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Guest Editorial

Special Section: Na-Tech Risk Assessment Methodologies and Mitigation Solutions in the Process Industries

The scientific community is currently paying particular attention on the effects of Na-Tech events to industrial facilities for the important economic and social impact that these events can entail on the society. In fact, effective risk analysis is critical for industrial plants to assure the necessary safety level as clearly demonstrated by very recent events as the 2011 Tohoku Earthquake. Nevertheless, the effort in developing new techniques is being more and more important as clearly proven by the rapid increasing of the contributions on this topic.

This special topic, titled "Na-Tech Risk Assessment Methodologies and Mitigation Solutions in the Process Industries," promoted by the Guest Editors: Oreste S. Bursi, Fabrizio Paolacci and Tomoyo Taniguchi, within the Seismic Engineering Technical Committee of the ASME Pressure Vessel and Piping Division, aims to bring together the latest methodologies and techniques for a reliable estimation of Na-Tech risk in process plants that represents one of the most diffused hazards in industrial facilities. Contributions were called from researchers and industry professionals, strongly active in this area. A total of ten papers were accepted that cover many of the key topics related to Na-Tech events and consequences in Industrial Facilities.

A comprehensive state of the art on seismic quantitative risk assessment methodologies is offered in the paper titled "Problems and Perspectives in Seismic Quantitative Risk Analysis of Chemical Process Plants" authored by Antonio C. Caputo, Fabrizio Paolacci, Oreste S. Bursi, and Renato Giannini, in which possible future developments for more resilient plants are also discussed. The authors identified a list of methodological improvements that can significantly enhance the quality of seismic quantitative risk assessment, which includes all possible uncertainties in plant assessment, the loss of containment from critical components (pipes, tanks, etc.), quantification of resilience of the plants and the nearby community against Na-Tech seismic events and the use of novel nondestructive evaluation techniques for the assessment of existing plants.

A group of four papers is dedicated to the seismic vulnerability and nonlinear behavior of above ground storage tanks, covering the most recent research trends. The first one titled "Seismic Performance Evaluation of Liquid Storage Tanks Using Nonlinear Static Procedures" authored by Konstantinos Bakalis, Athanasia K. Kazantzi, Dimitrios Vamvatsikos, and Michalis Fragiadakis presents a simplified approach for the seismic performance assessment of liquid storage tanks. The proposed methodology relies on a nonlinear static analysis using a simplified numerical model used to derive seismic fragility curves through incremental dynamic analysis.

A comprehensive investigation of the effects of structural randomness (material and geometry) on the seismic fragility analysis of above-ground unanchored tanks is offered in the paper: "Enhanced Seismic Fragility Analysis of Unanchored Steel Storage Tanks Accounting for Uncertain Modeling Parameters" by Hoang Nam Phan, Fabrizio Paolacci, and Silvia Alessandri. The authors demonstrated that the parameters associated with the geometry, i.e., the filling level and the shell and bottom plate thickness, entail the strongest effects. They also concluded that in the seismic risk assessment of a plant, the random variables of tanks associated with the ground motion, and the geometric parameters (i.e., filling level and plate thickness) should be included.

The third contribution concerning storage tanks is offered by Marta D'Amico and Nicola Buratti—"Observational Seismic Fragility Curves for Steel Cylindrical Tanks"—concerned the use of the observational method for the seismic fragility evaluation of storage tanks. In particular, the authors proposed the study of seismic fragility of above-ground storage tanks, based on observational damage data available in the literature. Seismic fragility curves obtained from this procedure are also compared with those available in the technical literature. A similar approach, but related to the use of synthetic indexes of seismic vulnerability of storage tanks is proposed by Valerio De Biagi, Bernardino Chiaia, Luca Fiorentini, and Cristina Zannini Quirini in the paper titled "Seismic Vulnerability Assessment of Fuel Storage Tanks in Italy." The authors compared the empirical fragility curves present in the literature with the fragility curves based on on-site data derived from 70 Italian storage tanks.

Two remarkable contributions on the seismic vulnerability analysis of piping systems belong to this special Topic. The first authored by Yong Hee Ryu, Abhinav Gupta, and Bu Seog Ju, titled "Fragility Evaluation in Building-Piping Systems: Effect of Piping Interaction with Buildings" regarding the dynamic interaction between piping systems and support structure. More precisely, this paper is focused on the evaluation of seismic fragility of a large-scale piping system in representative high-rise, midrise, and low-rise buildings using nonlinear time history analyses.

Piping systems are also treated in the paper "Numerical Study on Inelastic Seismic Design of Piping Systems Using Damping Effect Based on Elastic-Plastic Property of Pipe Supports," authored by Akira Maekawa and Tsuneo Takahashi. They showed that maximum seismic response acceleration of the examined piping system greatly decreased in the area surrounded by pipe elbows including the elastic–plastic support which underwent plastic deformations. The stable response reduction of the support suggests the applicability of the capacity design to the seismic design of piping systems.

Soil–structure interaction is also a crucial aspect in the evaluation of the seismic vulnerability of plant structures. This topic has been treated in the paper "Analytical and Semi-Analytical Methods for the Evaluation of Dynamic Thermo-Elastic behavior of Structures Resting on a Pasternak Foundation" by Xu Liang, Zeng Cao, Hongyue Sun, Xing Zha, and Jianxing Leng. Analytical and semi-analytical methods are proposed to analyze the dynamic thermo-elastic behavior of structures resting on a Pasternak foundation. The results obtained in this paper can serve as benchmark in future studies.

In the paper, authored by Roberto Javier Merino Vela, Emanuele Brunesi, and Roberto Nascimbene titled "Floor Spectra Estimates for an Industrial Special Concentrically Braced Frame Structure" the problem of the evaluation of the seismic action of nonstructural elements through floor spectra is analyzed. This work focuses on the derivation of floor spectra for a steel concentrically braced frame, which is a common type of lateral-load resisting system for industrial frames. The results are used to compute the seismic actions on a small liquid storage tank mounted on the case study frame.

Finally, a novel methodology for the identification of local defects in pressure vessels is presented in the paper titled "Novel Defect Location Method for Pressure Vessel by Using *L* (0, 2) Mode Guided Wave," authored by Shuangmiao Zhai, Shaoping Zhou, Shaojie Chen, Bin Yang, and Yong Li. The proposed method is based on direct-waves and fuzzy C-means clustering, whose effectiveness in the defect localization has been experimentally demonstrated.

The Guest Editors of this special topic want to sincerely express their gratitude to all authors for their valuable contributions that certainly represent a reference point for both risk and resilience evaluation of process industries in the next future. Moreover, they want to express their appreciation to the Chief Editor Prof. Young Kwon for having accepted and promoted the aforementioned special topic.

Oreste S. Bursi
Department of Civil, Environment and Mechanical Engineering,
University of Trento,
Trento 38123, Italy

Fabrizio Paolacci
Department of Engineering,
Roma Tre University,
Rome 00146, Italy

Tomoyo Taniguchi
Department of Civil Engineering,
Tottori University,
Tottori 680-8550, Japan