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In this issue

ONR's Expert Panel on Seismic Hazard and Climate Change

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In 2008, the UK Government fundamentally changed the nature of nuclear power policy in the UK by positively endorsing the possibility of new nuclear reactor build. Since that time there has been a number of policy and legislative initiatives paving the way for new nuclear build in the UK. In considering how best to regulate new nuclear build sites in respect to the challenges posed by natural external hazards, the following issues stand out as particularly significant:

- Natural hazards represent significant safety challenges to nuclear facilities at the levels of safety demanded in the UK.
- Such events when they occur are usually newsworthy.
- Regulatory judgments in relation to the nuclear industry, especially in relation to new build, are increasingly likely to be debated and challenged in the public arena.

In 2011 the Office for Nuclear Regulation (ONR)[1] [numbered superscripts refer to Endnotes at end of paper] set up an expert panel on seismic hazard and climate change because these were identified as particularly complex areas in which to provide regulatory judgments and special arrangements were needed to ensure such judgments are based on high quality technical advice.

Regulatory Setting

Leading up to the 2008 policy changes and immediately thereafter, the UK nuclear regulators, ONR and the Environment Agency (EA), geared up to handle the significant increase in work that the design, construction and subsequent operation of new nuclear power stations will require. The most visible aspect of this was the creation of the Generic Design Assessment (GDA) function within ONR, supported by EA, whose role is to assess potential new designs for compatibility with UK nuclear regulatory requirements. The other major change within ONR was the creation of a regulatory function to handle the granting of nuclear licenses for new build sites and the subsequent assessment of site-specific safety cases.

ONR was reorganised in 2009 to realise these changes and an important consideration was the ability to deliver high quality regulatory assessment of natural hazards analyses specific to new build sites based on up to date technical advice.

External Hazards and their Impact on Nuclear Facilities

External hazards are defined as those hazards that cannot be directly controlled by the site operator[2]. There are a large number of hazards that potentially fall within this definition, broadly categorised as either natural or man-made. Man-made external hazards of interest to nuclear sites typically include aircraft crash and the hazards presented by nearby industrial facilities, for example explosion and release of toxic gases. Natural external hazards include geological hazards, of which seismic vibratory action is an important example even in an intra-plate region like the UK, and capable faulting, i.e. fault movement that could directly affect safety at a nuclear facility, is an emerging hazard. Other natural hazards include extreme weather and coastal flooding and these are becoming increasingly important because of the potential impact of climate change effects.

It is recognised by the nuclear industry world-wide that natural hazards present significant safety challenges to nuclear facilities. The severity of the challenge and the consequences that result depend on the nature of the hazard, the geographical location of the nuclear site and the type of facility being considered. The challenge from significant natural hazards is usually sufficient to warrant a substantial amount of design and analysis effort on the part of site operators. In some cases, e.g. coastal flooding, external hazards can influence whether or not a site is suitable for selection in the first place. The combination of the perceived importance of natural hazards and their very uncertain nature provides a challenging environment in which to make regulatory judgments about nuclear safety.

Natural hazards are generally spectrum hazards, i.e. they can exist over a range of severity levels with more severe events usually being less frequent. This requires an analysis to be undertaken to define the probability or chance of the hazard affecting the site at a level that is greater than a given value.

The probabilistic aspects are often technically complex and tend to be the preserve of a relatively small number of specialists, many of whom are employed by academic research institutes. This arises because natural hazards are in general poorly defined by the current state of knowledge and are still subject to active research at this time. This is the case even when the basic physics is understood relatively well, as is the case with earthquake and meteorological hazards. In fact the state of knowledge is so limited that in some cases (earthquake hazard in low seismic areas for example) the only way to obtain reasonable estimates of hazard severity and probability of occurrence at a specified geographical location is by using expert judgment to interpret the limited body of data available.

Media Interest

Based on experience world-wide, when severe natural hazard events occur they can cause great damage to local communities and this makes them very newsworthy; extreme weather and earthquakes fall into this category and the events that flow from them always attract media attention. Furthermore, climate change may affect, adversely, many of the meteorological and flooding hazards, and this is an active and contentious topic of scientific and public debate both now and for the foreseeable future.

Moreover, the licensing of new build sites by ONR will take place in parallel with planning inquiries (local and national), to which ONR will act as a consultee, and possibly other kinds of public engagement. All of these are expected to be covered by the media.

The Government has recently set down standards of conduct that independent regulators like ONR must follow; these are based on the Hampton review[3], are embodied in ONR's enforcement policy[4] and express the desire generally to regulate in a more transparent and proportionate way. ONR is increasingly making its regulatory activities open to public scrutiny[5] and expects its regulatory judgments to be challenged in more detail than has historically been the case, especially in relation to new nuclear build. In addition to the judicial review process, the public can now make enquiries under the Freedom of Information Act and the Environmental Impact Regulations, which provide legal support to requests for information and require ONR (and other Government bodies) to respond in limited timescales.

The Need for Expert Advice

ONR needs to ensure that the regulatory judgements it makes are based on high quality technical advice. ONR will or could be required to do the following:

- Assess Licensee safety submissions, i.e. safety cases and supporting documents.

- Develop Lines-to-Take on particular issues that are ambiguous or contentious.
- Provide submissions to the national and local planning processes on issues relevant to external hazards; say the impact of climate change over the life of a new build site.
- Respond to questions from the public and Parliament, Freedom of Information requests and similar. When appropriate, provide briefings and statements to the media.
- Provide expert witnesses to the judicial process if external hazards issues concerned with the Licensing process are contested through the courts or judicial inquiries. For example, if the height of a new build site platform level is contested from the point of view of climate change induced sea level rise.

As noted above, the skills needed to do this are often drawn from universities and specialist consultancies. Therefore ONR decided to convene a panel of experts to cover the most challenging areas, which were deemed to be earthquake hazard and climate change effects, for the following reasons:

- Earthquake hazards are considered to provide a significant safety challenge and are uncertain and difficult to define for UK sites. Earthquakes provide a common cause challenge to all safety barriers simultaneously. Also, there is empirical and anecdotal evidence that seismic retrofit to nuclear stations is very costly if the initial design is flawed.
- Climate change phenomena are considered to be very uncertain in their potential importance over the lifetime of new build sites. Climate change is currently and likely to remain a vigorous area of basic research and a very contentious and highly politicised issue in the public domain. This affects all extreme weather and flooding hazards.

The Expert Panel on Seismic Hazard and Climate Change

The expert panel was set up over a period of time, but effectively became fully operational in 2011. The panel consists of the experts listed in Table 1.

The precise mix of personnel on the panel was a matter of judgment. Availability was a factor, as was the need

Table 1: ONR Expert Panel

Title	Academic affiliation	Supporting the EP on	Technical area
Prof. Julian Bommer	Consultant, formerly Imperial College London	Seismic hazard	Seismic hazard analysis Ground motion prediction equations
Dr Paul Burton	Univ. East Anglia	Seismic hazard	Seismic hazard Seismology
Dr Stephan Harrison	Univ. Exeter	Climate change	Climate prediction Natural hazards
Prof. Bob Holdsworth	Univ. Durham	Seismic hazard	Structural geology
Dr Roger Long	Univ. Durham (retired)	Seismic hazard	Seismotectonics
Prof. Mark Macklin	Univ. Aberystwyth	Climate change	Flooding and flood geomorphology
Dr Jean Savy	Consultant, formerly Lawrence Livermore National Lab	Seismic hazard	Seismic hazard Application in the US
Prof. David Smith	Univ. Oxford	Climate change	Tsunami and sea level rise Climate change variability
Alice Walker	Consultant, formerly BGS	Technical secretary	Instrumental seismology
Dr Richard Washington	Univ. Oxford	Climate change	Long term climate prediction

to avoid the potential for conflicts of interest between the work individual experts might do for ONR and work they might be doing for new build nuclear operators. This need to avoid conflicts of interest is especially important because it contributes to ONR's independence from the organisations it regulates.

The panel is currently engaged on assessing technical documentation from EDF-NNB covering seismic hazard and climate change effects at the Hinkley Point C site, and seismic hazard documentation from Horizon NP for the Wylfa B site.

Endnotes

1. ONR is an agency of the Health and Safety Executive (HSE), but is currently working to become a completely independent Statutory Corporation.
2. By comparison, internal hazards are those over which the operator does have a degree of control over the likelihood of the hazard being realised, e.g. internal plant fire.
3. http://www.berr.gov.uk/files/file22988.pdf.
4. http://www.hse.gov.uk/pubns/hse41.pdf.
5. Recent HSE research into risk communication highlights the importance of engendering public trust for safety issues that are contentious or invite public interest. One important conclusion of this work is for the regulator to be trusted by those raising concerns. A second important conclusion is that this trust requires the regulator to be in possession of the best available science. http://www.hse.gov.uk/research/rrhtm/rr785.htm.

Forthcoming Events

Date	Venue	Title	People
30/10/2013 at 18:00	Institution of Civil Engineers, 1 Great George St, London	*Time-scales of Performance-based Earthquake Engineering*	*Speaker*: **Iunio Iervolino** (University of Naples Federico II) *Organiser*: **Damian Grant** (Arup)
27/11/2013 at 18:00	Institution of Civil Engineers, 1 Great George St, London	*Barriers to Earthquake Preparedness: A Risk Representation Approach*	*Speakers*: **Helene Joffe** and **Tiziana Rossetto** (EPICentre Research Group, University College London) *Organiser*: **Andrew Mair** (Jacobs)

For up-to-date details of SECED events, visit the website: **www.seced.org.uk**

Announcement of the 2015 SECED Conference

SECED announce their intention to convene a 2 day conference on Earthquake and Civil Engineering Dynamics in June/July 2015 at Cambridge. This will be the first major conference to be held in the UK on this topic since SECED hosted the 2002 European Conference on Earthquake Engineering. The conference will provide an opportunity for both researchers and practitioners to share the latest knowledge and techniques for understanding the dynamic behaviour of structures, of earthquakes and of their effects on the natural and built environment. The conference will bring together experts from a broad range of disciplines, including structural engineering, nuclear engineering, seismology, geology, geophysics, geotechnical engineering, urban development, social sciences, business and insurance. Further announcements will be made through the SECED membership mailing list, the SECED website and newsletter.

Sponsors are being sought for the conference and should contact Professor Tiziana Rossetto via e-mail for further information: t.rossetto@ucl.ac.uk.

On 29th May 2013, SECED held its biennial Mallet-Milne lecture, presented by Dr Roger Musson of the British Geological Survey. Dr Andrew Mair, SECED Chair, provided this report of the evening.

The Fourteenth Mallet-Milne Lecture

'A History of British Seismology' – Dr Roger Musson

Andrew Mair
SECED Chair

SECED's biennial Mallet-Milne Lecture is held in memory of the two founding fathers of engineering seismology: Robert Mallet and John Milne. It is somewhat ironic that two men widely credited with instigating the scientific study of earthquakes should come from the British Isles; an area of low seismicity in world terms. Both Mallet and Milne were relatively unknown in their homeland, yet were held in high esteem in Italy and Japan respectively, where they made significant contributions to the scientific understanding of earthquakes. Even a cursory look at the achievements of these two men shows that they are certainly worthy of having the series of lectures named in their honour.

The 2013 Mallet-Milne was, of course, particularly poignant, as it coincided with the centenary of John Milne's death. It was therefore fitting that we celebrated the continuing contribution of British seismologists and engineers to the field of earthquake engineering, by having Dr Roger Musson, a British seismologist who is active on the international stage, talking on the subject of 'A History of British Seismology'.

Whilst earthquakes may be as old as history, it was still surprising to learned from Roger's lecture that the oldest theoretical writing on earthquakes in Britain dates back to the end of the 12th century, when Alexander Neckam, who was abbot of Cirencester, compiled a work called *De Naturis Rerum* (Of the nature of things), which was in effect an early encyclopaedia of natural history, and which contained a chapter on earthquakes. The first writing on earthquakes was, of course, much earlier, with the first observations of earthquakes being recorded in Iona on the West Coast of Scotland, around 750 AD.

Roger structured his lecture around one question: 'Is there anything that makes British seismology distinctively British?' He went on to suggest that there were three factors that give British seismology a distinctive character; the influence of seismicity, the influence of organisation and the influence of politics; and structured his presentation around these themes.

In terms of seismicity, there is a simple, curious and inescapable fact: that for all the extent that Britain has been a powerhouse of scientific development, it does not offer much in the way of earthquakes to study. However, when it comes to theoretical seismology, it is not necessary to have great earthquakes on your doorstep; you can sit at home and study reports of earthquakes in distant lands. This was the case for Cambridge geologist John Michell, who was inspired by reports of the Great Lisbon Earthquake of 1 November 1755. In 1759 Michell gave an address to the Royal Society in which he outlined his ideas on seismicity. Michell was the first to realise that the propagation of earthquake motion was by means of elastic waves through a solid medium, which in turn led to the concept of earthquake location for the first time. He even proposed two methods for determining the location of an earthquake source; the first being that waves reach the observer closest to the source first, and the second being that if each observer can observe the direction from which the waves arrive, these can be traced back to find the origin. Thus the basic principles of earthquake location were articulated for the first time, albeit scientific measurement was not sufficiently accurate to put these ideas into practice.

Similarly, the lack of earthquakes on one's doorstep did not deter Robert Mallet, who in 1857 travelled to Italy to study the effects of the damaging Great Neapolitan Earthquake. Mallet had an abundance of cracked walls and fallen stones from which to take measurements, resulting in the publication of his seminal work the 'Great Neapolitan Earthquake of 1857: The First Principles of Observational Seismology'.

The one exception to having to travel overseas to study earthquakes was Raphael Meldola, a chemist living in Essex, who was on hand to carry out an investigation into the April 1884 Colchester earthquake, together with local geologist William White. Being a shallow earthquake, the Colchester event caused a significant amount of damage, yielding a study zone which was rich in data in UK terms. The investigation by Meldola and White was of a very high standard, with their findings including a detailed map of the epicentral area. Roger believed this was the first use of the term 'epicentre' in Britain.

Five years after the Colchester earthquake Charles Davison started undertaking macroseismic surveys of British earthquakes. Davison was a schoolmaster by profession, and seismology was simply a hobby for him. However, despite only being a hobby he single-handedly undertook macroseismic surveys of the majority of significant British earthquakes for the next 30 years or so. Davison stopped work in the 1920s, but he passed on his work to the geologist ATJ Dollar. Dollar maintained a network of volunteers across the country, whom he supplied with postcards on which they could record the effects of an earthquake and post to him.

With respect to the second part of Roger's hypothesis, the influence of organisation, he suggested that in Britain, much of the scientific activity was arranged around the British Association for the Advancement of Science (BAAS), founded in 1831. Anyone who was anyone in any field of science would attend the meetings, so there was fertile ground for cross-pollination between disciplines. Research was supported by a system of committees. The first committee to study earthquakes was set up in 1840, with David Milne as Secretary (no relation to John Milne). Later Robert Mallet had a committee, originally to develop a seismic recording instrument, but which broadened in scope, and John Milne had a committee to support his work in Japan. Various committees evolved over the years, some ceasing to function after a period, others merging,

Dr Roger Musson delivering the Fourteenth Mallet-Milne Lecture; 'A History of British Seismology'

with the final committee ceasing to operate in the 1980s.

The BAAS committee set up by David Milne was in response to the Comrie, Perthshire earthquake of 23 October 1839, which was followed by an earthquake swarm. This presented an unmissable opportunity to study earthquakes, hence the importance of setting up a BAAS committee to mount an investigation. This committee achieved a number of firsts in seismology; the first use of an inverted pendulum instrument in seismology, the first use of a horizontal pendulum instrument, the first time a network of instruments was deployed with the aim of locating an earthquake source, and the first occurrence of what we would understand today as a seismic bulletin. Milne also made macroseismic surveys of the larger earthquakes and compiled a catalogue of historical British earthquakes. Roger referred to Milne in his lecture as a 'kindred spirit' and, considering his achievements, believed he was worthy of the title of 'The First Seismologist'.

The final part of Roger's hypothesis centred on politics. In the latter part of the 19th century the British Empire was at its height. As the world's leading industrial nation British scientists and engineers were held in high esteem internationally. When Japan came out of its self-imposed historical isolation it was to Britain that it looked, with invitations being sent from Japanese universities to attract leading academics who could give them access to the latest scientific knowledge. Those who accepted the Japanese invitation included, William Ayrton (Scottish), John Perry (Scottish), James Ewing (Scottish), Cargill Knott (Scottish), Thomas Gray (Scottish), Thomas Mendenhall (American) and of course John Milne (English). They had little or no interest in earthquakes when they left Britain, but that would change when they were to experience several events in Japan. Of particular significance was the Yokohama earthquake of 1880, which led to Milne co-founding the Seismological Society of Japan.

In 1895 Milne's house and laboratory in Japan were destroyed by fire, and he decided to return to Britain, settling at Shide Hill House, on the Isle of Wight. It was during his time at Shide Hill House that Milne was to set about establishing a global seismic network, using his horizontal pendulum seismometer, which he developed with the assistance of Thomas Gray and with the backing of a BAAS committee. Making the most of Britain's influence in the world at the time, he lobbied the Foreign Office to get British diplomats to persuade a number of countries to set up seismic recording stations using his instruments. Within two years there were 27 stations around the world sending back readings to Shide. The results were published annually in bulletins that became known as the Shide Circulars. Following Milne's death the Shide Circulars were reorganised under the auspices of the International Seismological Summary, which later became the International Seismological Centre, which continues the work to this day from its base in Thatcham.

In concluding his talk, Roger referred to the oft overused phrase 'innovative cutting-edge science'. He said that cutting edge and important were not synonymous, but when John Milne was active in seismology his work on global earthquake monitoring was most certainly both cutting edge and important. Earthquake monitoring is no longer cutting edge, but it remains as important as ever. It was the work of Milne and his contemporaries that gave us our history, and it was that history that gave us our culture as

The Fourteenth Mallet-Milne lecturer Dr Roger Musson with SECED Chair Dr Andrew Mair

scientists and engineers. He urged us not to neglect it.

For those who missed the Mallet-Milne lecture, you can still view a recording of the event on line; a link is available via the SECED website, www.seced.org.uk. In addition, and in keeping with tradition, the lecture was published as an edition of the Bulletin of Earthquake Engineering, in this case, Volume 11, No. 3 (Musson, 2013). This year for the first time ever, the Mallet-Milne lecture is also available as an Open Access publication, which means that it is freely available to download on-line at http://link.springer.com/journal/10518/11/3/page/1.

The move towards open access publication is a reflection of the age in which we now live, and is in response to an increased demand for electronic publication rather than the printed page, particularly among the younger generation. In this modern electronic age it is easy to forget the vast resource of printed works that are retained in the ICE library, and we are indebted to Mike Chrimes and his team at the ICE for unearthing a variety of historical publications and images relating to earthquake engineering, and particularly works by Robert Mallet and John Milne. These were available to view in a series of display cases outside the lecture theatre. They made very interesting viewing.

The Mallet-Milne lecture is a significant undertaking for SECED, and we are very grateful for the generous support which we received from our sponsors; the Institution of Civil Engineers, the Gray-Milne Fund and the British Geophysical Association.

Following the lecture Dr Musson was presented with an engraved quaich as a memento of the evening.

References

Musson R. M. W. (2013). A history of British seismology. *Bulletin of Earthquake Engineering*, **11**: 715–861.

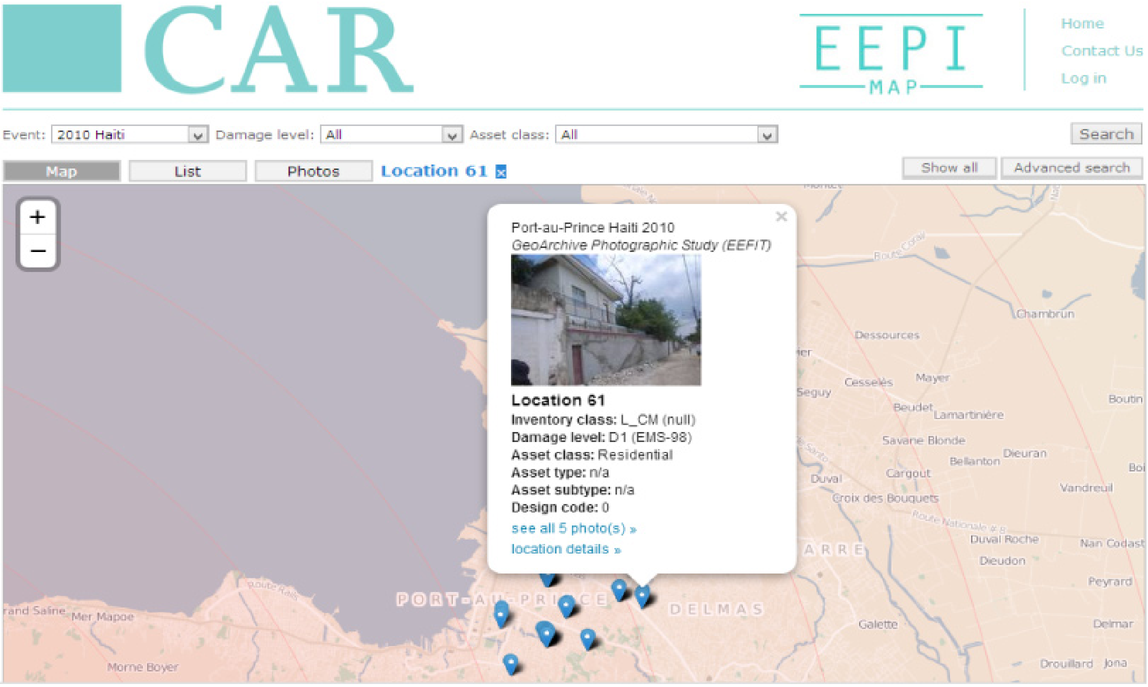
Earthquake Engineering Photographic Investigation Map

Roxane Foulser-Piggott
Cambridge Architectural Research Ltd

The Earthquake Engineering Photographic Investigation Map (EEPI Map) is a tool developed by Cambridge Architectural Research which enables photographs to be used to investigate building vulnerability to hazards, and analyse post-earthquake event damage patterns and shaking intensity. The first version of the website and a project report are available at: http://eepi-map.com/overview/.

EEPI Map is based on a comprehensive geo-referenced photographic database (containing nearly 12,000 photographs) which contains attributes of buildings and engineered structures, and includes a large number of photographs from previous Earthquake Engineering Field Investigation Team (EEFIT) missions.

As demonstrated by the photographs currently in the EEPI Map database, photographs are taken as part of the majority of field surveys of earthquake-affected regions. These photographs often form an important part of desk studies conducted after the field survey to analyse damage patterns and shaking intensity. However, previously, the way in which these photographs were catalogued and stored did not maximise the utility of this source of information. EEPI Map aims to increase the utility of photographs in post-event analysis of hazard affected regions. Although the project is independent, it has been designed to be compatible with a number of Global Earthquake Model (GEM) initiatives.



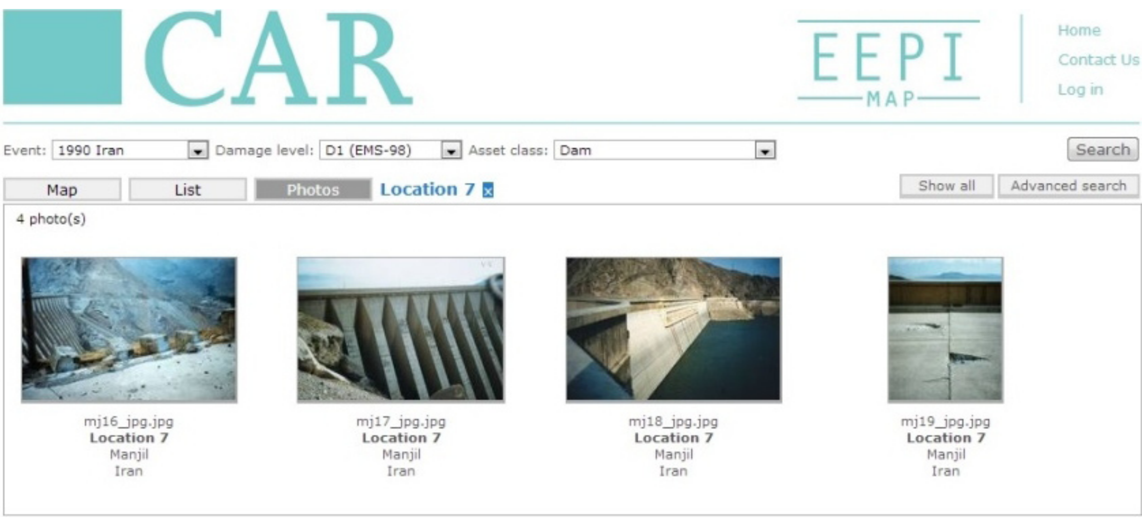
Example map displaying photographs and their locations in Haiti. Clicking on a location displays a thumbnail photograph and photograph attributes.

EEPI Map has the following capabilities:

- EEPI Map can be added to by the public or by professionals, using a mobile application under development, to upload photographs along with building inventory (pre-event) or building damage information (post-event).
- Seismic Experts can inspect uploaded photographs via a web interface and assign geo-locations, building typologies and damage attributes.
- It can be searched online to provide photographs and information on structures useful to engineers, researchers and practitioners. An example of this functionality is shown, where a search for Asset Class: Dam and Damage Level 1, displays 4 photographs.

These basic functions improve current methods of displaying and searching the photographs taken on field missions, e.g. EERI photograph database (available to members of EERI only) and the Virtual Disaster Viewer (http://vdv.mceer.buffalo.edu/vdv).

- Data is stored in an industry-standard geospatial earthquake consequences database structure.
- It can be used as a framework to analyse the attributes of the photographs to give information on building vulnerability, damage level and, in the case of earthquakes, predictions of shaking intensity.
- Photographs and associated metadata can be extracted from the EEPI Map server through standard interfaces such as WFS and WMS.



Search results on EEPI map: Asset Class – Dam; Damage Level – 1.

The information provided by EEPI Map is freely available and will have a number of potential user groups – for example earthquake engineers, insurers, and the media – and can also be used for education purposes. EEPI Map information on damaged buildings will also form the photographic appendix to the proposed new International Macroseismic Intensity Scale, IMS-14 (Foulser-Piggott and Spence, 2013); an internationally applicable update to EMS-98 (Grünthal et al.).

The EEPI Map project has a number of immediate aims for development, which include the acquisition of more photographs and modifications to the existing cataloguing system and database. There are also a large number of planned extensions, enhancements and applications of the EEPI Map which would ultimately provide an extremely useful tool for the analysis of pre- and post-disaster images for earthquake risk assessment.

The EEPI Map report (Foulser-Piggott et al., 2013) gives detailed information on the status of EEPI Map and the planned future developments. This includes proposed field investigation team photograph guidelines and the development of semi-automatic intensity assignment based on photographed locations and recorded attributes. For further information or to contribute photographs to the database, please contact: roxane@carltd.com.

References

Foulser-Piggott, R., & Spence, R. (2013). Review and revision of the EMS-98 vulnerability table. *Conference on Earthquake Engineering and Structural Dynamics (VEESD)*, Vienna.

Foulser-Piggott, R., Ruffle, S., Spence, R., & Baker, H. (2013). EEPI Map - Earthquake Engineering Photographic Investigation Map: An overview. *CAR Report*, Available at: http://eepimap.com/static/eepimap.pdf.

Grünthal, G. (ed) (1998). The European Macroseismic Scale 1998. Council of Europe, Luxembourg.

Notable Earthquakes October 2012 – December 2012

Reported by British Geological Survey

Issued by: Davie Galloway, British Geological Survey, April 2013.
Non British Earthquake Data supplied by The United States Geological Survey.

			Time			Dep	Magnitude			
Year	Day	Mon	UTC	Lat	Lon	km	ML	Mb	Mw	Location
2012	08	OCT	03:11	49.60N	2.93W	8	2.2			GUERNSEY, CHANNEL ISLES
2012	08	OCT	09:28	53.22N	1.05W	1	1.6			OLLERTON, NOTTS
Felt Ollerton (2 EMS).										
2012	09	OCT	12:32	61.03S	153.96E	10			6.6	BALLENY ISLANDS
2012	10	OCT	05:18	52.85N	1.36W	11	1.8			CASTLE DONINGTON, LEICS
2012	12	OCT	00:31	4.89S	134.03E	13			6.6	PAPUA, INDONESIA
2012	12	OCT	21:33	56.91N	4.75W	8	1.3			SPEAN BRIDGE, HIGHLAND
Felt Bohuntine (2 EMS).										
2012	24	OCT	00:45	10.09N	85.30W	17			6.5	COSTA RICA
2012	25	OCT	23:05	39.88N	16.01E	6			5.3	SOUTHERN ITALY
One person died of a heart attack in Cosenza.										
2012	27	OCT	17:07	56.38N	6.10W	1	1.1			MULL, ARGYLL & BUTE
Felt Pennyghael, Mull (2EMS).										
2012	28	OCT	03:04	52.79N	132.10W	20			7.8	QUEEN CHARLOTTE ISLANDS
2012	31	OCT	15:59	55.97N	5.94W	7	2.7			JURA, ARGYLL & BUTE
Felt Islay (2EMS).										
2012	07	NOV	16:35	13.96N	91.85W	24			7.4	OFFSHORE GUATEMALA
At least 48 people killed, 155 injured, around 100 still missing presumed dead and dozens of buildings damaged in Quetzaltenango and San Marcos. Tsunami recorded with wave heights of 30 cm at Puerto Chiapas.										

			Time			Dep	Magnitude			
Year	Day	Mon	UTC	Lat	Lon	km	ML	Mb	Mw	Location
2012	08	NOV	09:10	49.25N	3.41W	15	2.3			ENGLISH CHANNEL
2012	11	NOV	01:12	23.01N	95.89E	14			6.8	MYANMAR
At least 26 people killed, 230 others injured and over 500 homes and buildings damaged or destroyed in the Shwebo area.										
2012	11	NOV	22:14	14.13N	92.16W	20			6.5	OFFSHORE GUATEMALA
2012	16	NOV	18:12	49.28N	155.43E	29			6.5	KURIL ISLANDS
2012	21	NOV	09:08	55.85N	10.31W	34	2.7			ATLANTIC, NW OF IRELAND
2012	22	NOV	19:46	55.78N	6.26W	12	2.0			ISLAY, ARGYLL/BUTE
Felt Bruichladdich, Bridgend, Bowmore, Port Charlotte, Kilchonan, Gruinart and Portnahaven, Islay (3 EMS).										
2012	28	NOV	21:37	54.51N	2.99W	8	2.1			PATTERDALE, CUMBRIA
Felt throughout most of southern Cumbria in Patterdale, Ambleside, Bowness-on-Windermere, Ings, Old Hutton, Kendal, Keswick, Ulverston, Glenridding, Grasmere, Windermere, Braithwaite, Coniston, Penny Bridge, Crosthwaite, Penrith, Selside, Workington, Grange-over-Sands and Kentmere (3 EMS).										
2012	05	DEC	09:53	64.41N	4.29W	20	3.0			NORWEGIAN SEA
2012	05	DEC	13:02	64.44N	4.26W	20	2.9			NORWEGIAN SEA
2012	07	DEC	08:18	37.89N	143.95E	31			7.3	HONSHU, JAPAN
At least five people injured in Miyagi and five injured in Tokyo.										
2012	08	DEC	01:11	57.51N	5.56W	6	1.7			SHIELDAIG, HIGHLAND
Felt Shieldaig (3 EMS).										
2012	10	DEC	16:53	6.53S	129.83E	155			7.1	BANDA SEA
2012	11	DEC	19:22	56.86N	4.85W	8	1.6			SPEAN BRIDGE, HIGHLAND
Felt Spean Bridge, Roybridge and Torlundy (3 EMS).										
2012	14	DEC	23:03	50.96N	0.82W	9	2.9			CHICHESTER, WEST SUSSEX
Felt Chichester and Coldwaltham (West Sussex), Haslemere, and Hindhead (Surrey) and Hove (East Sussex) (3 EMS).										
2012	21	DEC	22:28	14.34S	167.29E	201			6.7	VANUATU

SECED

SECED, The Society for Earthquake and Civil Engineering Dynamics, is the UK national section of the International and European Associations for Earthquake Engineering and is an affiliated society of the Institution of Civil Engineers. It is also sponsored by the Institution of Mechanical Engineers, the Institution of Structural Engineers, and the Geological Society. The Society is also closely associated with the UK Earthquake Engineering Field Investigation Team. The objective of the Society is to promote co-operation in the advancement of knowledge in the fields of earthquake engineering and civil engineering dynamics including blast, impact and other vibration problems.

For further information please contact the SECED Secretary at the ICE at: secretary@seced.org.uk.

SECED Newsletter

The SECED Newsletter is published quarterly. All contributions of relevance to the members of the Society are welcome. Manuscripts should be sent by email. Diagrams, pictures and text should be attached in separate electronic files. Hand-drawn diagrams should be scanned in high resolution so as to be suitable for digital reproduction. Photographs should likewise be submitted in high resolution. Colour images are welcome. Hard copy manuscripts are also welcome.

Please contact the Editor of the Newsletter, Damian Grant, for further details: damian.grant@arup.com.

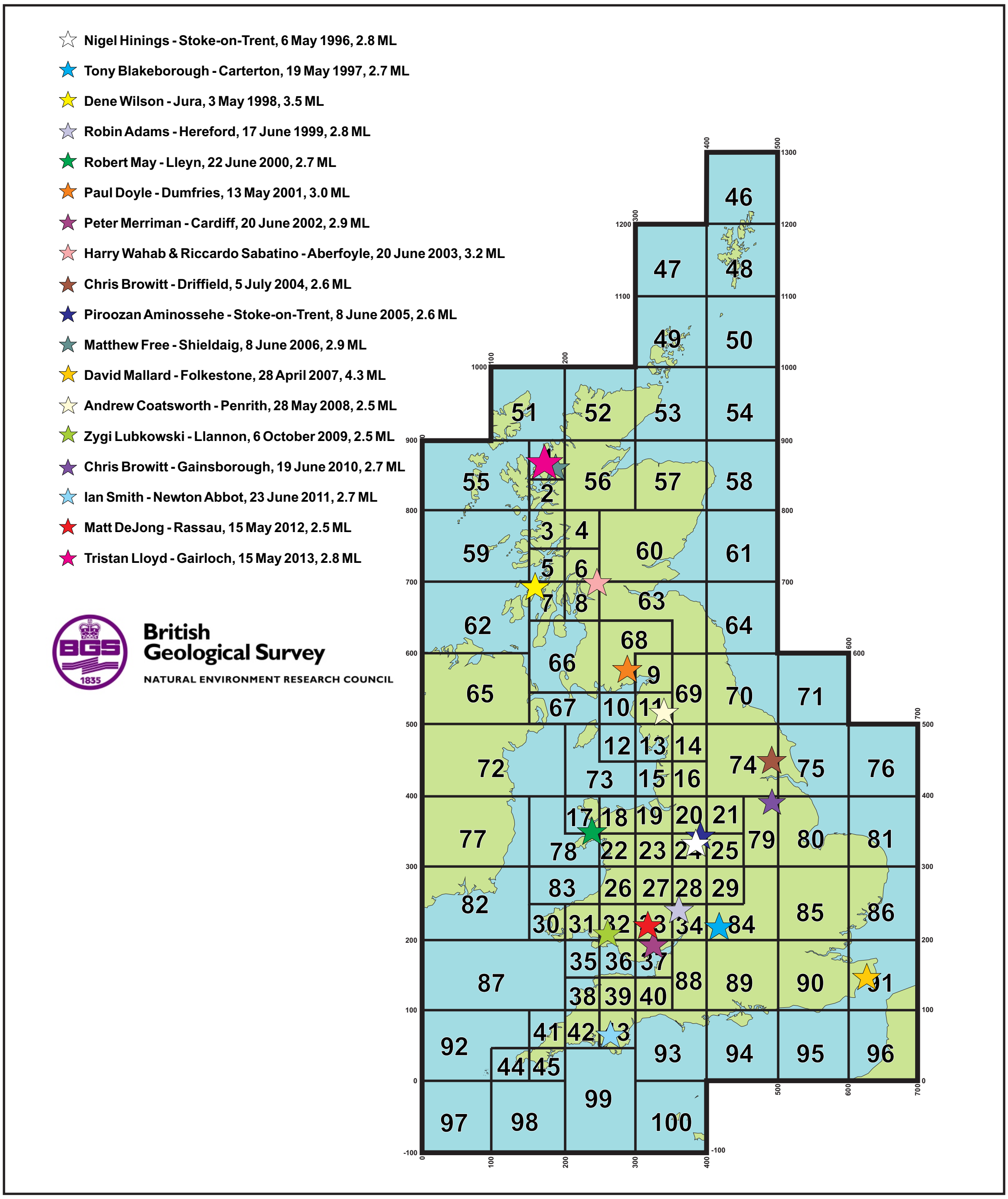
SECED Earthquake Competition Result 2013

This year's SECED Earthquake Competition ended with a bang when a M_L 2.8 tremor struck in Gairloch, Scotland, on 15th May.

The successful predictor this year was Tristan Lloyd, who placed half his £2 investment on the auspiciously labelled square #1 (see map below for previous winning squares), and converted the price of a London cup of coffee into a celebratory bottle of bubbly. Tristan was presented with his prize at the September meeting.

Tristan modestly attributes a large, unquantified portion of his success to blind luck, along with 'understanding a map of UK seismicity'. A glance at the list of illustrious previous winners below should convince the reader that luck plays but a small role in deciding who takes home the annual prize.

Look out for Alice Walker, the competition organiser, at the SECED AGM in April to enter 2014's competition. But watch out – Tristan plans to defend his title next year!



Earthquake Competition Winners, 1996–2013