XP-RESILIENCE

Extreme loading analysis of petrolchemicals plants and design of metamaterial-based shields for enhanced resilience

The tremendous impact of natural hazards, such as earthquakes, tsunamis, flooding, etc, which triggered technological accidents, referred to as natural technological (**NaTech**) events, was demonstrated by:

- the recent Tohoku earthquake and the following Fukushima disaster in 2011 (Nakashima et al., 2014) ;
- the UK's 2015 winter floods which topped £5bn, with thousands of families and businesses that faced financial problems because of inadequate or non-existent insurance.

The **NaTech problem** is quite relevant as up to 10% of industrial accidents, involving the release of Chemical, Biological, Radiological, Nuclear and high-yield Explosives (CBRNE) substances, were triggered by natural hazards (Campedel, 2008).
Although the number of lives lost each year to natural disaster is reduced, the recovery costs of major disasters continue to rise (OSTP, 2008). In fact, each year, NaTech disasters cause an estimated $52 billion in damages in the United States in terms of life lost, disruption of commerce, properties destroyed, and the costs of mobilizing emergency response personnel and equipment. Similar figures apply to Europe.

To implement and support the Seveso II Directive 2012/18/EU which regulates the control of major accident hazards involving dangerous substances (European Parliament, 2012), XP-RESILIENCE intends to establish a **network of individual research projects** working towards **Advanced Modelling and Protection –via metamaterial-based isolators/layouts- of Complex Engineering Systems for Disaster Reduction and Resilient Communities**. In fact, today there is a stronger need than ever to grow researchers that combine a robust academic foundation in reliability/resilience with practical experiences, technological expertise with awareness of the socio-economical context and conviction to furthering research with an entrepreneurial spirit. Hence, the objective of XP-RESILIENCE is to offer innovative research

training ground as well as attractive career development and knowledge exchange opportunities for **Early Stage Researchers (ESRs)** through cross-border and cross-sector mobility for future growth in Europe. XP-RESILIENCE is an inter/multi-disciplinary and intersectoral programme as it includes seven academic partners, one Institute of Applied Science and seven private companies from ten different European countries. It represents **international excellence in risk based simulation/development** of "special risk" petrochemical plants, vibration reduction and community disaster resilience subjected to earthquakes, blast, fire, flooding, winterization, etc. Owing to the intense competition from countries such as USA, Japan, Korea, Taiwan, etc., **the training of ESRs** in such a network is **timely and of strategic importance in Europe**.

The fourteen recruited ESRs will benefit from direct access to state-of- the-art research expertise, relational databases (Hasan et al., 2015)and lab equipment (Bursi et al., 2014). They will be exposed to all knowledge domains along the risk chain in continuous contact with both the industrial world and community needs. This is part of innovative methods that are not currently offered in Europe. Finally, XP-RESILIENCE will provide training-through- research in:

- controlling resilience planning at the plant level and nearby built environment
- designing metamaterial-based vibration shields
- quantifying resilience for facility/community performance during and after a hazard event
- setting concepts of recovery and functionality
- interacting with academic and industrial partners

General Recruitment

14 Early Stage Researcher (ESR) have been recruited within the project and are currently working on the following topics:

- **ESR01:** Analysis and risk assessment of petrochemical plants endowed with innovative metamaterial-based shields under seismic/fire loadings. (More information)
- **ESR02:** Novel analysis of shallow and deep foundations and optimal layouts of subplants/plants under seismic conditions. (More information)
- **ESR03:** Advanced finite element analysis of steel and reinforced concrete support structures for petrochemical plants components subjected to seismic loading. (More information.)
- **ESR04:** Development of an optimal real-time monitoring system for petrochemical plants subjected to NaTech events. (More information)
- **ESR05:** Soil-structure interaction analysis of critical infrastructures of petrochemical plants. (More information)
- **ESR06:** Risk-targeting and hazard-consistent seismic action for design of selected components of petrochemical plants. (More information.)
- **ESR07:** Evaluation of fragility curves of components/systems and risk-based requirements analysis for software tool development of petrochemical plants. (More information.)
- **ESR08:** Development of new solutions for rapid detection, alert and damage assessment of HSLA welded pipelines. (More information)
- **ESR09:** Analysis and development of a risk-based framework for plants and community disaster resilience. (More information. Call to be opened)
- **ESR10:** FE models for simulations of civil components and mechanical equipment of plants. (More information)
- **ESR11:** Advanced soil modelling for FE analysis of critical civil infrastructures of petrochemical plants. (More information)

- **ESR12:** Development of a newly-conceived software tool based on a relational database for multi-hazard QRA for petrochemical facilities. (More information.)
- **ESR13:** Risk/Resilience-based design of petrochemical plants and development of recommendations for Eurocode extension. (More information)
- **ESR14:** Operational modal analysis of petrochemical plants based on optimal sensor placement. (More information)

To be eligible, candidates must comply with mobility requirements. Please see http://ec.europa.eu/research/participants/data/ref/h2020/other/guides_for_applicants/h2020-guide-appl16-msca-itn_en.pdf for details.

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