ASEAN FORUM ON NATURAL CATASTROPHE EXPOSURES IN ASEAN

The ASEAN Forum on Natural Catastrophe Exposures within the ASEAN region held a two days conference in Grand Park City Hotel in Singapore on July 16-17, 2009. The whole thing started in November 2007 when a handful of scientists and practitioners, under the instigation of Mr. Teddy Hailamsah, came to the idea while discussing the possibility of having an official ASEAN Forum on natural disasters by combining not only academician (scientist and engineers) but also incorporating several practitioners such as insurers, bankers, ad other related business people. In fact it was initiated by the ASEAN Insurance Council (AIC) suggesting to have a gathering of academician specializing in Asian natural disaster research, insurance or practitioners and other relevant public and private sector organizations to facilitate a dialogue, information exchange, and initiate appropriate action. To spearhead this project the ASEAN Natural Disaster Research Works Sharing (ANDREWS) Committee was formed, under the auspices of the AIC, comprising representatives from various technical universities and relevant research institutions.

During the July 2009 conference in Singapore two important topics came to the fore, these are: 1) the problem of ash fall from volcanic eruptions. As we all know ash from volcanic eruptions could damage sophisticated equipments and instruments in the industry and laboratories such as: computers, and engines of jet planes. This session was introduced by the Chairman of the session, Prof Chris Newhall from the National Technical University in Singapore (NTU). Another panel discussion which attracted a large number of participants was the question of forming a regional insurance pool within the ASEAN countries.

Among the prominent speakers of which papers attracted much attention was the paper by Prof MT Zen from the Institute of Technology of Bandung, Indonesia and Head of the Research and Development Division of PT Asuransi MAIPARK Indonesia, who spoke about the possibility of a mega catastrophe triggered by the Anak Krakatau eruption in the Sunda Strait, between Java and Sumatra.

Other prominent speakers during the panel on regional pool of earthquake insurance pool in ASEAN were Mr. John Tan, founder of Asia Capital Reinsurance Group (ACR) in Singapore, and Mr. Frans Sahusilawane, President Director of PT Asuransi MAIPARK Indonesia. Excerpts of the paper by Mr. Frans Sahusilawane and by Prof Zen are being reproduced in this edition of WASPADA.

Conclusions of Andrew’s Panel on the ASEAN Earthquake Insurance Pool
1. Listening to each of ASEAN’s Experts there is no doubt that the founding of an Earthquake Insurance Pool is very possible. Of course, each member country will have to determine itself with regards to the pace of the process.
2. Taiwan and Indonesia can well be the example of how the pooling process has been made. It is very interesting to note that in the case of Indonesia the pooling initiative in 2003 was taken:
   (i) Before Indonesia was hit by a real devastating quake.
   (ii) The initiative was taken by the industry at the instigation of Indonesia’s Ministry of Finance in 2003
3. In 2007 MAIPARK completed the first phase of its Earthquake Catastrophic Model which is the first one in South East Asia.

Krakatau in the Sunda Strait: A Mega Catastrophy in the Making

In the early 80th the first author considered the Sunda Strait Area as to be a volcano tectonic depression. In a short unpublished note but communicated to the meeting of the Geophysical Society (Bandung Chapter, Panghegar Hotel, 1992) Zen mentioned that the Sunda Strait Region is a Sunda Geo-Tumor area like the Batak Tumor in North Sumatra (van Bemmelen 1949, 1954). During this Sunda Strait research-days and the Sumatra Fault days Zen was inspired by the Batak Tumor Concept of van Bemmelen (1949; 1954) and tried to apply the concept to unravel the Sunda Strait problem. One of the many arguments he used was the presence of so many granite batholiths in Sumatra island, whereas granite batholiths are not so numerous in Java. One of the many examples that he quoted was the large Bengkunat granite batholith in Bengkulu which was mentioned to be 11 km long. In Java the volcanoes are andesitic in nature. They do not have the granitic roots like so many volcanic centres in Sumatra. As examples he mentioned the Toba tuffs deposits, the Maninjau tuffs deposits, the Ranau tuffs deposits. In West Banten pumestone tuff deposits are found. But they are from the Krakatau 1883 eruption. The volcanoes in Sumatra Island along the Barisan mountains, all have acid batholiths as their roots. This is not the case with the volcanoes in Java.

The Krakatau 1883 eruption was preceded by a gigantic one in 535 AD (Wohletz, 2000). Escher (1950) in his block diagram on the evolution of the Krakatau Complex (Fig. 2) hinted that before the Danan-Perbuatan-Rakata eruption in 1883, there was a hypothetical Proto Krakatau volcano. When this exploded and disappeared Escher did not mention a word. Wohletz (2000) put the Proto Krakatau eruption at 535 AD, Escher (1950) did not mention the date of the destruction of the Proto Krakatau and Zen’s (long before 1883, about 1 million year ago) super volcanic eruption of the Sunda Geo-Tumor leading towards the collapse of the Sunda Geo-Tumor and the formation of the Sunda Strait Basin could lead to the same phenomena. The history of Sumatra Island and its clockwise rotation (Ninkovitch, 1976), the opening of the Sunda strait (Zen, Jr, 1993), and the formation of the Sumatra fault System are closely connected. The rotation of Sumatra Island caused the oblique subduction and the right lateral movements along the Sumatra Fault System. The origin of the Sumatra Fault is estimated to be Plio-Pleistocene age (2 million years) by Danny Hilman Natawijaya (personal communication with the senior author on June 15, 2009). The volcanoes of Sebesi, Sebuku, Rajabasa, Krakatau, and the Panaitan volcanic remnant in the South are lying in one volcanic lineament. Within the Sunda Strait itself there are several caldera-like depressions detected by Nishimura (1994) by means of a gravity survey. The eruptions of the Sunda Geo-Tumor were not from the Krakatau complex only but from many volcanic centres in the Sunda Basin. The gigantic eruptions in 535 AD (Wohletz, 2000) could be the same proto eruption hinted by Escher (Escher, 1950) were followed by the collapse of the upper part of the Sunda Geo-Tumor through emptying the magma chamber and lack of support of the roof, leaving a depression which is the present day Sunda basin/strait.

Seismicity of the Sunda Strait region.

Along the south, the western end of the Sunda Strait there were many earthquake occurrences in the past; some of them quite big. The one taking place in 1903 was particularly very big, recorded at M=8. However, there are other ones, less big but, many. This region has become a seismic-gap region for some time, therefore very dangerous. The authors of this paper consider an earthquake of magnitude 8 as being very dangerous in the vicinity of Anak Krakatau. Most of this volcano is submerged under water. Besides, it is located at the edge of the old caldera rim. This region is being dissected by faults and graben structures. Any disturbance along these fault lines or zone might easily cause cracks to be formed in the volcanic body which is under water, and can easily reach the hotter part of the volcanic body to cause a phreatic eruption. This on the other hand can cause a phreato-magmatic eruption, which again could change into a plinian eruption which finally causes the collapse of the volcanic body followed by a tsunami. This will be disastrous for the cities around the Sunda Strait. But, tsunami or no tsunami, the tephra fall, especially the fine ash fall will be very disastrous for crops in Banten, many parts of West Java and in Lampung area. It will be a problem to the

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Fig. 1. Index map of the Sunda Strait area between Java and Sumatra Island with Anak Krakatau volcano in the middle.

Fig. 2. Evolution of the Proto Krakatau Volcano until the birth of Anak Krakatau in 1927 by Escher (1950).
engines of jet planes parked in the nearby airfields, even in the airport of Cengkareng, Halim, and Pondok Cabe in Tangerang, and also to the computers in the industrial complexes nearby. It might be a nuisance also in Singapore, Batam and Bintan (Fig.3).

If the process really evolves into a phreato- plinian process it is most probably a chemical kinetic process; without the interference of a phreatic process it is most probably a thermodynamic one. It is a matter of the speed of ash formation, and that is the speed of nucleation. Whether an earthquake in the Indian Ocean nearby will trigger a phreatic eruption or whether the eruption really evolves into a gigantic plinian eruption which causes the collapse of half of the volcanic body is an academic question. We do not say it is not important, but we do say that the dilemma it causes is more relevant right now than the academic consideration.

A dilemma conclusion.

What conclusions and consequently what recommendation should this prestigious gathering voice out. The people around the Sunda Strait area like frogs airing out a swan song while a time bomb at the bottom of the pond is ticking the precious seconds away from their lives. We know this. But, again what shall we say? Shall we recommend to stop developments or evacuate the whole area? Our dilemma is similar to Hamlet’s. To change his famous words of “To be or not to be” into “To develop or not to develop”. Be sure Hamlet could not stop the development. The time bomb will explode…one day…When we do not know, but it will. The most important thing for this gathering is “what shall we say?” No matter what, the development will go on. The Java-Sumatra bridge will be built one day, if not the Java-Sumatra tunnel; the ferry service between Merak and Bakauheni will increase its frequencies, the industrial complexes will grow, tourists resorts will sprawl like mushrooms after a heavy rain; there will be more people living around Sunda Strait by the day. A dilemma and an irony, a blessing or a curse! However we have the moral obligation to say something more meaningful, and not resembling something which comes very close to a “banality”. Our last remark concerning the geological sciences is the following: “it looks like that geologists have developed a very effective tool in analyzing and reconstructing very slow processes in the geological past, look at the works of Emil Argand, Paul Termier, Kaiser and Staub. What they did in reconstructing the evolution of the Alps was amazing and unbelievably beautiful. But it seems to me that geologists are still powerless in analyzing and unravelling fast evolving processes like what happens at the foci of earthquakes or at the hearths of volcanoes when they are in eruption. What approaches do we recommended to cope with this problem?

A phreato-magmatic eruption.

A similar event took place in the Pematang Bata area in the marshy region in the Pematang Bata area. Surface water spilt into the cracks in the ground opened by the earthquakes and caused a phreatic eruption which also changed into a phreatomagmatic eruption, and finally changed into a real magmatic eruption. The detonation could be heard in Kebumen in Central Java (Stehn, 1933). A similar event took place, with the Taal volcano in Lake Bombon, 40 km South of Manila in 1965. The conclusion of this short paragraph is that one can not neglect earthquakes near a volcanic area especially of which volcanic body lies under water and surrounded by human settlements. A very interesting question arises from this discourse is of course what reactions evolve in such a process? A pure chemical kinetics or a thermodynamic reaction instead?
The authors try to summarize by means of Fig.4-6 what are at stake and what underwriters ought to know; how many people will be affected, what cities will suffer and the approximate economic loss the Krakatau might inflict to the surrounding regions. We are aware that our estimated loss is much too low since we do not include the values within the dwelling houses, the infrastructures, and the social economic disruption the calamity will cause. We beseech that this gathering can really open many eyes (the Indonesian government, that is to say The Nat’l Agency for Natural Disaster Management (BNPB) that we face a very serious and a big problem, and that is the economic development around Sunda Strait itself.

The eruption mechanism.
Explosive eruptions are so varied in their products and effects that it is difficult to generalize on the processes that produce them. The only feature they share in common is a sudden release of energy by gas under pressure, however, the manner in which the expansion acts on the rocks or magma differs a great deal. Explosivity does not correlate directly with either volatile or even silica content alone. It is a function of both, and most important are the rate of expansion and the degree to which gases expand in the rising magma. This is of great importance since it is the manner in which this expansion takes place beneath the surface that governs the pressure released in a discharging vent. McBirney (1979) expressed very clearly that “two magmas of differing viscosities may release the same energy and volume of gas but erupt in a totally different way.” The eruptive behaviour of magma is very much controlled by the manner in which gas expands in the rising magma. Assume that two columns of rising magma, A and B are identical in all respects and begin to vesiculate at the same depth but, because of differences of viscosity or rate of ascent, the rate of expansion in A is more rapid (see Fig 7); the pressure released at the surface will be higher for column B. For that reason, the magma of that column will erupt with greater violence.

The authors of this paper are of the opinion that the rate of vesiculation will be strongly influenced by the presence of water in the magma. Therefore island-arc volcanoes tend to be more explosive than continental ones. Marine sediments contain quite a lot of water. Therefore submarine volcanoes (Krakatau, Santorini, Tambora) or volcanoes close to the shore (Vesuvius, Bandai San) tend to be more violently explosive. Look at the similarity between the Santorini Complex in the Aegean Sea which buried the Minoan Civilization, with the Krakatau volcanic complex. Krakatau is not too far from the subduction zone. Soft water-rich marine sediments are being scraped by the subduction process. This explains the explosivity of Indonesian volcanoes, Krakatau in particular.
Conclusions

The Sunda strait area has become a spot of very high exposure due to development processes. In case an eruption like in 1883:

- Population affected > 38 million
- Dwelling houses affected in and around Sunda strait 9.8 million
- Total estimated economic loss in trillion of IDR : 1.2
- Disruption of social-economic activities
- Agriculture
- Infrastructure

Recommendations

1. The area in and around Sunda Strait shows a very high vulnerability. Serious steps have to be taken from now on or in order to secure a rather “smooth” emergency situation.
2. A long term land use policy has to be implemented, using the “guidelines” of the seismic hazard map already in existence; imposing building codes, and refurbishing plus strengthening the houses and buildings.
3. It is therefore imperative that short term contingency planning involving the provincial governments must be set up, followed by routine drill exercises.
4. The Insurance Community must do the utmost to increase the Insurance Penetration and the Insurance Density in this particular region.
5. At the meantime let all of us think, think hard, as how to avert the disastrous effect of a large scale ash fall. A joint integrated research project can be contemplated on this subject.

At the meantime let Horatio be known that there are more things between Earth and Heaven than he can think of in his own philosophy.

References


BUILDING A SUSTAINABLE NATURAL CATASTROPHE INSURANCE POOLING MODEL FOR THE REGION
Frans Y. Sahusilawane

Insurers and reinsures in the region have long been using insurance and reinsurance pools as a device to overcome problems of shortage of capacity in covering undesirable or target risks. Some of these pools have vanished but some still exist carrying with them interesting success story.

An example for the unsuccessful pool is ASEAN Reinsurance Pool (ARP) established by ASEAN countries in 1970’s, (later transformed into a corporate - ASEAN Reinsurance Company). The successful ones are FAIR General Reinsurance, Aviation, and Oil & Gas Pools; and Indonesia’s 30-year old Special Risk Insurance Consortium (SRIC – or KARK in Indonesian)


After a series of strong earthquakes in their territories in late 1990s, Turkey and Taiwan took initiatives to establish their catastrophe insurance pools, TCIP (1999) and TREIP (2002).

These pools of insurance and reinsurances have reasons behind their success or failure. By looking at their experience one may figure out whether we have grounds to build a sustainable natural catastrophe insurance pooling for the region, and if so, how to do it properly.

Pools suitable only for special business. Too many threats in environment of Pool for general business.

Climate Change, Urbanization, Development of Mega cities, all contribute to potential huge loss from high concentration of value exposed to increasing frequency of catastrophe events; Governments increasingly become aware of limitation of national budget to absorb potential vast amount of loss from
increasing high concentration of value, also Recognition of PPP (Public Private Partnership) as a solution, are the strong reasons to build a natural catastrophe pool in the region.

To build a Sustainable Natural Catastrophe Pool requires several important things. First is awareness and recognition of exposure and being exposed. Secondly, commitment, compulsion, lack of alternative capacity, discipline is also needed. Third, Limitation of financial strength to absorb big catastrophe economically and awareness of being exposed to increasing value concentration in mega cities which are exposed to natural disaster and recognition of being benefited from economies of spread through pooling of such exposure with other regions or countries. And finally, government’s involvement as a driving force is imperative.

Fig. 1. Scheme of Commitment, compulsion, alternative capacity, discipline in natural catastrophe pool’s requirement

<table>
<thead>
<tr>
<th>Earthquake Events</th>
<th>Date</th>
<th>Magnitude</th>
<th>Casualties</th>
<th>Economic Losses (million USD)</th>
<th>House Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natuna Earthquake</td>
<td>26.11.07</td>
<td>7.2</td>
<td>31</td>
<td>55</td>
<td>4.45% - 828</td>
</tr>
<tr>
<td>Aceh Earthquake</td>
<td>26.11.04</td>
<td>9</td>
<td>176,733</td>
<td>5,000</td>
<td>-</td>
</tr>
<tr>
<td>Niua Earthquake</td>
<td>28.03.05</td>
<td>8.6</td>
<td>905</td>
<td>666</td>
<td>-</td>
</tr>
<tr>
<td>Padang Earthquake</td>
<td>10.04.05</td>
<td>6.7</td>
<td>0</td>
<td>222</td>
<td>49</td>
</tr>
<tr>
<td>Javaarta Earthquake</td>
<td>26.09.06</td>
<td>6.9</td>
<td>5,749</td>
<td>3,100</td>
<td>284.452 - 17.688</td>
</tr>
<tr>
<td>Palu Earthquake</td>
<td>17.03.05</td>
<td>7.7</td>
<td>607</td>
<td>17.5</td>
<td>-</td>
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<tr>
<td>Padang Earthquake</td>
<td>26.09.07</td>
<td>6.3</td>
<td>87</td>
<td>167</td>
<td>17.979 - 12.802</td>
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<tr>
<td>Bengkulu Earthquake</td>
<td>22.09.07</td>
<td>8.4</td>
<td>25</td>
<td>164</td>
<td>40.613 - 21.627</td>
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<tr>
<td>Donmu Earthquake</td>
<td>26.11.07</td>
<td>6.7</td>
<td>3</td>
<td>8.8</td>
<td>-</td>
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<tr>
<td>Donmu Earthquake</td>
<td>26.11.08</td>
<td>7.7</td>
<td>-</td>
<td>12.9</td>
<td>-</td>
</tr>
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<td>Gorontalo Earthquake</td>
<td>16.11.08</td>
<td>7.8</td>
<td>1</td>
<td>800</td>
<td>1.418 - 409</td>
</tr>
<tr>
<td>West Papua Earthquake</td>
<td>04.01.09</td>
<td>7.6</td>
<td>3</td>
<td>329</td>
<td>4.432 - 2.956</td>
</tr>
</tbody>
</table>

Source: National Disaster Management Agency (BNPB)

As an example of successful effort of pool establishment in Indonesia is the creation of Indonesian Earthquake Reinsurance Pool (IERP) which then transform to become a limited company of PT Asuransi MAIPARK Indonesia.

Almost 20% of destructive and tsunamigenic earthquake occurred in Indonesia. Both pre-disaster and post disaster spending by the Indonesian Government were increasing from year to year.

Fig. 2. Economic loss and casualties due to earthquake in Indonesia
Question after series of earthquakes in late 1990s that hit China, Iran, Turkey, and Taiwan: “Will Indonesian insurance companies survive a strong EQ in Indonesia?

In 2001, after 1 year of research, TKARBA Working committee concluded handling of earthquake insurance in Indonesia were improper, and; most companies would have problems if a strong EQ hit areas like Jakarta or west Java. As a response, IERP was established in 2002, this pool started its operation on 1 January 2003. Later with several considerations, IERP was transformed to PT Asuransi MAIPARK Indonesia in December 2003 and started its operation in 1 January 2004.

The transformation from pool to PT Asuransi MAIPARK Indonesia is concerned as follows: problem of legal entity, problem of joint and several liability, continuous research and updating data base, also continuous participation in DRR.

The mission of the pool are: To promote proper handling of earthquake insurance in Indonesia insurance industry; To collate statistic, prepare nationwide database and risk profile; To do research and studies on earthquake risk and related matters, and also to generate local capacity.

Reason why handling earthquake risk first is that we have expertise, resources and spread exposure that gives us a chance to do it economically.

Earthquake Tasikmalaya 2 Sept 2009

On September 2nd, 2009 at 2:55, there was an earthquake with a SR 7.0. The location of the earthquake was 125 km southwest of Kota Tasikmalaya (7.809° LS 107.259° BT) with a depth of 46.2 km. The cause of the earthquake is the crash of Indian-Australian plate with the Eurasian plate in the south island of Java.

The earthquake was felt in Jakarta and almost every place in West Java. The maximum earthquake intensity is VII MMI in Garut, VI MMI in Bandung, Cianjur, Tasikmalaya and Sukabumi and V MMI in Bekasi and Bogor. Based on BNPB report, the numbers of victims were 81 people died, 45 people missing, 1,238 people wounded, and 177,490 refugees. 225,051 units of dwelling houses were damaged (65,738 units were heavily damaged, 36,336 units were medium damaged and 122,977 units were lightly damaged).

More will be discussed in the next edition WASPADA.