CSIR-STRUCTURAL ENGINEERING RESEARCH CENTRE

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To,

Shri Bijender Goel,

Managing Director,

M/s Terra Techcom Pvt. Limited, New Delhi

Dear Sir,

Sub: Brief Report on the test conducted on 'Early Earthquake warning and security system', at CSIR-SERC, Chennai on 10/March/2016

The sensor and the measurement system, termed as "secty lifePatron" bearing Sl. No. 91/DEQ(m)004-007 GR, which constitute the 'Early Earthquake warning and security system' developed by M/s. secty electronics GmbH, Germany and marketed by M/s Terra Techcom Pvt. Limited, New Delhi, is tested at the Advanced Seismic Testing and Research Laboratory (ASTaR) of CSIR-Structural Engineering Research Centre (CSIR-SERC) on 10/March/2016.

The scope of the test include,

1. Evaluation of the threshold acceleration levels of the given earthquake warning system
2. Interpretation of test results and submission of report

The equipment has been connected to an 'L' fixture and rigidly anchored to the 4m X 4m tri-axial shake table system of CSIR-SERC and subjected to base excitation in the form of tri-axial acceleration input along X, Y (horizontal) and Z (vertical) directions. The acceleration time history of a typical recorded earthquake motion (Duzce Earthquake, Turkey, 1999 and supplied by M/s. Secty Electronics Gmbh, Germany) is applied in the three orthogonal directions, with progressively increasing values of Zero-Period Acceleration/Peak Ground Acceleration (ZPA or PGA). To evaluate the working robustness of the equipment, another input in the form of a linearly ramping up modulated swept sine acceleration time history with a frequency range of [redacted] also applied along the Z direction with four different values of ZPA/PGA. Prior to the actual test conditions these two time histories are simulated in the laboratory, with an iteratively modifiable transfer function between the drive displacement to the target acceleration, until the root mean square error between the target and achieved signatures have reached a minimum. This trial test is done in the absence of the equipment, with a dummy mass simulating the mass of the equipment.

The instrument has eight channels for generation of warning signal. Each channel sends out a DC square pulse of 15.0 V output synchronized with the sensing of a threshold acceleration level in the Z-direction (global vertical), which varies with progressively increasing values, characteristic of that channel. This threshold values are factory-set and are adjustable only at the factory. The input

acceleration values and the warning pulses are recorded synchronously in a data acquisition system of the laboratory to evaluate the threshold acceleration level at which the instrument sends the warning signal for each channel. Since 15 V is a non-standard voltage input, and is beyond the full-scale input of the DACS, it is scaled down to half (by a serially added resistor) and recorded. The main scope of the test is to evaluate the threshold values of acceleration for generation of warning signals and this will be evaluated and reported after further processing of the data with DC offset corrections and band-passed filter output with [redacted] band pass filter. This will be made available in the form of a detailed report to be submitted by CSIR-SERC.

Main observation is summarized as follows:

1. The instrument 'Early Earthquake warning and security system' does generate warning voltages of 15 V DC, at each channel with progressively increasing acceleration inputs, triggered by the Z-direction acceleration, which also de-triggers after sensing a lower threshold value.
2. These threshold values for triggering the output voltage for each channel range from [redacted] to [redacted] channels 1 to 8 in a progressively increasing order. These values will be however confirmed and given in the detailed report.
3. The time lapse between the sensing of this threshold acceleration level to the beginning of the strong motion earthquake (in the form of arrival of strong 'S' wave input) could be used as the pre-warning time. However, this time lapse of pre-earthquake warning is a function of the actual velocity of 'P' and 'S' waves in a region and also dependent on the distance between the earthquake source to this instrument location. Hence, for a given situation, whether this will give sufficient warning time, is conditional and beyond the scope of this project carried out at CSIR-SERC

Regards,

Yours Sincerely,

(N.Gopalakrishnan) 11/03/16

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