory Group for Emergencies

approaches are not adequate; specifically (a) in preparedness we lack detailed information e.g. building details, and (b) we can't easily model ingress / exfiltration and complex sources. Focus tends to be on large scale, wide area major radiation events; are our models adequate for urban environments.

- 4.3.3 To what extent are uncertainties and lack of knowledge considered in (a) emergency exercises, and (b) emergency response?

For (a) and (b) uncertainty is acknowledged but not quantified or adequately expressed. Neither consider uncertainties in detail, and not beyond typical and worst case scenarios. Exercises are too simple/straightforward; they tend to lack imagination; during accidents modellers have enough difficulty to produce an outcome in time; they have no time to sit back and think of uncertainty - this requires independent persons/roles.

- 4.3.4 Do decision-makers practice making protection decisions under uncertainty and do modelling outputs support them?

A view was that decision-makers do practice making protection decisions under uncertainty, but modelling outputs do not support them. EA has experience of this in flooding – inevitably they are sometimes working in a vacuum and make decisions on best available information. Furthermore, it was recognised that whilst uncertainty is considered, it is usually only considered for typical and worst case, and modelling is not conducted to effectively quantify it.

- 4.3.5 Do emergency planning and response exercises fully exercise the modelling capabilities and use/challenge the outputs provided?

There were a range of views, as detailed here, but the consensus was that the response community are not fully exercised. The capability is not truly exercised, and there is no challenge or feedback. Planning and response exercises don't fully utilise modelling capabilities; there is a need to identify reasonably foreseeable and 'worst case' less likely scenarios and challenge our capability; this will help us think outside the box and be better prepared for the unexpected. Modelling is often one step in a decision process and other considerations are often of a higher priority. Modelling is conceived as something very technical, done by experts and is normally not challenged.

4.4 Improving collaboration across the UK and internationally (Topic 4)

In summary, there was a feeling that there is some disconnect between planning for national policy and planning for local emergency response. As an example, the REPPiR 19 methodology was considered inconsistent with that adopted in the NSRA for radiological incidents. However, perhaps the aims are different in that REPPiR is a guide to developing off-site emergency plans for operators and local authorities, whereas NSRA is for Government to understand the key events that are particularly stretching in terms of developing a national response.

It was also felt that there are inconsistencies between the different contaminant types e.g. radiation, chemical, volcanoes and that this could be improved by holding collaborative events, networking, secondments, workshops, training, joint projects. Also sharing resources such as example case studies hosted in a shared database/forum/portal would be beneficial.

There were comments that modelling could be improved to encompass all spatial and temporal scales and all hazards and adapted as necessary to the scenarios of interest. This should include urban-scale modelling.

There should be more joint exercises, across sectors (disciplines) and these should be more challenging. These might be conducted under a cross-government coordination committee for emergency planning and response. The general consensus was that collaboration should be improved for example by more cross-government decisions on emergency planning and response policy areas and also with co-operation on regulation e.g. risk framework.

4.4.1 Do you think that the national policy in planning (e.g. the national security risk assessment) is fully achieved by the current approaches in modelling, exercising and response planning?

The consensus was that the national policy in planning is not fully achieved by the current approaches in modelling, exercising and response planning (and furthermore there was a general view that there exists a disconnect between these three areas). There is the potential for different levels of modelling and exercising across sectors. Much of national policy and risk mitigation depends on local approaches but it is unclear how aggregated bottom-up feedback can influence national policy. In radiation emergencies, the different definitions within REPPIR 19 and NSRA will create a disparity in these areas; if REPPIR definitions can be adopted within NSRA then there should be greater alignment. UK and international planning policy has some fundamental differences; the IAEA approach is to establish a Precautionary Action Zone (PAZ) which is based on deterministic radiological consequences; in the UK the Detailed Planning Zone (DEPZ) is based on conservative bounding assumptions of stochastic consequences under worse case conditions; uncertainties are not random, they are conservative systematic factors above some likely assumptions.

4.4.2 Are there any areas of weakness or inconsistency that should be addressed?

More sharing of approaches and information/data is needed. Preparedness and response can differ, e.g. approaches taken, people involved, a more dynamic link both ways is needed; silos are easily established where radiation, chemicals, volcanic work carried out separately; at the operational level information flow for modelling is problematic. REPPIR and NSRA definitions are different as mentioned in 4.1; REPPIR, NSRA and IAEA don't cover smaller, more realistic scenarios which means planning may not be proportionate and modelling is not feasible at the required resolution (e.g. urban settings); conversely there are instances, for some contaminants at least, where a greater emphasis on very large (and likely, less probable) accident scenarios would also be of significant value. There are gaps in protection in respect of near-field dispersion, enough temporal and spatial resolution of met wind variations, suitable temporal resolution for short term exposures; a framework of full-scale modelling approaches does not exist.

4.4.3 How could these weaknesses/inconsistencies be overcome?

A number of suggestions were listed here. Can we build all hazard approaches as a foundation, then focus on commonalities, then 'bolt-on' the more specific needs/functions? Adopting REPPIR definitions within relevant NSRA risk areas (and assessing the usefulness of a risk

framework wider than nuclear). Joint exercises e.g. across sectors and more challenging exercises. Under a full-scale frame work (in terms of temporal and spatial scales) to develop different scale focussed models with interfaces to exchange data.

- 4.4.4 How could best practice in emergency planning and response be shared across the different disciplines?

Events (held regularly), networking, case studies – hosted in a shared database/forum/portal, secondments, workshops, training, joint projects. A cross-government/industry CBRN (and perhaps wider dispersal event) coordination committee for emergency planning and response from each of the communities. Joint exercising (e.g. Sellafield chemical and radiation event). A fast-response model to deal with complex background (e.g. urban dispersion) is urgently needed.

- 4.4.5 Do you think it would be useful to improve collaboration between the relevant UK government agencies and also industry and academia (in the UK and overseas) to share good practice on these topics? If so, how? Are there existing collaborations in place?

There was a strength of feeling that improved collaboration would be beneficial. Can UKRI or other UK research institutes fund knowledge transfer networks? Can UK/EU H2020 research funding be sought for co-creation → operational users need to lead the work of academics/small and medium-sized enterprises/government on tools. There needs to be more cross-government decisions across the emergency planning and response policy areas (also with co-operation on regulation e.g. risk framework); international bodies should generate and simulate fora as well as projects/initiatives (e.g. EC); also bi-lateral action (including joint exercises) between countries could provide information exchange in this area (mindful that there are significant differences in some areas between UK policy and international, e.g. the use of RWC¹¹). With relatively small communities in each country we would benefit hugely from interacting internationally and sharing experiences; the challenge is mechanisms/resources to do this (e.g. Met Office has links to Australia and New Zealand). Collaboration is important and we should follow the lead of successful examples such as INSARAG for international collaboration (<http://www.insarag.org/>). Shared funded and joint partnership projects, studentships, regular meetings, shared information (databases) should all be sought. The possibility for a sand-box style workshop where various people involved in emergency planning and response could work together on hypothetical emergency scenarios should be explored; external contributions could be helpful e.g. those in public relations, science communication etc.

¹¹ Reasonable Worst Case