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DELIVERABLE

PROJECT INFORMATION

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Abstract

This deliverable collects the three newsletters that were issued within Task 7.2 'Development of communication, awareness and dissemination material and tools'. The first newsletter gives the list of the main past and forthcoming events and focuses on the scientific work of the project. The second newsletter highlights the achievements during the first half of the STREST project, presents the 1st year workshop held at JRC Ispra and outlines the next steps. The third newsletter presents the main recent and forthcoming dissemination activities. It also provides an overview of the results obtained for two exploratory applications of the stress-test method.

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1 Introduction

The dissemination activities aim at communicating to regulators and operators of non-nuclear critical infrastructures (gas and electricity networks, transportation networks, medical service networks, petrochemical plants, and in general all high risk and high economic and environmental impact infrastructures) the products developed during the project, namely harmonized methodologies for risk assessment leading to the standardization and implementation in Europe of stress test methodologies for main classes of infrastructures against natural hazards. Overall, the dissemination activities will have an impact on the society at large, by incorporating stress test methodologies in current management and long-term planning of critical non-nuclear infrastructures.

This deliverable collects the three newsletters that were issued within Task 7.2 'Development of communication, awareness and dissemination material and tools'. The newsletters are available on the project website (www.strest-eu.org/opencms/opencms/results).

The first newsletter was published in December 2014. It gives the list of the main past and forthcoming events and focuses on the scientific work of the project, i.e. the probabilistic method and disaggregation technique used for the risk assessment and the proposal for stress tests, which considers low probability / high consequence events.

The second newsletter, published in June 2015, highlights the achievements during the first half of the STREST project, presents the 1st year workshop held at JRC Ispra and outlines the next steps.

The third newsletter was published in April 2016. It presents the main recent and forthcoming dissemination activities. It also provides an overview of the results obtained for two exploratory applications of the stress-test method.

2 Newsletter 1, 15 December 2014



Harmonized approach to stress tests for critical infrastructures against natural hazards

Newsletter 15 December 2014

Highlights

Probabilistic risk method

Stress tests start from risk assessment of critical infrastructures (CIs) subject to one or multiple hazards. The metric of risk is the loss, or the consequence of failure. State-of-the-art risk assessment is aimed at obtaining the annual rates of events causing exceedance of any loss value. Once the annual rate of loss exceedance curve is obtained, it is possible to perform loss disaggregation, aimed at obtaining the probability that a specific value of a variable involved in risk assessment is causative for the occurrence or exceedance of a loss value of interest. This provides a distribution enabling to identify, for example, the values of earthquake intensity most likely causing the exceedance of the considered loss value. Even more interestingly, the loss may be disaggregated with respect to the system's response, which may help to identify the component the damage of which most likely causes the exceedance of the loss value of interest.

STREST test design proposal

Stress tests and risk assessment are infrastructure management tools that, respectively, provide the bases for ambiguity-averse and risk-averse decision-making. The aim of these tools is to verify the safety and resilience of individual components as well as of whole CI systems with respect to the expected and unexpected events.

The aim of **stress tests** is not only to identify and verify the response of a CI with respect to design event levels but also to characterize the extreme and rare events with high, and possibly cascading, consequences for the integrity of the system, the so called "beyond design basis" events.

Latest News

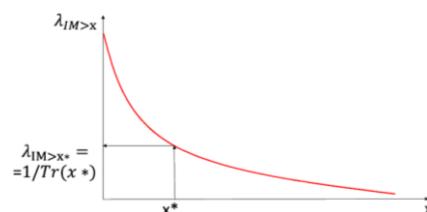
- The final results from WP2 "State-of-the-art and lessons learned" are now available online at www.strest-eu.org

Upcoming events

- STREST 2nd Year Meeting, Fall 2015, Thessaloniki

Past events

- 1st Year STREST Workshop, 29-31 October 2014, Joint Research Centre (JRC), Ispra, Italy
- Joint WPs 3-4-5 Workshop, 26-28 February 2014, Utrecht
- WP2 Workshop, 14 January 2014, Zurich
- STREST kick-off meeting, 21-22 October 2013, Zurich



CI generic hazard curve



Harmonized approach to stress tests for critical infrastructures against natural hazards

Newsletter 15 December 2014

The CI performance space is defined in terms of the probability of loss in an event. Extending the acceptable operational occurrence and design basis checks, a **stress test** systematically investigates the low probability/high consequence beyond design basis event space using probabilistic and deterministic means.

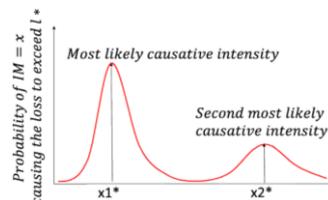
First, consequences of "perfect storms", single extremely rare and intense hazards are investigated by examining the tails of hazard probability distributions. Second, the "cascades" off simultaneous occurrences or sequences of events are analysed using the MATRIX approach to discover probable event combinations that may result in large losses. Further, large system-level losses are disaggregated to identify vulnerable components and single or multiple hazards that may cause their failure. Finally, expert elicitation may be used to determine "black swan" events and scenarios that may lead to previously unconsidered CI performance. The outcomes of **stress tests** are intended to update the society and the owners on the current state of risk-benefit trade-offs implicit in the operation of the CI systems.

Extreme event definition

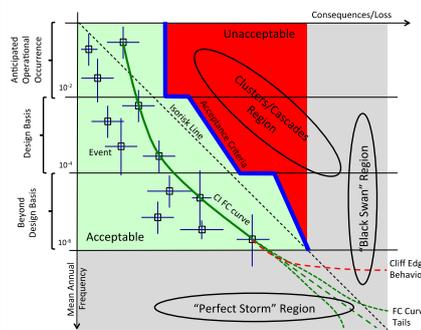
The project compares, reviews and evaluates the strengths and weaknesses of novel approaches for the assessment of epistemic uncertainties and the definition of optimal methodologies for expert elicitation in hazard/risk assessment. Analyses conducted on pilot sites help quantifying the uncertainty reductions brought by on-site monitoring, show how on-site measurements contribute to this reduction and illustrate the added value of site-specific analysis. This analysis will provide clear guidelines and cost-benefit analysis to decision-makers facing site-specific hazard analysis.

The spatial variability and correlation of hazard intensities (e.g. ground motion intensities and frequency characteristics) are assessed in order to evaluate aggregated probabilities of exceeding limit values across an extended footprint, such as the probability of exceeding critical values of surface permanent and differential ground displacement, ground strains and peak ground velocity for geographical extended infrastructures (e.g. major pipelines, main road or railway networks comprising bridges and tunnels) or a distributed class of infrastructures (e.g. dams in a mountain range).

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Loss disaggregation in terms of event intensity



The (mean annual) frequency vs. consequence (loss) plot, the FC plot, shows the Acceptance Criteria (blue line) in the Anticipated Operational Occurrence (AOO), the Design Basis (DB) and the Beyond Design Basis (BDB) that divides the event space into acceptable and the unacceptable regions. The low probability and high consequence "perfect storm", "cascade" and "black swan" events are in the grey area.

3 Newsletter 2, 15 June 2015



Harmonized approach to stress tests for critical infrastructures against natural hazards

2nd Newsletter 15 June 2015

Highlights

Achievements

In the first half of this three-year project, STREST has reviewed the literature related to stress tests and extreme event assessment and has developed most of the hazard assessment models needed as input for risk analysis and for the STREST stress test design framework. The main results are summarized as follows:

- Most of the key findings from stress tests of nuclear facilities are applicable also to non-nuclear critical infrastructures (CIs), though risk-informed modifications may be appropriate.
- A **harmonized approach** could significantly increase public discussion and acceptance of how to deal with risks related to CIs in the European Union.
- The risk of **cascading effects** is underestimated. It is required to understand system weaknesses and to prioritise prevention and mitigation measures, coupled with a cost-benefit analysis.
- Models developed in previous FP7 projects, e.g. the general multi-risk framework for the quantification of cascade effects, can help build new stress tests.
- To guarantee robust results while reducing the financial costs, **epistemic uncertainties** must be assessed using a smart combination of methods including multiple-expert procedures, logic trees or Bayesian approaches and classical expert elicitation.
- Regarding **distributed CIs**, the permanent fault displacements will be the result of very rare events for pipelines crossing the fault segments closer to the edges. Relatively more frequent earthquakes should be of concern for pipelines that are more likely to cross the fault at the middle portion of segments.

STREST website

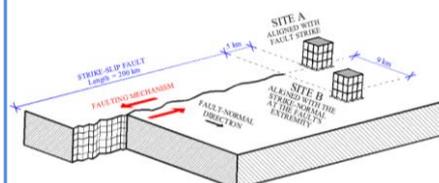
For information about the project and all published deliverables visit www.strest-eu.org.

Upcoming events

- STREST 2nd Year Meeting, 12-13 October 2015, Thessaloniki

Past events

- WP5 workshop, 22 May 2015, Zurich
- WP4 workshop, 19 December 2014, Naples
- 1st Year STREST Workshop, 29-31 October 2014, Joint Research Centre (JRC), Ispra, Italy
- Joint WPs 3-4-5 Workshop, 26-28 February 2014, Utrecht
- WP2 Workshop, 14 January 2014, Zurich
- STREST kick-off meeting, 21-22 October 2013, Zurich



Probabilistic seismic hazard analysis showed that forward directivity could have an important impact on near-source structural demand



Harmonized approach to stress tests for critical infrastructures against natural hazards

2nd Newsletter 15 June 2015

- Once **fault rupture cascading** is considered, the maximum magnitude in Turkey increases from 8.1 to ~8.5, which may have an impact on pipeline stress tests. In the case of strong earthquake clustering in Northern Italy, the risk migrates towards lower-probabilities–higher-consequences scenarios.
- OpenQuake was adapted for the probabilistic seismic hazard assessment in which the rate, location and magnitude of **induced earthquakes** vary in response to a dynamically changing pressure field. This tool can demonstrate the impact of modelling assumptions.

STREST 1st Year Workshop

The 1st Year STREST Workshop was held on 29-31 October 2014 at the Joint Research Centre in Ispra. The workshop counted with more than 60 participants among project partners, the International Advisory Board and representatives of the FP7 projects ASTARTE, INDUSE2, INFRARISK, INTACT, PREDICT and RAIN.

The STREST methodology and the advancement of the exploratory applications of new stress test concepts to the six test sites were discussed at the workshop.

The main objective was to explore **synergies** between FP7 projects, as concerns extreme events and cascades, critical infrastructure taxonomy and stress test methods. It was concluded that the areas where common work would be beneficial are: common approach to uncertainty estimation, review of 'good practice' in risk analysis, harmonization of hazard indicators and risk metrics, and the wider involvement of stakeholders.

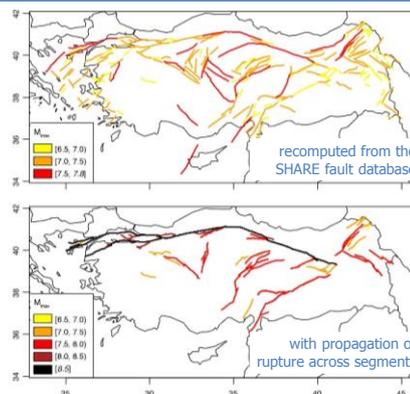
Next steps

In the early stage of the second period, the integrated low probability-high consequence hazard assessment for critical infrastructures will be finalized by combining the results of all the hazard models already produced.

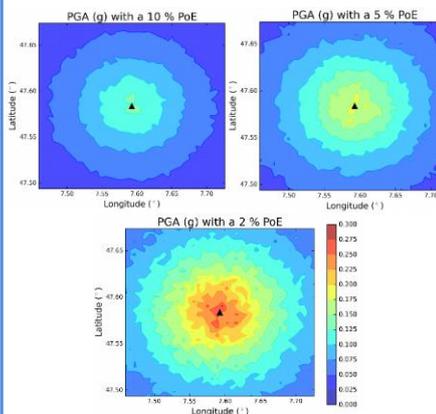
Results on hazard assessment, vulnerability models, the **framework for stress tests** and the applications will be reviewed and discussed at the second year project meeting that will take place on 12-13 October 2015.

In the last year, efforts will focus on the testing of innovative stress tests at the **application sites**.

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Maximum magnitude of earthquakes in Turkey



Peak ground acceleration resulting from geothermal injection (10, 5 and 2 % probability of exceedance)



Participants of the STREST 1st Year Workshop, Ispra, 29-31 October 2014

4 Newsletter 3, 15 April 2016



Harmonized approach to stress tests for critical infrastructures against natural hazards

3rd Newsletter 15 April 2016

Dissemination activities

Final Workshop, 16 September 2016

The final dissemination workshop of STREST will take place in Ljubljana on the 16th of September 2016. It aims at communicating the products developed during the project and it will present the results of applications from a large selection of CIs: petrochemical plants, hydropower dams, oil pipelines, gas networks, port infrastructures and industrial districts.

Invited researchers from partner European projects will also present their main findings.

The workshop is addressed to a wide range of stakeholders, including regulators, owners and operators of non-nuclear CIs, civil protection services, and the scientific and technical community.

The workshop is open to all interested stakeholders and participation is free of charge. The programme and more information are available at the project website.

Euronews documentary on STREST

Within its Futuris program on European research projects, Euronews produced a documentary on STREST.

The four minute long documentary presents an overview of the project, the stress-test methodology developed within STREST and indicative results of the exploratory application on dams of the Valais region in Switzerland.

Interviews with project partners and filming took place in early April at the Hydraulic Constructions Laboratory of EPFL and at the Rossens dam near Fribourg.

The documentary will be broadcast in 13 languages and 155 countries all over the world. Watch out for it on television and at euronews.com/programs/futuris.

STREST website

For information about the project and all published deliverables visit www.strest-eu.org.

Upcoming events

- Final STREST Workshop, 16 September 2016, Ljubljana
- STREST 3rd Year Meeting, 14-15 September 2016, Ljubljana

Main past events

- STREST 2nd Year Meeting, 12-13 October 2015, Thessaloniki
- 1st Year STREST Workshop, 29-31 October 2014, Joint Research Centre (JRC), Ispra, Italy
- STREST kick-off meeting, 21-22 October 2013, Zurich



Filming of the documentary at EPFL (top) and at the Rossens dam (bottom)



Harmonized approach to stress tests for critical infrastructures against natural hazards

3rd Newsletter 15 April 2016

Scientific publications

The results of the project are communicated to the scientific/technical communities through the participation of STREST partners in key international conferences. To-date, four articles were published in conference proceedings and nine papers in peer-reviewed journals. STREST will produce a set of six reference reports with technical guidelines and recommendations, derived from the main deliverables of its work packages and written specifically for end-users, regulators and plant operators.

Exploratory applications

Thessaloniki port

The Thessaloniki port is part of the Orient-East Med Core Network Corridor. Natural hazards are expected to have low individual impact on the port but large collective one.

A full probabilistic hazard and risk assessment for tsunamis was developed, based on multiple simulations of tsunami inundations from all the potential seismic sources of the Mediterranean sea and on the evaluation of the potential damages to the harbour's components and of the consequent system performance.

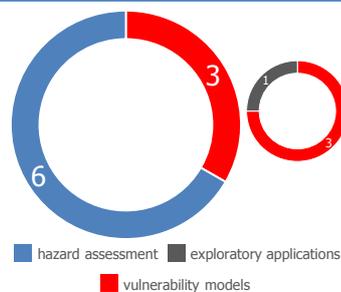
A simulated tsunami, generated by an eventual strong earthquake on the Anthemountas fault, would cause withdrawal of the sea during the first minutes after the earthquake and then the first positive tsunami wave would impact the coast in about 40 minutes, causing the highest inundation in the western part of the harbour.

Furthermore, the infrastructure's resilience was studied for various damage scenarios and recovery sequences for the cranes and electricity substations, considering the availability of repair crews and back-up systems.

Large dams in the Valais region

A generic multi-risk framework was developed for the performance assessment of dams. It conducts multiple simulations, generating random events, evaluating the system response and computing damages and losses. The studied natural hazards include earthquakes, floods, mass slides, internal erosion and seepage, and icing.

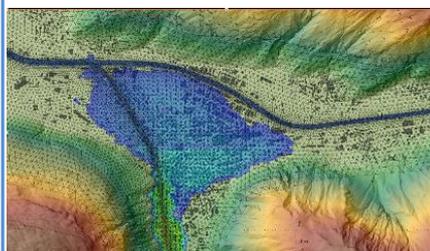
For a set of 21 routed dam-break hydrographs, a coupled 1D/2D numerical model of a conceptual dam was used to simulate the downstream wave propagation and estimate inundation depths, flow velocities, and flood arrival times and consequent damage to buildings and roads.



Number of articles in peer-reviewed journals (left) and conference proceedings (right), by subject



Tsunami hazard assessment (top) and recovery of harbour elements (bottom)



Simulation of flood routing downstream of a conceptual dam

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