

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
BEFORE THE COMMISSION

In the Matter of	)	
NextEra Energy Seabrook, LLC	)	Docket No. 50-443
(Seabrook Station, Unit 1)	)	October 7, 2026

DECLARATION OF VICTOR E. SAOUMA, Ph.D

Under penalty of perjury, Victor E. Saouma declares as follows:

Introduction and Purpose of My Declaration

1. My name is Victor E. Saouma. I am Professor Emeritus of Civil Engineering at the University of Colorado in Boulder. I am also the Managing Partner of X-Elastica, a small consulting firm based in Boulder, Colorado. The work of X-Elastica focuses on the nonlinear seismic analysis of complex concrete and reinforced concrete structures, those suffering of chemical deterioration in particular. A copy of my Curriculum Vitae is attached to my declaration as **Exhibit 1**.
2. I have been retained by the C-10 Research and Education Foundation (C-10) to provide my professional evaluation of the current state of knowledge of NextEra Seabrook, LLC (NextEra) and the U.S. Nuclear Regulatory Commission (NRC) regarding alkali-silica reaction (ASR) at the Seabrook nuclear power plant. ASR is a specific form of alkali-aggregate reaction (AAR), the broader class of deleterious reactions between alkalis in cement paste and reactive aggregate constituents.
3. As discussed in my attached expert report, *ASR Research Program Gaps and Structural Test Evidence: A Unified Technical Assessment* (Oct. 7, 2026) (hereinafter “Technical Assessment”) (**Exhibit 2**), this point in time is significant for three reasons.
 - (a) First, approximately ten years have passed since NextEra applied to the NRC for approval of a program for assessment and monitoring of ASR in Seabrook safety structures, including Seismic Category I structures such as the Containment Enclosure Building (CEB). It is also approximately ten years since completion of the Large-Scale Test Program (LSTP), a three-year program of testing of ASR-affected concrete beams by the Ferguson Structural Engineering Laboratory (FSEL) at the University of Texas (Austin). NextEra based its ASR assessment and monitoring program on the results of the LSTP. At this decade milestone, it is appropriate – and indeed essential – to review lessons learned from the LSTP, including guidance that was missed or ignored at the time of the LSTP as well as significant developments in the understanding of ASR’s behavior in nuclear power plant structures since then. Taken alone or together, the missed prior guidance and subsequent technical developments show that the LSTP was not an adequate technical basis for assessing the seismic resistance of the Seabrook CEB, nor for predicting the future progression of ASR and its structural consequences in that safety-related structure.

- (b) Second, recent ASR monitoring results indicate that some Seabrook structures are trending to exceed the upper bound of the expansion range evaluated in the LSTP, as early as 2034. This discovery is significant, because it shows that the LSTP was not a reliable predictor of how fast ASR would progress at Seabrook.
 - (c) And third, the discovery that ASR is progressing more rapidly than predicted by NextEra and the NRC is significant because it triggers a requirement for additional laboratory testing of ASR-affected specimens.
4. Before proceeding with further testing, it is important to revisit the inadequacies of the LSTP, including inadequacies that were visible at the time and inadequacies that have been demonstrated by the significant body of research and testing – some sponsored by the NRC at great cost – that have been published since 2017. This includes test results showing that the specific LSTP testing approach is not a reliable technical basis for predicting ASR’s structural effects on the seismic performance of the Seabrook CEB’s cylindrical reinforced-concrete shell.
 5. Unfortunately, NextEra appears to be preparing to repeat or approximate the LSTP, in disregard of the significantly increased understanding of ASR’s behavior that has been developed over the past ten years. As discussed in my Technical Assessment, to carry through with a reprise of the LSTP, without modifying the tests to take that new information into account, would be a costly and dangerous mistake. NextEra would waste resources for a result that is likely to be misleadingly optimistic and therefore dangerous to the public and the environment. The NRC should take great care to ensure that the next set of tests does not repeat the mistakes of the LSTP.

My Background and Qualifications

6. I am *Professeur des Universités* in France, and have been a visiting Professor at the Swiss Federal Institute of Technology (Lausanne), January-June 1990; 1997-1998, and Sept.-Dec. 2011. I was also a visiting Professor, (typically 1 summer month): at the *Université de Toulouse* (2009), *Politecnico de Catalunya*, (2007, 2010); and *Ecole Normale supérieure de Cachan*, (1992, 1994, 2007). I was an invited Professor for two years (2003-2004) at the *Politecnico di Milano*.
7. I am qualified by training and experience in the fields of [AAR](#), [Fracture Mechanics](#), [numerical simulations of dams and nuclear reactors](#), probabilistic based safety assessment, seismic analysis, chloride diffusion experimental mechanics and structural testing.
8. I have received three degrees in Civil Engineering: a Ph.D. from Cornell University in 1980, an M.E. from Cornell University in 1977, and a B.E. from the American University of Beirut in 1977.
9. I am a leading international expert in the field of AAR. I have developed what is probably the most widely referenced and copied model for AAR (in Abaqus, Vector3, Grizzly/Moose at the Idaho National Laboratory and LS-Dyna by the National Institute for Standards and Technology (NIST) as well as in China, Switzerland, and Canada. My research has encompassed material

and structural testing, theoretical and computational models, numerical simulations of dams and nuclear reactors. I published a book on Numerical Modeling of AAR; and I have published over 30 papers on AAR, chloride diffusion, Seismic Analysis and Stochastic Analyses.

10. In the Fall of 2025, I organized and co-taught with three other international leaders a short course [Management of Alkali Aggregate Affected Structures; Analysis, Performance & Prediction](#) to 50 participants from 17 countries.
11. In the spring of 2026, I published [The Four Books of Structural Analysis, From the History of Mechanics to Modern Computational Methods](#), a four-volume approximately 3,300 page treatise on structural analysis. This book is available online at no cost.
12. In addition, I have published extensively on related topics, including fracture mechanics, risk-based assessment of bridges and dams, chloride diffusion, and experimental dynamics, and have edited a book on the latter subject. More recently, I made substantial contributions to the preparation of a report for the Electric Power Research Institute (EPRI) on the numerical modeling of nuclear concrete containment vessels.

My experimental and computational work includes large-scale testing of concrete fracture properties for EPRI; dynamic centrifuge testing of dam models in Japan; real-time hybrid simulation—a sophisticated form of dynamic structural testing—for the National Science Foundation (NSF); experimental investigations of alkali-silica reaction (ASR), including expansion, its effects on shear strength, and expansion under varying environmental and loading conditions, for the Nuclear Regulatory Commission (NRC); and three-dimensional numerical simulation of ASR-induced expansion in dams for the Bureau of Reclamation.

13. I am the former Director and Principal Investigator of the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES), NSF Center on Fast Hybrid Test at the University of Colorado, Boulder (2006-2009).
14. I have served as President of [FraMCoS](#) (Fracture Mechanics of Concrete), a scientific organization focusing on the fracture and cracking of concrete (and organized FraMCoS IX).
15. I was the Chair of International Union of Laboratories and Experts in Construction Materials, Systems and Structure (RILEM's) Technical Committee 259-ISR for Prognosis of deterioration and loss of serviceability in structures affected by alkali-silica reactions. This committee sought to expand our knowledge in the prognosis of structures affected by ASR, and to develop a benchmark problem to validate numerical codes that assess ASR.
16. I have also served as a member of the Materials Aging and Degradation (MAaD) External Review Committee (ORNL, Light Water Reactor Sustainability R&D Program); a member of the Expanded Proactive Materials Degradation Analysis Expert Panel (PMDA) for concrete in nuclear reactors; and Reviewer of the French research program MACENA (associated with VeRCoRs).
17. I have conducted research on ASR for the Swiss Dam Safety office, the Tokyo Electric Power Service Company, Oak Ridge National Laboratory, the NRC, and the U.S. Bureau of Reclamation.

18. I also spent four years conducting research for the Electric Power Research Institute on the applicability of fracture mechanics to concrete dams; and nine years conducting research for the Tokyo Electric Power Service Company on the seismic response of dams (numerical and experimental).

My ASR Research and Testing on Behalf of the NRC

19. In 2014 and 2017, the NRC awarded me a \$703,000 contract to provide support for “Experimental and Numerical Investigation of Alkali Silica Reaction in Nuclear Reactors.” The initial grant award is posted on the NRC’s ADAMS Publicly Available Records System (PARS) Library (“ADAMS”) at ML14274A265. As stated at page 4 of the grant award, the impetus for my proposed research stemmed from “the apparent challenge confronting the NRC in assessing safety issues pertaining to the Seabrook nuclear power plant which suffers from Alkali Silica Reaction (ASR), and in particular NRC request that the licensee determines the long term safety of the plant within the framework of ML121250588 (2012).” (ML121250588 is the NRC’s “Seabrook Alkali-Silica Reaction Issue Technical Team Charter.” The Charter’s purpose is to “provide coordination of the onsite inspections, in-office technical reviews, and other associated evaluation and assessment activities involving NextEra’s review and resolution of the ASR issues at Seabrook Station.”).
20. In December 2017, I submitted a four-volume report on my research:
- (a) Vol. 1-A: Design of an AAR Prone Concrete Mix for Large Scale Testing (93 pages)
 - (b) Vol. 1-B: AAR Expansion; Effect of Reinforcement, Specimen Type, and Temperature (123 pages)
 - (c) Vol. 1-C: Effect of AAR on Shear Strength of Panels (90 pages)
 - (d) Vol. 2: Diagnosis & Prognosis of AAR in Existing Structures (210 pages)
 - (e) Vol. 3-a: Risk Based Assessment of the Effect of AAR on Shear Walls Strength (25 pages)
 - (f) Vol. 3-b: Probabilistic Based Nonlinear Seismic Analysis of Nuclear Containment Vessel Structures with AAR (216 pages)
 - (g) Final Summary Report (23 pages)

My Final Summary Report is posted on ADAMS at ML19044A772. I also made an oral in-person presentation to the NRC near completion of my project.

21. For the record, I have not received a response to my report from the NRC.

NIST ASR Research and Testing on Behalf of the NRC

22. In 2014, in addition to my research contract, the NRC also entered an Interagency Agreement with NIST regarding “Structural Performance of Nuclear Power Plant (NPP) Concrete Structures Affected by Alkali-Silica Reaction (ASR).” As described in the Statement of Work, the objective of this research study was “to develop a technical basis and regulatory guidance for NRC staff to evaluate ASR-affected concrete structures. The research will assess the structural performance of ASR-affected concrete structures for design basis static and dynamic loading and load combinations through its service life, including the period of extended operation for the 20 year license renewal period.”
23. The NIST Grant Statement of Work also promised the development of a new methodology for assessing ASR in nuclear plants:

In brief, a testing procedure will be developed that will yield data on material and mechanical properties of concrete for performing a structural evaluation of ASR-affected structures. A methodology will also be developed for estimating the extent of the reaction over time, whereby a relationship can be established between the extent of the expansion due to ASR and the changes in mechanical properties of the concrete structures.

In addition, a significant component of the NIST study was the conduct of shear capacity testing in shear walls containing ASR. Thus, the NIST Grant included “Task 3: Seismic Response Characteristics of ASR-Affected Concrete Structural Member,” whose “Objective” was to “develop a methodology for assessing the degradation of seismic resistance of structural members and systems due to ASR.” By testing shear walls, NIST more closely approximated the concrete walls of the Seabrook containment building than testing of ASR in concrete beams, on which NextEra would subsequently base a license amendment request (“LAR”) for NRC approval of its ASR monitoring program.

24. To carry out Task 3, NIST proposed to use the following “Approach:”

To avoid sustaining serious damage due to seismic excitation, structures are designed such that the lateral displacement of vertical members (such as columns and walls) and the end rotation of horizontal members (such as beams and girders) should not exceed the specified allowable values. If the stiffness and energy-absorbing capacity are reduced due to ASR, the response of structural members to earthquake excitation may exceed the design limits, thereby making the structure susceptible to serious damage or collapse during the design level earthquake. At the present time, seismic analysis procedures for nuclear power plant structures subjected to ASR degradation are not available in the open literature. NIST will carry out cyclic loading tests of 3/4-scale normal (one) and ASR-affected (three) concrete shear walls to assess the effects of ASR on strength and stiffness. Such tests will yield information on the effects of ASR degradation on the energy absorption properties of concrete shear walls. The cyclic loading protocol for these tests and the reinforcing ratio and details

for shear walls will be developed in collaboration with NRC to ensure applicability to NPPs.

25. NIST published the results of Task 3 in 2022 in NIST Technical Note 2180: Weigand, et al., *Structural Performance of Nuclear Power Plant Concrete Structures Affected by Alkali-Silica Reaction (ASR); Task 3: Assessing Cyclic Performance of ASR-Affected Concrete Shear Walls* (Jan. 2022). NIST Technical Note 2180 confirmed the conclusion of my own research and testing for NRC that ASR degrades the condition of shear concrete walls.
26. As summarized in § 4.1.1.4.1.1 of my Technical Assessment, NIST tested four reinforced concrete shear wall specimens at $h_w/l_w = 2.0$ under reversed cyclic lateral loading. The control specimen used the same reactive concrete mix as the reactive specimens, dosed with lithium nitrate to suppress ASR, and was aged and tested alongside the ASR specimens — providing the most rigorous material comparison in any program to date and, unlike the LSTP, eliminating the confounding effect of normal concrete maturation gain.
27. The results of NIST’s testing of ASR shear walls, as reported in NIST Technical Note 2180, showed a significant degradation of shear capacity. In particular:
 - (a) NIST reported a 30% reduction in compressive strength; 70% reduction in modulus of elasticity; and 40% reduction in splitting tensile strength in ASR-affected concrete at approximately 0.23–0.25% expansion. These material degradation effects caused statistically significant reductions of 26% in normalized yield moment capacity and 11% in peak flexural capacity, with the normalized yield moment M_y/M_n falling below 1.0 for all three reactive specimens.
 - (b) NIST concluded explicitly that ACI 318 capacity calculation procedures are unconservative for ASR-affected walls — a conclusion that is independent of wall aspect ratio because it rests on material degradation that is present in any ASR-affected concrete structure.

My Work on Behalf of C-10 Research and Education Foundation

28. Since 2018, I have been retained by C-10 to evaluate work done by NextEra, NextEra’s consultants, and the NRC technical staff regarding the presence of ASR in concrete at the Seabrook nuclear power plant; and the effect of ASR on the integrity of the concrete, including the containment. In the course of my review, I evaluated both public and proprietary documents regarding NextEra’s investigations. (While I have reviewed proprietary information in the course of my work for C-10, neither this Declaration nor my Technical Assessment contains any proprietary information.) I also applied the insights of my work under the NRC contract described above in ¶¶ 19-20.
29. On Feb. 12, 2019, I prepared a report for C-10 entitled “Concerns Regarding the Structural Evaluation of Seabrook Nuclear Power Plant.” C-10 submitted my report to the NRC Commissioners in support of their Emergency Petition for Exercise of Commission’s Supervisory Authority to Reverse No Significant Hazards Determination and Immediately Suspend License Amendment and License Renewal Decisions (Feb. 13, 2019) (ML19044A768) (hereinafter

“2019 Emergency Petition”). My report explained the basis for my expert opinion that the LSTP and related finite analysis were substandard and inadequate to support any conclusion that the ability of the Seabrook containment to withstand a design basis earthquake had not been unduly compromised by the presence of ASR.¹

30. Without addressing the merits of my criticisms and concerns, the Commission denied C-10’s Emergency Petition in *NextEra Seabrook, L.L.C.* (Seabrook Station, Unit 1), CLI-19-07, 91 N.R.C. 1 (2019).
31. Since the Commission’s decision in 2019, nothing has changed my expert opinion that the manner in which NextEra’s consultants have analyzed the impact of ASR on Seabrook and developed an ASR monitoring program is seriously deficient and thereby poses an unacceptable risk to public health and safety. Subsequent developments, including NIST Technical Note 2180 and other testing results, have further confirmed my opinion.
32. In 2019, I submitted written and testimony to the NRC’s Atomic Safety and Licensing Board (ASLB) regarding significant inadequacies in NextEra’s application for approval of a license amendment containing a program for assessment and monitoring of ASR at Seabrook. The hearing was held on Sept. 24 through 27 in Newburyport, Massachusetts. While the ASLB generally approved NextEra’s license amendment, it imposed significant additional monitoring requirements on NextEra in response to my testimony. *See NextEra Seabrook, L.L.C.* (Seabrook Station, Unit 1), LBP-20-09, 92 N.R.C. 58 (2020).
33. At the time of the ASLB hearing on NextEra’s license amendment application, NIST Technical Report 2180 had not been published, nor had the results of similar testing programs other than my own been published. Since then, however, as reflected in § 4.1.4 of my Technical Assessment, every major research program aside from the LSTP that has investigated the structural effects of ASR in a nuclear context used shear walls or geometry-specific shear panels as the test specimen. When those programs are examined carefully, a consistent pattern emerges that directly contradicts the LSTP finding: across all programs using geometry-representative specimens and properly controlled mixes, no program reproduced the LSTP’s strengthening result. The two programs employing time-matched, lithium-suppressed controls — NIST and my own — measured reductions in capacity (on the order of 11–26% and 20%, respectively), while the remaining programs found no strength increase together with adverse effects on stiffness, ductility, and energy dissipation. Under these circumstances, it would be an unconscionable waste of the NRC’s resources to permit NextEra to repeat or approximate the LSTP for the next phase of ASR testing.
34. NIST Technical Note 2180 further confirmed the conclusion of my own research and testing: that ASR degrades concrete shear capacity and, as a consequence, reduces the seismic resistance of the Seabrook CEB’s cylindrical reinforced-concrete shell.

¹My February 12, 2019 expert report was submitted as a proprietary document. At the same time, C-10 also submitted a non-proprietary summary of my report (ML19044A773). A publicly available redacted version of my complete report was prepared in 2019 and is posted on ADAMS at ML19254F151.

35. I discussed the significance of the NIST study for Seabrook Station in my *White Paper, Assessment of NIST Shear Wall Tests and Their Relevance for Seabrook Safety* (Apr. 30, 2025) (ML25121A280, pdf p. 172). To summarize the findings of that White Paper:
- (a) NextEra predicted an increase in shear strength in ASR-affected structures based on beam tests from the LSTP. Although this increase was not necessarily relied upon for explicit numerical credit, the claimed LSTP strengthening (or non-degradation) result materially influenced the regulatory basis for the ASR monitoring program. In contrast, NIST's shear-wall tests at $h_w/l_w = 2.0$ (intermediate aspect ratio) — a more appropriate configuration — showed a decrease in strength, demonstrating the inapplicability of LSTP results and raising serious concerns about the adequacy of NextEra's assessment and monitoring program.
 - (b) This disparity between the NIST and LSTP results was foreseeable. The selection of out-of-plane beam-shear tests to predict CEB behavior reflected a fundamental misunderstanding: cylindrical shells resist lateral loads primarily through membrane action (in-plane shear) with minimal bending — not beam flexure, which captures out-of-plane shear. Tests should have been performed on specimens which capture in-plane shear failure, as consistently done by other researchers studying cylindrical shells. Given its prior research on CEB shear behavior (e.g., Cornell/MIT projects), the NRC had the knowledge and responsibility to recognize that the proposed NextEra beam test was fundamentally non-representative.
 - (c) Moreover, it appears NextEra did not conduct an adequate literature review; chemical prestressing effects, long documented (e.g., Ahmed, Burley, and Rigden, 1998), show that reinforced concrete beams can exhibit apparent increases in shear capacity under certain restrained test conditions, even as ASR degrades the concrete's material properties.
 - (d) NextEra relied on the empirical equation $E = 57,000\sqrt{f'_c}$ (MPR-ML16279A050, 2017) to relate compressive strength to elastic modulus. However, NIST found the experimental data widely scattered, not clustering around the equation. This scatter highlights the need to explicitly account for uncertainties. NIST's findings thus invalidate the procedure developed in (NRC-ML18226A205, 2018) for inferring past expansion.
36. My April 2025 White Paper was peer-reviewed by Dr. Jacky Mazars, Prof. Emeritus, Polytechnic Institute, Grenoble Alpes University (France) (pdf p. 201) (*see Exhibit 3*) and by Dr. Stein Sture, Prof. Emeritus, Laboratory for Atmospheric and Space Physics, University of Colorado Boulder (U.S.) (*See Exhibit 4*).
37. In May 7, 2025, I presented my April 2025 White Paper and a power point summarizing my findings. *See* Presentation to ACRS re: Assessment of NIST Shear Wall Tests and Their Relevance for Seabrook Station Safety (May 7, 2025) (Meeting Transcript, ML25121A280, pdf pp. 172-206).
38. At a subsequent ACRS full committee meeting on September 3, 2025, George Thomas of the NRC Staff gave a power point presentation responding to my April 2025 White Paper (ML25261A269, pdf pp. 117-28). At the same meeting, I presented my response to Dr.

Thomas, which is set forth in my *White Paper, Technical Response to NRC's Rebuttal of My Analysis of NIST ASR Findings for Seabrook Safety* (Aug. 31, 2025) (Meeting Transcript ML25121A280, pdf pp. 129-148). To summarize the concerns raised in my White Paper, I found that the NRC Staff's response had failed to meet basic scholarly standards in approving NextEra's inappropriate test methodology and NextEra's flawed expansion reconstruction. Further, instead of addressing these fundamental technical concerns, the Staff had deflected them with irrelevant discussions and unsubstantiated assertions.

39. My August 2025 White Paper was peer-reviewed by Dr. Stein Sture. *See Exhibit 4.*

My Current Assessment of ASR at Seabrook and the Inadequacy of the NRC's Regulatory Oversight

40. As set forth in my Technical Assessment, the LSTP is grossly inadequate both to assess ASR-induced degradation of shear capacity — and the resulting loss of seismic resistance — and to predict the future progression and severity of ASR at Seabrook.
41. From the start, the LSTP was inconsistent with NISTIR 7937, ASR testing guidance issued in 2013 by NIST for ASR testing in nuclear plant structures. As set forth in § 3 of my Technical Assessment, these inconsistencies related to large-scale instrumented structural elements (§ 3.1), confined core testing (§ 3.2), and future expansion prediction (§ 3.3). As discussed in my Technical Assessment and as summarized in Table 1, the deficiencies are extensive and significant. Further, there is no indication that NextEra plans to correct those deficiencies.
42. As discussed in §4.1.1 of my Technical Assessment, during the ten years that have passed since NextEra sought NRC approval of its ASR assessment and testing program, the NRC's technical staff have contracted for, and then largely ignored, a significant body of guidance and research by NIST and other institutions. Instead, the Staff has deferred to NextEra on an issue that is novel, complex, and safety-significant — and that, if incorrectly assessed, could compromise the seismic resistance of safety-related structures and thereby put public safety at risk. That deference is particularly difficult to justify where neither NextEra nor its contractors appear to have established recognized technical expertise in ASR through the peer-reviewed literature; to my knowledge, they have not published even one peer-reviewed technical paper on the structural behavior of ASR-affected reinforced concrete. Only in 2020, when NextEra's program was challenged in a licensing hearing before the ASLB, did the NRC impose additional monitoring requirements on NextEra. And even then, the ASLB did not question the fundamental concept of the LSTP's testing concrete beams instead of shear walls.
43. As set forth in § 4.1 and 4.1.1–4.1.3 of my Technical Assessment, NextEra's laboratory tests disregarded the foundational principle of experimental mechanics that each test specimen should be as representative of the prototype as laboratory scale and resources allow. Where the prototype is a large-diameter cylindrical reinforced concrete shell subjected to in-plane membrane shear under seismic loading — as in the Seabrook CEB — the appropriate test article is a shear wall or geometry-specific shear panel representative of that behavior, not an out of plane shear beam. The difference is significant: aside from the Seabrook testing program, every major research program conducted since 2016 (Canadian, Japanese, NRC-funded American) used shear walls or shear panels *and found adverse structural effects*.

44. As discussed in § 4.2 of my Technical Assessment, the LSTP also omitted the single most important instrumentation required to characterize ASR's effects on structural capacity: strain gauges on the longitudinal reinforcement. Direct strain measurements were necessary to quantify the additional (and "parasitic") tensile strain imposed on the steel reinforcement and the corresponding compressive state imposed on the concrete. Those strain changes are the direct mechanical manifestation of the phenomenon described as "chemical prestressing." Yet NextEra invoked that phenomenon only for its asserted beneficial consequence — an apparent increase in shear strength — while failing to recognize its adverse consequences. Thus, the LSTP presented only the supposed benefit of "chemical prestressing," without providing a complete and balanced assessment of both its beneficial and detrimental structural effects.
45. Another methodological deficiency, as set forth in § 4.3 of my Technical Assessment, concerns the LSTP's use of a so-called control specimen. The program did not use an ASR-free, time-matched control; instead, it used a specimen from the same ASR-reactive mix tested shortly after casting, and compared it to nominally identical specimens tested months or years later. That comparison is inherently biased because concrete naturally continues to gain strength with time, whether or not ASR is present.
46. Finally, as discussed in § 5 of my Technical Assessment, the Commission has reason for serious concern that the ACRS, a watchdog arm of the NRC relied on by the agency for their expert review of highly technical licensing issues, may have biased the NRC's review process in 2018 by making an undocumented and unsupported claim that NRC-sponsored ASR research by NIST and "large Canadian and European programs" had "produced similar results to the LSTP." In fact, NIST had not produced any research results at that time, and the results that NIST subsequently produced in 2022 were *not* consistent with the LSTP. The ACRS did not correct this unsupported assertion in 2025, when it reported to the NRC Commissioners on a "multi-year review" of NextEra's measures for addressing ASR at Seabrook. Given the importance of the ACRS' opinions to the NRC's decision-making process, the ACRS' incorrect and misleading assertion should be acknowledged and corrected, and the ACRS should be required to address the substantial body of research that contradicts its 2018 assertion.

Conclusion and Recommendations

47. In my expert opinion, Seabrook is now operating without the complete technical basis needed to demonstrate continued structural adequacy of its safety-related concrete structures. This situation compromises the seismic qualification of Category I safety structures like the CEB.
48. Unless major changes are made to the next phase of ASR testing at Seabrook, and unless the NRC draws the necessary technical and regulatory conclusions from those test results, this unacceptable situation is likely to continue for the next 24 years, through a renewed operating license term that does not expire until 2050 – or possibly until 2070 if Seabrook's operating license is renewed for a second term.
49. From the beginning, the LSTP was inconsistent not only with NRC-funded NIST guidance, but also with the then-existing state of the art in ASR assessment, structural testing, and experimental mechanics. It was therefore deficient in design, instrumentation, and controls. These

deficiencies fatally undermined the credibility of NextEra's assertion that the LSTP showed ASR would have a strengthening effect on concrete in Seabrook safety-related structures, including the cylindrical reinforced-concrete shell of the CEB.

50. Further, both NextEra and the NRC Staff have disregarded the fact that the two other independent NRC-funded ASR testing programs that used representative geometry and rigorous controls — including the NIST testing conducted for the NRC at considerable expense — found adverse structural effects, thereby contradicting NextEra's assertion that ASR would have a strengthening effect.
51. The ACRS's 2018 endorsement of the LSTP was factually unsubstantiated and may have biased decisions by both the NRC Staff and the ASLB. While subsequent ASR testing, including testing conducted by NIST and myself, conclusively demonstrated that this endorsement was incorrect, the ACRS repeated the endorsement in 2025 without addressing the contradictory research results.
52. Given the persistent failures in regulatory oversight by both the Staff and the ACRS over the past ten years, I believe it is necessary at this time for the Commissioners to step in and take measures to correct the Staff's continuing disregard for NIST's guidance and the results of multiple research programs into the effects of ASR on concrete shear walls such as are used in the Seabrook CEB. I would also urge the Commissioners to seek accountability from the ACRS for its erroneous and misleading statements in support of the LSTP.
53. The Commission should direct the NRC Staff to undertake a prospective review of NextEra's plans to conduct another round of ASR testing. That prospective review should include an independent assessment by qualified external experts in ASR-affected reinforced concrete, nonlinear structural behavior, and the seismic performance of nuclear safety-related structures. This review should apply the guidance of NISTIR 7937, as well as the results of ASR testing on shear walls that has been conducted since 2016. Thus, it is extremely important that any supplemental testing program for ASR at Seabrook must use geometry-representative squat shear wall or shear panel specimens, instrument the reinforcement with strain gauges, employ time-matched lithium-suppressed companion controls, and develop a validated expansion prediction model calibrated to Seabrook concrete mixtures.
54. I wish to offer the Commission my own expert services as a consultant on these matters. I will provide my services voluntarily, at no charge to the NRC or NextEra.

The statements of fact in this declaration and in my report are true and correct to the best of my knowledge, and the opinions stated therein are based on my best professional judgment.

Executed in Accord with 10 CFR 2.304(d) by:



Victor E. Saouma

Dated: October 7, 2026

EXHIBIT 1 TO SAOUMA DECLARATION

Saouma Curriculum Vitae

VICTOR E. SAOUMA

Last Updated: April 2026

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Retired Dec 2023; *all post retirement activities are on my web site.*

Professional Experience

- *Professeur des universités*, France, 2012-
 - Visiting Professor, Swiss Federal Institute of Technology (Lausanne), Civil Engineering (Sept. Dec. 2011).
 - Former Director and Principal Investigator of the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES), NSF Center on Fast Hybrid Test at the University of Colorado, Boulder; 2006-2009.
 - Visiting Professor, (typically 1 summer month): *Université de Toulouse* (2009), Politecnico of Catalunya, (2007, 2010); Ecole Normale Supérieure de Cachan, (1992, 1994, 2007);
 - Visiting Professor, *Politecnico di Milano*, Department of Structural Engineering, 2003-2004.
 - Visiting Professor, Swiss Federal Institute of Technology (Lausanne), Civil Engineering (January-June 1990); Material Science Department, 1997-1998.
 - Professor (1995 to present), Associate Professor (1988-1995), Assistant Professor (1984-1988), Department of Civil, Environmental, and Architectural Engineering, University of Colorado, Boulder.
 - Assistant Professor, Department of Civil Engineering, University of Pittsburgh, Pittsburgh, PA, Sept. 1981-Dec. 1983.
 - Research Associate, Department of Civil Engineering, Princeton University, Princeton, N.J., Oct. 1980 - Aug. 1981.
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Relevant Committee Memberships

- President, 2013-2016, (and Fellow) of the *International Association of Fracture Mechanics for Concrete and Concrete Structures (IA-FraMCOs)*.
 - Chairman, 2015-2019, of the [RILEM committee](#) on *Prognosis of deterioration and loss of serviceability in structures affected by alkali-silica reactions*.
 - Past Member of the *Materials Aging and Degradation (MAaD)* External Review Committee (ORNL, Light Water Reactor Sustainability R&D Program).
 - [Member](#), 2010-2014, of the *Expanded Proactive Materials Degradation Analysis Expert Panel (PMDA)* for concrete in nuclear reactors; Nuclear Regulatory Commission.
 - Past: In connection with the VerCoRs study (1/3 model of a reactor containment building to be tested by *Electricite de France, EdF*): Member of the Scientific Committee of MACENA, *Managing confinement structures in the event of an accident*.
 - Member of the Scientific Committee of OECD/NEA/CSNI CAPS ASCET - *Assessment of Structures subject to Concrete Pathologies*.
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Education

- Cornell University, Ph.D. in Civil Engineering, September 1980.
 - Cornell University, M.E. in Civil Engineering, January 1977.
 - American University of Beirut, B.E. in Civil Engineering, June 1975.
 - Lycée Chateaubriand, Rome, Baccalaureat Série Scientifique, 1971.
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Research Interests

- Nonlinear (static and dynamic) analysis of major structures (nuclear containers, dams) due to aging or severe load.
 - Computational and experimental (fracture) mechanics.
 - [Alkali Silica Reactions](#).
 - [Real time hybrid simulation](#).
 - Large scale and innovative laboratory testing.
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Teaching

Undergraduate:

Statics
Strength of Material
Structural Analysis
Reinforced Concrete
Computer Literacy for Undergraduates
Matrix Structural Analysis
Structural Analysis for Architects

Graduate:

Continuum Mechanics
Computer Graphics
Finite Elements
Fracture Mechanics
Nonlinear Structural Analysis of Frames
Advanced Reinforced Concrete
Prestressed Concrete

Publications

Books

1. Saouma, V.E. *The Four Books of Structural Analysis* (2026), 3,000 pp., trilingual (EN/FR/ES); freely available for download.
 2. Saouma, V.E. and Hariri-Ardebili, M. (2020) *Aging, Shaking and Cracking of Infrastructures; From Mechanics to Concrete Dams and Nuclear Structures*, Springer-Nature.
 3. Saouma, V.E. (Ed.) (2020) *Diagnosis & Prognosis of AAR Affected Structures*, Springer-Nature.
 4. Saouma, V.E. (2013) *Numerical Modeling of AAR*, 320 pages, Taylor& Francis;
 5. Saouma, V. and Sivaselvan, M. (Eds) (2008) *Hybrid Simulation: Theory, Implementation and Applications*
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Archival Publications

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<https://doi.org/10.1016/j.engstruct.2020.111709>
99. Saouma, V.E., Hariri-Ardebili, M.A., Graham, L., 2020, **A Stochastic Computational Method for Global Behavior of Alkali-Silica Reaction.** *Cement Concrete and Research*, Vol. 132, 106032.
<https://doi.org/10.1016/j.cemconres.2020.106032>
98. Saouma, V. and Hariri, M. (2019) **Integrative Experimental and Numerical Study of ASR Affected Nuclear Concrete Containment**, *Materials and Structures*, Vol. 53, No. 1.
<https://doi.org/10.1617/s11527-019-1433-y>

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96. Saouma, V.E. and Hariri-Ardebili, M.A., 2019, **Seismic capacity and fragility analysis of an ASR-affected nuclear containment vessel structure**, *Nuclear Engineering and Design*, Vol 346, pp. 140-156, <https://doi.org/10.1016/j.nucengdes.2019.02.011>
95. Saouma, V. and Hariri-Ardebili, M. (2019) **Shear Strength of AAR Affected Concrete**, *Under Preparation*
94. Hariri-Ardebili, M.A.. and Seyed-Kolbadi, S.M. and Saoumaa, V.E. and Salamon, J. and Rajagopalan, B. (2018) **Random Finite Element Method for the Seismic Analysis of Gravity Dams**, Vol. 71, pp. 405-420
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93. Liaudata, J. and Carol, I. and Lopez, C. and Saouma, V. (2018) **ASR Expansions in Concrete under Triaxial Confinement** *Cement and Concrete Composites*, Feb., pp 160-170
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89. Saouma, V. and Hariri-Ardebili, (2018) **Sensitivity and Uncertainty Analysis of AAR Affected Reinforced Concrete Shear Walls**, *Engineering Structures* V. 172, pp. 334-345.
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 1. Saouma, V.E., Ingraffea, A.R., and Catalano, D., **Fracture Toughness of Concrete; K_{ic} Revisited**, *Journal of the Engineering Mechanics Division, ASCE*, Vol. 108, No. EM6, pp. 1152-1166, 1982.
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Major Conference Organizer

- 9th International Conference of the International Association of Fracture Mechanics of Concrete and Concrete Structures, IA-FraMCoS, Berkeley, CA, June 2016 (235 participants, 205 presentations, 32 countries) <http://framcoss.org/FraMCoS-0.php>
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Special Reviewed Publication

25. Hariri-Ardebili, M. and Saouma, V. (2019) **Long Term Assessment of Dams Suffering from Alkali Aggregate Reaction State of the Art Review**, Bureau of Reclamation report No. XX
24. Saouma, V. and Hariri-Ardebili, M. **Road Map for the Structural Assessment of Concrete Dams Suffering from ASR; Application to Seminole Dam**, Bureau of Reclamation report No. XX
23. Saouma, V. (Editor) & Fournier, B. and Katayama, T. and Leemann, A. and Lothenbach, B. and Martin, R.P. and Menéndez, E. and Sanchez, L. and Sellier, A. and Wood, J. **Diagnosis & Prognosis of AAR in Existing Structures** Technical Report to be Published by RILEM
22. Saouma, V., Spark, R. and Graff, D. (2017) **Design of an AAR Prone Concrete Mix for Large Scale Testing**, NRC Grant NRC-HQ-60-14-G-0010.
21. Saouma, V., Howard, D., Graff, D., and Hariri, M. (2017) **AAR Expansion; Effect of Reinforcement, Specimen Type, and Temperature**, NRC Grant NRC-HQ-60-14-G-0010.
20. Saouma, V., Graff, D., Howard, D. and Hariri, M. (2017) **Effect of AAR on Shear Strength of Panels**, NRC Grant NRC-HQ-60-14-G-0010.
19. Saouma, V. and Hariri, M. (2017) **Risk Based Assessment of the Effect of AAR on Shear Walls Strength**, NRC Grant NRC-HQ-60-14-G-0010.
18. Saouma, V. and Hariri, M. (2017) **Probabilistic Based Nonlinear Seismic Analysis of Nuclear Containment Vessel Structures with AAR**, NRC Grant NRC-HQ-60-14-G-0010.
17. Saouma, V. (2017) **Structural Modeling of Nuclear Containment Structures**, Special publication by Electric Power Research Institute (EPRI).
16. Hariri-Ardebili, M., Saouma, V., LePape, Y. (2016) **Independent Modelling of the Alkali-Silica Reaction: Mock-up Test Block**, Report ORNL/TM-2016/537
15. Saouma, V., Hariri-Ardebili, Puatatsananon, W., and Le Pape, Y. (2015) . **Preliminary Results on the Alkali-Silica Reaction in Massive Reinforced Concrete Structures: Numerical Simulations of Coupled Moisture Transport and Heat Transfer and Structural Significance of Internal Expansion**, ORNL/TM-2014/489
14. Saouma, V., Hariri-Ardebili, M., and Le Pape, Y. (2015) **Effect of Alkali-Silica Reaction on Shear Strength of Reinforced Concrete Structural Members**, ORNL/TM-2015/588.
13. Graves, H., Le Pape, Y., Naus, D., Rashid, J., Saouma, V., Sheikh, A., Wall, J. [Expanded Material Degradation Assessment \(EMDA\)](#), Volume 4: [Aging of Concrete](#) *Technical Re-*

port NUREG/CR7153, Vol. 4; ORNL/TM-2013/532.

12. Saouma, V.E. and Sivaselvan, M.V. (Eds.) (2008) **Hybrid Simulation; Theory, Implementation and Applications**, Taylor & Francis.
 11. Bourdarot, E., Mazars, J., and Saouma, V.E. (Eds.), **Fracture and Failure of Concrete Dams**, Balkema, 1994.
 10. Reich, R. and Saouma, **Fracture Mechanics Analysis of Gravity Lock Monolith**, *Engineering Technical Letter, No. ETL 1110-2-344*, US Army Corps of Engineers Civil Works, Engineering Division, Nov. 1992.
 9. Plizzari, G., Saouma, V.E., and Waggoner, F., **Sperimentazione in Centrifuga di Dighe a Gravita in Calcestruzzo**, *Studi e Ricerche*, Vol. 13, Scuola di Specializzazione in Costruzioni in C.C., Fratelli Pesenti, Politecnico di Milano, pp. 359-394, 1992.
 8. Saouma, V.E., and Brühwiler, E., **Engineering and Design Fracture Mechanics Analysis of Concrete Hydraulic Structures**, *Engineering Technical Letter, No. ETL 1110-2-8003*, US Army Corps of Engineers Civil Works, Engineering Division, Nov. 1991.
 7. Saouma, V.E., Dungan, R., and Morris, D., (Eds.), **Proceedings of the International Conference on Dam Fracture**, GS-7491, Electric Power Research Institute, Palo-Alto, Sept. 1991.
 6. Saouma, V.E., **Innovative Analysis and Design Procedures for Concrete and Arch Dams**, in *Jubilee Volume commemorating the retirement of Prof. L. Serafim*, Coimbra, Portugal, Oct. 1991.
 5. Saouma, V.E., Ayari, M.L., and Boggs, **Static and Dynamic Fracture Mechanics of Concrete Dams**, in *Fracture Mechanics of Concrete Structures, From Theory to Applications*, L. Elfgren Editor, pp. 336-354, Chapman and Hall, 1989.
 4. **Computer Application in Concrete Technology**, ACI, SP106, 1988.
 3. Saouma, V.E., Ayari, M.L., and Boggs, H., **Fracture Mechanics of Concrete Gravity Dams**, in *Fracture of Concrete and Rock*, S. Swartz, and S. Shah Editors, pp. 311-333, Springer-Verlag, 1989, (Translated into Chinese).
 2. Saouma, V.E., Sikiotis, E.S., **On the Optimization of Partially Prestressed Concrete Beams**, in *Partial Prestressing, From Theory to Practice* M.Z. Cohn, Ed., PP. 411-425, Martinus Nijhoff Publ., 1986.
 1. Ingraffea, A.R., Saouma, V.E., **Numerical Modelling of Discrete Crack Propagation in Reinforced and Plain Concrete**, in *fracture Mechanics of Concrete, Structural Application and Numerical Calculation*, G.C. Sih, and A. de Tomaso, Editors, Martinus Nijhoff Publ., 1984.
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Consulting Activities

1. Seoul National University; Structural Evaluation of Hanbit Nuclear Power Plant Number 4, S. Korea. (2020)
2. C-10 (*pro-bono*) in the matter of C-10 vs NextEra Energy Seabrook, LLC) Docket No. 50-443, ASLBP No. 17-953-02-LA-BD01. Wrote the emergency petition, multiple motions, direct and verbal testimony.
3. Pressurized cracks in concrete offshore structures, Shell Norway (through Reinertsen).

4. Review of Detensioning Plans for CR-3 (Progress Energy) through Structural Integrity.
5. Cracking of Crystal River nuclear reactor containment vessel (Progress Energy) through Performance Improvement International, San Diego.
6. Weidlinger & Assoc., New-York. Rebuttal report of a fracture mechanics based explanation for the fatal parking garage collapse at the Tropicana casino resort in Atlantic City, NJ.
7. Tokyo Electric Power Service Company, Tokyo, Japan.
8. New-York City Department of Environmental Protection (through Gannett Flemming), Gilboa Dam.
9. Cracking in solid rocket propellants, Bayern-Chemie GmbH, Aschau/Inn, Germany
10. Iran Water Power Company (Karun 4 dam), Tehran, Iran.
11. Edison Ellettricità, Turin, Italy.
12. Electricité de France, Paris
13. Obayashi Corporation, Japan
14. Tokyo Electric Power Service Company, Japan
15. US Bureau of Reclamation
16. Hilti Corporation, Lichtenstein.
17. Schnabel Engineering, Denver, CO
18. Swiss Dam Safety Authority, Berne, Switzerland
19. ISMES, Bergamo, Italy
20. ESI, Paris, France
21. PCS Mining, Saskatoon, Canada.
22. ACS Martin, L. A., CA
23. Hanna Mining, Cleveland, OH
24. General Dynamics, Fort-Worth TX
25. TERRA-TEK INC., Salt-Lake City, UT
26. CTICM, Paris, France
27. Southern Utility Company
28. US Army Corps of Engineers

Funded Research

Principal Investigator			
Jan. 2018- Dec. 2020	Long Tern Assessment of Dams Suffering from Alkali Aggregate Reaction	US Bureau of Reclamation	\$592,327
May. 16- Sept. 16.	Independent Modeling of the Alkali-Silica Reaction Mock-Up Test Block	Oak Ridge National Laboratory	\$ 60,000
Oct. 14 - Sept. 17	Experimental and Numerical Investigation of Alkali-Silica Reactors	Nuclear Regulatory Commission	\$ 703,197

May 16-Dec 16	Report on Numerical Modeling of Nuclear Structures	Electric Power Research Institute	\$35,000
Jan. 15 - Aug. 15	Alkali-Silica Reaction in Nuclear Power Plants	Oak Ridge National Laboratory	\$ 36,000
Jan. 14 - Jan. 14	Alkali-Silica Reaction in Nuclear Power Plants	Oak Ridge National Laboratory	\$ 138,000
Oct 12 - Dec 12	Developing Corporate Performance-Based Seismic Design Guideline Works	Enerjisa, Turkey	\$48,500
Oct. 09 - Dec. 10	Unconventional Fracture Tests for Crystal River Project	Progress Energy	\$130,000
Oct. 08-Nov. 09	Development of Finite Element Code Mercury	NEESinc	\$120,000
Jul. 08 - Mar. 10	3D Nonlinear Dynamic Analysis of Dams; Software Development and Technical Support.	Tokyo Electric Power Service Company	\$1,000,000
Jul. 07 - Mar. 10	AAR Expansion in Concrete under Triaxial Confinement.	Tokyo Electric Power Service Company	\$120,000
September 07	NEESinc	Workshop Organization at CU-NEES	\$7,500
Jul. 06 - Mar. 07	AAR Expansion in Concrete under Triaxial Confinement.	Tokyo Electric Power Service Company	\$64,000
Jul. 06 - Mar. 07	Life Prediction of AAR Affected Structures	Tokyo Electric Power Service Company	\$20,000
Jul. 06 - Mar. 07	3D Nonlinear Dynamic Analysis of Dams; Software Development and Technical Support.	Tokyo Electric Power Service Company	\$150,000
Jul. 06	Integration of Fast Hybrid Testing with a Cluster of 124 CPU	University of Colorado (Prof. Cai, Co-Pi)	\$28,000
Jan. 06-Sep. 09	Operation and Maintenance of the Colorado NEES Site	National Science Foundation	\$949,063
Nov. 05 - Mar. 06	Nonlinear Fracture Mechanics of Solid Rocket Propellant	Bayern-Chemie GmbH, Aschau/Inn, Germany	—
Jun. 05 - Mar. 06	Nonlinear Simulation of an AAR Affected High Voltage Transmission Tower	Tokyo Electric Power Service Company	\$20,000
Dec-04 - Mar. 05	Numerical Simulation AAR Deterioration in a High Voltage Transmission Tower	Tokyo Electric Power Service Company	\$ 10,000
Jan. 03 - Dec. 04	Cyclic Response of Concrete Joints	Italian Ministry of Research	38,000 Euro
Mar. 02 - Dec.02	Generation of a 3D Finite Element Mesh for a Nuclear Reactor Panel	Electricité de France	10,000 Euro
Jan-02-Dec-04	Numerical Investigation of Alkali-Aggregate Reactions in Dams	FOWG, Switzerland	CHF 100,000

Aug. 02 - Mar. 07	Static and Dynamic Dam Safety Investigation Using Fracture Mechanics	Tokyo Electric Power Service Company	\$ 891,599
Aug. 00 - Jul. 02	Static and Dynamic Dam Safety Investigation Using Fracture Mechanics	Tokyo Electric Power Service Company	\$ 635,423
Jun. 00 - May 02	Deterioration of Reinforced Concrete; A Fracture Mechanics Approach	National Science Foundation	\$ 128,000
Jan.94 - Aug. 94	Mixed Mode Testing of Rock/Concrete Interfaces	Electric Power Research institute	\$ 57,000
Aug. 93 - Jul. 94	Development of Instructional Workbenches for Small Scale Structural Testing	Univ. of Colorado	\$ 20,000
Jan. 93 - Dec. 93	Large Scale Mixed Mode Testing of Rock/Concrete Interfaces	Electric Power Research Institute	\$ 171,312
Jan. 90 - Dec. 91	Uplift Pressure in Dam Cracks under Seismic Loading, and 3D Fracture Analysis of Concrete Gravity Dams	Electric Power Research Institute, and Pacific Gas and Electric	\$ 150,000
Jun. 89 - May 92	Fracture Mechanics of Concrete Dams: Part II From Theory to Applications; Static Case.	Electric Power Research Institute	\$ 592,000
May 89 - Aug. 90	Effect of Uplift Pressure on Fracture Characterization of Concrete: Design and Evaluation of Testing Procedure	Electric Power Research Institute	\$ 41,857
Jul. 88	Donation of two Apollo DN3500 workstations	Apollo Computer	\$ 54,000.
Feb. 88 - Jan. 89	Design and Checking Automation of Reinforced Concrete Structures	U.S. Army Corps of Engineers	\$ 60,037.
Feb. 88 - Jan. 89	Load Module Development for 3DSAD	U.S. Army Corps of Engineers	\$ 42,493.
Dec. 87 - Feb. 88	Integrated Computer Aided Design of Complex Structures	General Dynamics, Advanced Analysis Group	\$ 21,000.
Dec. 87 - Jun. 88	Implementation of a Distributed Finite Element Based Structural Optimization Program on a CRAY/XMP	Cray Research	Computer and Technical Support
Jun. 87 - Nov. 88	Fracture Mechanics of Concrete Dams	Electric Power Research Institute	\$ 131,809
Dec. 86 - Sep. 87	Elasto-Plastic Fracture Mechanics of Welded Plates	National Bureau of Standards	\$ 9,594.
Sep. 86 - Jun. 87	Instructional Expert System for ACI Code Provisions	University of Colorado	\$ 3,998.

Sep. 86 - Aug. 87	Expert System Development for R/C Beam Design Checking; Part I.	U.S. Army Corps of Engineers	\$ 99,820.
Aug. 86 - Dec. 86	Finite Element Simulation of Rock Hydrofracture near a Subsurface Cavity	U.S. Army Corps of Engineers	\$ 7,200.
Sep. 85 - Aug 86	Engineering Research Equipment Grant: Network of High Performance "Computational Workstations" (Co P.I. K. Willam. C. Gustafson) Matching Fund	National Science Foundation University of Colorado	\$ 76,400. \$ 50,000.
Feb. 86 - Sep. 86	An Automated Model for the Load Definition Module of the 3DSAC CDAMS Program	U.S. Army Corps of Engineers	\$ 13,000.
Oct. 85 - Sep. 86	Implementation of an Integrated Fatigue Life Prediction Program on a Cray	General Dynamics, Fort-Worth, TX	\$ 47,000.
Sep. 85 - May 86	Application of Artificial Intelligence to Reinforced Concrete Design	CRCW, Univ. of Colorado	\$ 2,500.
Sep. 85 - Aug. 86	Fracture Mechanics of Concrete Dams	Bureau of Reclamation	\$ 9,995.
Aug. 85 - Dec. 85	Numerical and Experimental Studies on Bitt Cutter Performance	PCS Mining, Saskatchewan	\$ 17,000.
Oct. 83 - Nov. 85	Partially Prestressed Concrete Beam Optimization	National Science Foundation; Research Initiation Grant	\$ 47,967.

Co-Principal Investigator			
Apr 89 - Mar 91	Brittle-Ductile Failure Mechanics of Mortar and Concrete (Co P.I. K. Willam & S. Sture)	US-AFOSR	\$ 137,971.
	Personal Contribution 33.3%		\$45,990
Jul. 88 - Jan. 91	Load Prediction and Structural Response of Bridges (Co-P.I. G. Goble, D. Frangopol, J. Dow)	Federal Highway Agency	\$ 800,000.
	Personal Contribution 10%		\$80,000
Jun. 88 - May 89	Simulation of Progressive Failure in Solids and Structures (Co-P.I. K. Willam, S. Sture)	National Science Foundation	\$ 191,000.
	Matching Fund	University of Colorado	\$ 15,000.
	Personal Contribution 25%		\$51,500
Oct. 87 - Sep. 89	Simple Load Capacity Tests for Bridges to Determine Load Posting Levels (Co P.I. G. Goble, D. Frangopol)	Pennsylvania Department of Transportation	\$ 220,572.
	Personal Contribution 33%		\$72,788

Aug. 87 - Jul. 88	Brittle-Ductile Failure Mechanics of Mortar and Concrete (Co P.I. K. Willam & S. Sture) Personal Contribution 15%	US-AFOSR	\$ 50,000. \$7,500
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Wrote final proposal for the establishment of the **Bechtel Computer Aided Design Laboratory**, \$1,000,000.

Short Courses

1. [Management of Alkali Aggregate Affected Structures; Analysis, Performance](#) (50 participants from 17 countries).
2. Fracture Mechanics; University of Rome (Roma 3), July 2011
3. Fracture Mechanics; Polytechnic University of Catalunya, Summer 2010.
4. Short course on AAR, Paris, October 2009.
5. Workshop on Dam Research Needs, Boulder Sept. 2007
6. Workshop on Fast Hybrid Simulation, Boulder Aug. 2007
7. Alkali Aggregate Reactions in Massive Concrete Structures; Boulder, CO, April 2007
8. Workshop on Fast Hybrid Simulation, Boulder Nov. 2006
9. Alkali Aggregate Reactions in Massive Concrete Structures; Boulder, CO, April 2005
10. Alkali Aggregate Reactions; and Dynamic Analysis of Dams; International Center for Structure mechanics (CISM), Udine, December 2004.
11. Nonlinear Dynamics of Concrete Dams, 4 hours in a Course at the Politecnico of Milan on Nonlinear Dynamic Analysis of Structures, July 2004.
12. *Recent Advances in Engineering for Concrete Dams*, with Dungar, R., and Boggs, H.; 58 Participants from 14 countries, Sept. 9-10 1991 Boulder CO.

Invited Papers

18. Saouma V. and Hariri, M. (2018) **Probabilistic Cracking, Ageing and Shaking of Concrete Dams**, International Symposium on Dam Safety, Istanbul Turkey.
17. Saouma, V. (2016) **Size Effect: From Irwin to Bažant and Mandelbrot**, invited paper to the first Bažant Workshop at the 9th triennial Conference organized by the International Association for Fracture of Concrete and Concrete Structures, Berkeley, June 2016.
16. Saouma, V. (2013) **Application of the Cohesive Crack Models to Concrete, Ceramics and Polymers** Keynote Lecture at the 8th triennial Conference organized by the International Association for Fracture of Concrete and Concrete Structures, Toledo, April 2013.
15. Saouma, V. and Puatatsananon, W. **Chemo-Mechanical Model for Alkali-Silica Reaction**, 1st International Conference on Numerical Modeling Strategies for Sustainable Concrete, Aix-en-Provence, May 2012.
14. Saouma, V., Uchita, Y., Yagome, Y. **Research needs in Seismic Safety of Dams**, *Proceedings of the 4th US-Japan Workshop on Advanced Research on Dams*, Technical Memorandum No. 4075, Public Works Research Institute, Tsukuba, Japan, pp. 279–293 May, 2007.
13. Saouma, V. **Advanced Joint Modelling**, in *NW-IALAD, European network on Dam Engineering*, Barcelona, November, 2004.
12. Saouma, V. **Nonlinear Dynamics of Concrete Joints; from Theory to Dam Applications**, in *NW-IALAD, European network on Dam Engineering*, Zurich, Sept. 2004.
11. Saouma, V. and Chang, S.Y., **Numerical Simulation of Reinforced Concrete Deterioration due to Steel Corrosion, Freezing-Thawing and Mechanical Load Effects** in *Life-Cycle Performance of Deteriorating Structures: Assessment, Design and Management*, Special Publication of ASCE, Eds., D.M. Frangopol, E. Bruhwiler, M.H. Faber, and B. Adey, 2003
10. Saouma, V.E. and Uchita, T., **3D Nonlinear Dynamic Analysis of Concrete Dams**, *ICANCEER International Conference on Advances and New Challenges in Earthquake Engineering Research*, Harbin, PRC, Aug. 2002
9. Saouma, V.E., **Numerical Simulation of Concrete Deterioration**, *NSF Workshop*, Prague, July 2002
8. Saouma V. E., Červenka J., **Finite Element Analysis of R/C Structures A Hybrid Approach**, *US Japan Seminar on Post-Peak Behavior of Reinforced Concrete Structures Subjected to Seismic Loads* Lake Yamanaka, Oct. 25-29, 1999.
7. Saouma V. E., Červenka J., Slowik V., & Chandra Kishen J. M., **Mixed mode fracture of rock-concrete interfaces**, *US-Europe Workshop on Fracture and Damage of Quasi-Brittle Materials: Experiment, Modeling and Computer Analysis*, Prague, Czech Republic, Sep. 21-23, 1994.
6. Saouma, V.E., **Fracture Mechanics of Concrete Dams**, Keynote Speaker at the *Fracture Mechanics for Hydroelectric Power Systems Symposium*, Vancouver, September

- 1994.
5. Saouma, V.E., **Size Effects and Fractal Analysis of Concrete; Byproducts of a Dam Fracture Research Project**; *Int. Conference on Size Effect* Sendai Japan, Nov. 1993.
 4. Reich, R., Červenka, J., Plizzari, G., and Saouma, V., **Implementation and Validation of a Nonlinear Fracture Model in a 2D/3D Finite Element Code**, *First Bolomey Workshop*, ETH, Zurich, July 1992.
 3. Saouma, V., Červenka, J., Keating, S., Reich, R., and Waggoner, F., **Fracture Mechanics of Concrete Dams**, *Int. Conference on Fracture Mechanics of Concrete Structures*, Breckenridge, CO, June 1992.
 2. Saouma, V.E., Reich, R., **Fracture Mechanics Analysis of Lock and Dam 27**, *US Army Corps of Engineers Structures Conference*, Jacksonville, July 1991.
 1. Saouma, V.E., Ayari, M., and Boggs, H., **Fracture Mechanics of Concrete Gravity Dams**, *Fracture of Dams*, Session, International Conference on Fracture of Concrete and Rock, Houston, June 1987, Springer-Verlag, pp.311-333.
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Refereed Conference Proceedings

50. Y. Le Pape, V. Saouma, Z. J. Ma, J. V. Cabage, M. Guimaraes, K.G. Field, C.H. Mattus, D.J. Naus, J.T. Busby, **Significance of Alkali-Silica Reaction in Nuclear Safety-Related Concrete Structures**, Fontevraud 8 - Contribution of Materials Investigations and Operating Experience to LWRs' Safety, Performance and Reliability France, Avignon - 2014, September 14-18
49. Puntel, E. and Saouma, V. **Experimental Behaviour of Concrete Joint Interfaces Under Reversed Cyclic Loading**, in *Analytical Models and New Concepts in Concrete and Masonry Structures*, AMCM'2008, Lodz, Poland, June 2008.
48. Uruchida, S., Yagome, Y., Kubota, K., Uchita, Y., Saouma, V., **Experimental Investigation of Dynamic Uplift in Concrete Gravity Dams**, 10th ICOLD Annual Meeting Symposium, St Petersburg, June 2007
47. Al-Mahaidi, R., Pham, H.B., Saouma, V., **Discrete-Smeared Crack Finite Element Mechanisms in RC Members**, 8th International Symposium on Fiber Reinforced Polymer Reinforcement for Concrete Structures, FRPRCS-8, Patras, July 2006
46. Pham, H.B., Al-Mahaidi, R., Saouma, V., **Modelling of CFRP-Concrete Bond Using Smeared and Discrete Cracks**, International Symposium on Bond Behaviour of FRP in Structures (BBFS 2005), Chen and Teng (eds.), 2005
45. Saouma, V., Perotti, L. **Alkali Aggregate Reactions in Dams; Stress Analysis and Long Term Predictions**, American State Dam Safety Official (ASDSO) Conference on Dam Safety, New Orleans, Sept. 2005.
44. Uruchida, S., Shimpou, T., Uchita, Y., Yagome, Y., Saouma, V. **Dynamic Centrifuge Analysis of Concrete Gravity Dam**, 73rd Annual Meeting of ICOLD, Teheran, IRAN, paper No. 085-04, 2005
43. Puntel, E., Bolzon, G., Saouma, V., **Numerical and Experimental Investigation of Joints Subjected to Cyclic Loading**, International Conference on Fracture Mechanics,

- Torino, page 396, March 2005.
42. de Sanctis, F., Saouma, V. Viggiani, G. and Denarie, E. **Fracture Mechanics Characterization of Fine-Grained Tuff** EURO-Conference on Rock Physics and Geomechanics, Postdam, 20-23 Sept. 2004.
 41. Noguchi, H., and Saouma, V., **An Investigation of Freeze-Thaw in Dam Concrete; Experimental and Numerical Study**, in Proceedings of Concrete Under Severe Conditions, Oh, B.H. Editor, Korea Concrete Institute, pp. 506-513, 2004
 40. Camata G., Spacone E. and Saouma V., **Nonlinear modeling of debonding failure of RC structural members strenghtened with FRP laminates**, Proceedings of 6th International Symposium on Fibre-Reinforced Polymer (FRP) Reinforcement for Concrete Structures (FRPRCS-6), Singapore, July, 2003.
 39. Camata G., Spacone E. and Saouma V., **Modeling FRP strengthened reinforced concrete structural members using nonlinear finite elements**, fib-Symposium Concrete Structures in Seismic Regions, May 6-9, Athens, 2003.
 38. Camata G., Spacone E. and Saouma V., **Nonlinear Fracture mechanics analysis of brittle failure modes of post-strengthening aged/damaged Reinforced Concrete structural members with Fiber Reinforced Polymer materials**, proceedings of Bond in Concrete - from research to standards, Budapest, November 2002.
 37. Hansen E.J. and Saouma, V.E., **Numerical Simulation of Reinforced Concrete Deterioration**, *FRAMCOS-3 Proceedings*, pp 1655-1668, Mihashi and Rokugo Eds., AEDIFICATIO publishers, 1998.
 36. Shinmura, A. and Saouma, V.E., **The Study of Water Leakage Through Fracture in Reinforced Concrete**, *FRAMCOS-3 Proceedings*, pp 1677-1686, Mihashi and Rokugo Eds., AEDIFICATIO publishers, 1998.
 35. Plizzari, G., Saouma, V.E, and Slowik, V., **Comportamento del Calcestruzzo Fessurato in Presenza di Carichi Ciclici di Ampiezza Variabile**, Gruppo Italiano Frattura, (IGF 11), pp. 297-306, Brescia, 1995.
 34. Slowik, F., Kishen, C., Saouma, V., and Morris, D., **Rock/Concrete Cracks; Myths and Realities**, WaterPower 1995, San-Francisco, July 1995.
 33. Červenka, J., Saouma, V. and Morris, D., **MERLIN: a 2D/3D Finite Element Program for Safety Assessment of Cracked Dams**, WaterPower 1995, San-Francisco, July 1995.
 32. Plizzari, G., and Saouma, V., **Linear or Nonlinear Fracture Mechanics of Concrete?** Proceedings of the 2nd International Conference on Fracture Mechanics for Concrete and Concrete Structures (FraMCoS2), Wittmann, F.H. (Ed.), Zurich, July 1995.
 31. Slowik, F. and Saouma, V., **Transient Fluid Fracture Interaction**, Proceedings of the 2nd International Conference on Fracture Mechanics for Concrete and Concrete Structures (FraMCoS2), Wittmann, F.H. (Ed.), Zurich, July 1995.
 30. Červenka, J., and Saouma, V., **Discrete Crack Modeling in Concrete Structures**, Proceedings of the 2nd International Conference on Fracture Mechanics for Concrete and Concrete Structures (FraMCoS2), Wittmann, F.H. (Ed.), Zurich, July 1995.
 29. Červenka, J., Boggs, H., Plizzari, G., and Saouma, V., **Non-Linear Analysis of Joint Behavior Under Thermal and Hydrostatic Loads for an Arch Dam**, *Third Benchmark Workshop on Numerical Analysis of Dams*, ICOLD, Paris, Spetember, 1994, Vol 1,

- pp. 255-277.
28. Červenka, J., Boggs, H., Plizzari, G., and Saouma, V., **Evaluation of Critical Uniform Temperature Decrease of a Cracked Buttress Dam**, *Third Benchmark Workshop on Numerical Analysis of Dams*, ICOLD, Paris, September, 1994, Vol 2, pp. 467-485.
 27. Reich, R., Červenka, J., and Saouma, V., **MERLIN: A Computational Environment for 2D/3D Discrete Fracture Analysis**, Proceedings of the EURO-C 1994 Conference on Computational Modelling of Concrete Structures, 1994.
 26. Slowik, V., and Saouma, V., **Investigation on Cracking of Concrete with Applications to the Seismic Safety of Dams**, Proceedings of the EURO-C 1994 Conference on Computational Modeling of Concrete Structures, 1994.
 25. Saouma, V.E., Boggs, H., and Morris, D., **Safety Assessment of Concrete Dams Using Fracture Mechanics**, Q.68, R.84, Proceedings of the 18th ICOLD (International Commission on Large Dam) Conference, pp. 1415-1435, Durban 1994.
 24. Perrone, C., Songer, A.D., and Saouma, V., **A Hypermedia-Based Framework for an Integrated Civil Engineering Curriculum**, American Society of Engineering Education, Gulf-Southwest Annual Meeting, Austin, TX, 1993
 23. Songer, A.D., Perrone, C., and Saouma, V., **aHyper CE: Computer Aided Instruction for the Introduction to Civil and Architectural Engineering**, American Society of Engineering Education, Gulf-Southwest Annual Meeting, Austin, TX, 1993
 22. Saouma, V., Červenka, J., Keating, S., Reich, R., and Waggoner, F., **Fracture Mechanics of Concrete Dams**, Proceedings of the Int. Conference on Fracture Mechanics of Concrete Structures, Elsevier Applied Science, pp. 404-412, 1992.
 21. Reich, J., Červenka, J., and Saouma, V., **Computational Fracture Mechanics of Concrete**, ASCE Specialty Conference in Computational Mechanics, Texas, 1992.
 20. Reich, R., Červenka, J., and Saouma, V.E., **Numerical Techniques for 2D and 3D Nonlinear Fracture Mechanics Based Analysis of Dams**, Proceedings of the Int. Conf. on Dam Fracture, pp. 163-182, Boulder CO. Published by Electric Power Research Institute, GS-7491, Palo-Alto, Sept. 1991.
 19. Saouma, V.E., Brühwiler, E., Keating, S., Ryan, J., and Schulz, J., **Innovative Fracture Testing Techniques for Dam Engineering**, Proceedings of the Int. Conf. on Dam Fracture, pp. 459-475, Boulder CO. Published by Electric Power Research Institute, GS-7491, Palo-Alto, Sept. 1991.
 18. Brühwiler, E., and Saouma, V.E., **Water Fracture Interaction in Cracked Concrete Dams**, Proceedings of the Int. Conf. on Dam Fracture, pp. 551-567, Boulder CO. Published by Electric Power Research Institute, GS-7491, Palo-Alto, Sept. 1991.
 17. Saouma, V.E., Brühwiler, E., Boggs, H., and Morris, D., **A Comprehensive Investigation of Fracture Mechanics of Concrete Dams**, Workshop on Application of Fracture Mechanics to Dam Engineering, Locarno, Sept. 17-18, 1990
 16. Brühwiler, E., and Saouma, V.E., **Fracture Testing of Rock by the Wedge Splitting Test**, Proceedings of the 31st US Rock Mechanics Symposium, June 1990, Golden CO, pp. 287-294
 15. Saouma, V., Dambowy, J., and Commander, B., **Automated Design of R/C Structures from Graphics to Expert Systems**, Proceedings of the second *Int. Conference on Computer Aided Analysis and Design of Concrete Structures*, pp. 479-489, Zell-Am-

- See, Pineridge Press, Vol. 1, N. Bicanic and H. Mang Ed.
14. Saouma, V.E., Broz, J.J., Boggs, H.L., and Brühwiler, E. **A Comprehensive Investigation of Fracture Mechanics of Concrete Dams**, *International Symposium on Analytical Evaluation of Dam Related Safety Problems, Theme A: Concrete Dams-Fracture Problems*, ICOLD 57th Executive Meeting, Copenhagen, July 1989.
 13. Saouma, V.E., Doshi, S., Jones, M.S., Sikiotis, E.S., **Research in Computer Aided Design of Reinforced Concrete at the University of Colorado**, *Proceedings of the ACI Symposium on Usage of Computers*, San Antonio, 1987.
 12. Saouma, V.E., Droz, P., **Mixed Mode Blunt Crack Instability Using a Path Independent Contour Integral**, *Proceedings of the 8th Int. Conf. on Structural Mechanics in Reactor Technology*, Brussels, Aug. 1985.
 11. Saouma, V.E., **Computer Graphics Aided Simulation of Crack Propagation**, *Proceedings of the XIII International Finite Element Congress*, Baden Baden, W. Germany, Nov. 19-20, 1984.
 10. Saouma, V.E., and Sikiotis, E.S., **Interactive Computer Graphics in the Design of Reinforced Concrete Buildings**, *Proceedings of the Int. Conf. on Computer Aided Analysis and Design of Concrete Structures*, pp. 937-950, Pineridge Press, 1984.
 9. Saouma, V.E., Jones, M.S., Jones, R.A., **CAI of Structural Analysis and CAE Laboratory Development**, *Proceedings of the National Conference on University Programs in Computer Aided Engineering, Design, and Manufacturing*, Lehigh University, 1984, pp. 179-185.
 8. Saouma, V.E., and Sikiotis, E.S., **Application of Partial Prestressing Optimization**, *NATO/ARW Partial Prestressing: From Theory to Practice*, M.Z. Cohn, Editor, Paris 1984.
 7. Saouma, V.E., and Sikiotis, E.S., **Interactive Graphics Nonlinear Constrained Optimization**, *NASA CP 2335, Research in Structures and Dynamics*, 1984, pp. 143-157.
 6. Saouma, V.E., and Kleinosky, M.J., **Finite Element Simulation of Rock Cutting: a Fracture Mechanics Approach**, *Proceedings of the 25th U.S. Symposium on Rock Mechanics*, Northwestern University, Evanston IL, June 1984, pp. 792-799.
 5. Saouma, V.E., **Computer Graphics Simulation of Crack Propagation**, *Proceedings of the Third International Conference on Numerical Methods in Fracture Mechanics*, Swansea, U.K., pp. 219-233, March, 1984, Pineridge Press.
 4. Saouma, V.E., and Zatz, I.J., **An Automated Finite Element Procedure for Fatigue Crack Propagation Analyses**, *paper No. AIAA 83-0841, Proc. of the 24th AIAA/ASME/ASCE/AHSSDM Conference*, Lake Tahoe, Nevada, June 1983, pp. 196-204.
 3. Saouma, V.E., and Ingraffea, A.R., **Discrete Crack Modelling in Reinforced Concrete**, *Proc. of the Engineering mechanics Specialty Conference*, ASCE, Purdue University, June 1983, pp. 1005-1008.
 2. Saouma, V.E., and Hoelzeman, R. **Computer Graphics Aided Instruction of Structure**, *Proc. of the Eighth Conference on Electronic Computation*, Houston, Texas, Feb. 1983, pp. 209-222.
 1. Saouma, V.E., and Ingraffea, A.R., **Fracture Mechanics Analysis of Discrete Cracking**, *Proc. of the IABSE Colloquium on Advanced Mechanics of Reinforced Concrete*,

Delft, 1981.

Lectures, Conference Presentations

96. Risk & Reliability Assessment of NCVS Subjected to AAR & Seismic Excitation; A Holistic Approach. Nuclear Regulatory Commission. Oct. 2017.
95. Aging and Shaking of Nuclear Containment Structures; Advanced Modelling. University of Grenoble/EdF Nov. 2017
94. Numerical Modeling of Alkali Silica Reaction, National Institute of Standards and Technology, Gaithersburg, April, 2015.
93. Ageing, Shaking and Cracking of Concrete Infrastructures, Swiss Federal Institute of technology, Lausanne, March 2015.
92. On Alkali Aggregate Reactions in Nuclear Power Plants, Nuclear Regulatory Commission, June, 2014.
91. Real Time Hybrid Simulation; Do we Still Need Shake table Tests; Universite de Grenoble, June 2014
90. Real Time Hybrid Simulation; Do we Still Need Shake table Tests; ETH Zurich, June 2014
89. Modeling of Alkali Silica Reaction; Oak Ridge National Laboratory, September 2013.
88. Nonlinear Analysis of Concrete Dams, Universidad de los Andes, Bogota Colombia. May 2013
87. Real Time Hybrid Simulation, Universidad de los Andes, Bogota Colombia. May 2013
86. Potential Applications of Real Time Hybrid Simulation in Aerospace Industry, presentation at Dassault Systemes, Paris, France, 2012
85. Potential Applications of Real Time Hybrid Simulation to *Electricite de France*, Cachan, May 2012
84. Aging, Shaking, and Cracking of Infrastructures: Dams and Nuclear Containment Vessels. Swiss Federal Institute of Technology, Lausanne, Nov. 2011.
83. On Nonlinear Analysis of Nuclear Reactor Containment Vessels; Food for Thought. Nuclear Regulatory Commission, October 2011.
82. Numerical Simulation of Alkali Aggregate Reaction in Nuclear Power Plants, Nuclear Regulatory Commission, October 2011.
81. Real Time Hybrid Simulation, Workshop on Adaptive Discretization and Applications, Roma 3, Italy, June 2011
80. Nonlinear Analysis of Dams, Special Seminar in Roma 3, Italy, June 2011
79. Dynamic Analysis of Reinforced and Massive Concrete Structures; Universita Federico II, Naples, Italy, May 2011
78. Real Time Hybrid Simulation vs Shake Table Tests, UCLA, Jan. 2011.
77. Real Time Hybrid Simulation vs Shake Table Tests, University of Washington, April 2011.
76. Real Time Hybrid Simulation in Reinforced Concrete; *Mécanique de l'Endommagement Appliquée au béton et aux structures en béton; Workshop en l'honneur de Jacky Mazars*, June 2010.

75. Real Time Hybrid Simulation vs. Shake Table Test' National Institute of Standards and Testing (NIST), Nov. 2010.
74. Nonlinear Dynamic Modeling of Concrete dams, XXXIV Jornadas Sudamericana de Ingenieria Estructural, San Juan, Argentina, Sept. 2010.
73. Cracking of Concrete; From Material Characterization to Structural Analysis; Oak Ridge National Laboratory; 1st Annual Coordinated Nuclear Materials Research Meeting; July 2010.
72. Nonlinear Analysis of Concrete Dams, Vattenfall, Sweden, May 2009.
71. Hybrid Simulation of reinforced Concrete Structures, University of Toulouse, May 2009
70. Nonlinear analysis of concrete Dams, Univesity of Roma (3), March 2009.
69. Numerical Modelling of alkali-Aggregate Reactions, University of Toulouse, March 2009.
68. CU-NEES Fast Hybrid Testing Facility, 6th NEES Annual Meeting in Portland, June 2008.
67. Concrete Dams; Aging, Cracking and Shaking. Delft Technical University, May 2008
66. Hybrid Simulation Research at CU-NEES, presented at the French Atomic Energy Commission, Saclay, France 2007
65. Modelling AAR with Merlin, ICOLD Workshop on Chemical Expansion in Concrete, Granada, 2007
64. Modeling of Alkali-Aggregate Reactions in Concrete, Swiss Federal Institute of Technology, Lausanne, July 2007.
63. Hybrid Testing at CU-NEES, LMS Corporation, Louvin, Belgium, July 2006.
62. Hybrid Testing Perspective, Central Research Institute of the Power Industry (CRIEPI), Abiko, Japan June 2006.
61. Seismic Analysis of Concrete Dams, Shimizu Laboratory, Tokyo, June 2006
60. Discrete Crack Models in Fracture Mechanics, Ecole des Mines, Sophia-Antepolis, France, July 2005.
59. 3D Nonlinear Dynamics Analysis of Concrete Dams. EPFL, Lausanne, March 2005.
58. Alkali Aggregate Reactions in Concrete Dams, US Bureau of Reclamation, March 2005
57. Nonlinear Finite Element Modeling of CFRP; *SIKA Research Group*, Zurich, November 2004.
56. Advanced Analysis of Dams; *ENDESA*, Barcelona, November 2004.
55. Nonlinear Analysis of Concrete Dams; *Korean Water Company (KOWACO)*, Seoul, June, 2004.
54. Dynamic Analysis of Arch Dams; From Theory to Applications. *Ministry of Water Resources*, Teheran, Iran, June 2004.
53. Theory of Dynamic Analysis of Arch Dams. *Sharif University*, Teheran, June 2004.
52. Nonlinear Dynamic Analysis of Dams; *Department of Applied Mathematics, Politecnico di Milano (MOX)*, May, 2004
51. Numerical Simulation of Alkali Aggregate Reaction in Concrete Dams, US Bureau of Reclamation, April 2004.
50. Dam Engineering Challenges; Seismic and AAR Analysis; *Accademia Nazionale dei Lincei*, Rome March 2004
49. Dam Engineering Newest Challenges; *University of Rome, La Sapienza* Oct. 2003

48. Numerical Simulation of Concrete Deterioration, *Italcementi*, Bergamo, July 2003.
47. Fracture Mechanics of FRP Reparation, *University of Lecce*, July 2003.
46. 3D Nonlinear Dynamic Analysis of Dams, *University of Grenoble*, March 2003.
45. Deterioration of Reinforced and Massive Concrete; *University of Grenoble*, March 2003.
44. Numerical Simulation of Concrete Deterioration, *Swiss Federal Institute of Technology*, Lausanne, July 2002
43. 3D Nonlinear Dynamic Analysis of Concrete Dams, Tsinghua University, Beijing, PRC, Aug. 2002
42. Fracture Mechanics of Concrete Dams, China Yangtze Three Gorges Project Development Corp., and China Three Gorges University, Yichang, PRC, Aug. 2002
41. 3D Nonlinear Dynamic Analysis of Concrete Dams, China Institute of Water Resources and Hydropower Research (IWHR), Beijing, PRC, Aug. 2002
40. Numerical Simulation of Concrete Deterioration, *University of Venice*, June 2001.
39. Fracture Mechanics of Dams, *Politecnico of Milan*, June 2001.
38. Fracture Mechanics of Dams, *Tokyo Electric Power Company (TEPCO)*, Tokyo, Japan, October 1999.
37. Reflections on, and Applications of Fracture Mechanics in Concrete. *Politecnico di Milano*, Dec. 1998.
36. Fiber Optics Based Determination of Strains Around the Fracture Process Zone in Concrete WST. *Swiss Federal Institute of Technology*, Lausanne December 1998.
35. Dynamic Uplift Pressures in Dams under Earthquakes, *Swiss Federal Institute of Technology*, Zurich June 1998.
34. Numerical Simulation of Concrete Bridge Deck Deterioration, *Prof. Z. Bažant's 60th Birthday Anniversary Workshop* in Prague, March 1998
33. Applications of Fracture Mechanics in Structural Engineering, *University of Leipzig*, Nov. 1997.
32. Fracture Mechanics of Concrete Dams, *ENEL/CRIS Milan Italy*, Nov. 1997.
31. Numerical Simulation of Concrete Bridge Deck Deterioration, *Ecole Normale Supérieure de Cachan*, France, Oct. 1997.
30. 4th International Benchmark Workshop on Numerical Analysis of Dams, (Organized by ICOLD), Madrid, Sept. 1996 (Round Table)
29. Fracture Mechanics of Concrete Dams, *Central Research Institute of the Japanese Electric Power Industry*, Chiba, Japan, Nov. 5. 1993.
28. Fracture Mechanics of Concrete, *Obayashi Construction Company*, Tokyo, Japan, Nov. 4, 1993.
27. Water Fracture Interaction in Concrete, *Norwegian Institute of Technology (NTH)*, Trondheim, Norway, July 1993.
26. Fracture Mechanics of Concrete, *University of Rome, La Sapienza*, July 1992.
25. Fracture Mechanics Research on Dam Cracking; *B.C. Hydro*, Vancouver; Oct. 16, 1992.
24. Fracture Mechanics of Concrete Dams, *Universidad Politécnica de Madrid*, July 1992.
23. Fracture Mechanics of Concrete Dams, *Ecole Normale Supérieure de Cachan*, Paris, France, March 1992.
22. Int. Conference on Fracture of Concrete, Breckenridge, CO 1992.

21. Fracture Mechanics of Concrete, *ISMES*, Bergamo, July 1990.
20. Fracture of Dams, *Tsinghua University*, Beijing, April 1990.
19. Fracture Mechanics of Concrete Dams, *Institute of Water Conservancy and Hydroelectric Power Research*, Beijing, April 1990.
18. Fracture of Concrete, *Swiss Cement Industry Research institute*, Wildegg, March 1990.
17. Fracture Mechanics of Dams, *Laboratoire Central des Ponts et Chaussées*, Paris, March 1990.
16. Fracture Mechanics of Concrete Dams, *ACRES International*, Niagara Falls, Canada, Dec. 7-8 1989.
15. Fracture Mechanics of Concrete Dams, *University of California*, Berkeley, Nov. 6 1989.
14. Fracture Mechanics of Concrete, *Colorado State University*, April 1989.
13. Fracture Mechanics of Concrete Gravity Dams, *Bureau of Reclamation*, Denver, March 1989.
12. Fracture Mechanics of Concrete Gravity Dams, *Northwestern University*, March 1989.
11. Fracture Mechanics of Concrete Gravity Dams, *EPRI Electric Power Advisory Group*, Chattanooga, TN, March 1989.
10. Fracture Mechanics of Concrete Gravity Dams, *Polytechnic of Madrid*, November, 1987.
9. Fracture Mechanics of Concrete Gravity Dams, *CRIS/ENEL*, July 1987, Milan, Italy.
8. Fracture Mechanics of Anisotropic Rock cutting, *Dowell-Schlumberger Research laboratory*, Tulsa, OK.
7. Computer Graphics in Structural Design, *King Faisal University*, Saudia-Arabia, march 18-23, 1986.
6. Some Engineering Applications of Fracture Mechanics, *Waterways Experimental Station*, Vicksburg, MS. Sept. 20-24, 1985.
5. Development of a mixed smeared and discrete crack model for concrete and geomaterial, *Dept. of Civil Engineering, Swiss Federal Institute of Technology*, Lausanne, Switzerland, June 1-15, 1983, June 1-15, 1984.
4. Finite Element Simulation of Crack Propagation, *Eidgenoessisches Institut fuer Reaktor-forschung (EIR)*, Shaufhausen, Switzerland, July 30, 1982.
3. Finite Element Modeling of R/C using fracture mechanics, *Instituto Sperimentale Modellie Strutture (ISMES)*, Bergamo, Italy, July 1982.
2. Finite Element Simulation of Crack Propagation *Swiss Federal Institute of Technology*, lausanne, Switzerland, July 9, 1982.
1. Automated Nonlinear Finite Element Analysis of Reinforced Concrete; a Fracture Mechanics Approach, *Swiss Federal Institute of Technology*, Zurich, Switzerland, June 21, 1981.

Supervised Dissertations

Ph.D.:

12. Golsa Mahdavi **Nonlinear Transient Analysis of an AAR affected Dam** 2020-2022.
13. Hariri, Mohammad **Innovative Numerical Modeling of Concrete Dams**, 2012-2015

12. Kang, Dae-Hung **Computational Environment for Real Time Hybrid Simulation**, 2010.
11. Puntel, Eric **Experimental and numerical investigation of the monotonic and cyclic behaviour of concrete dam joints**, Politecnico di Milano 2004.
10. Puatatsananon, Wiwat **Numerical Simulation of Coupled Chemical-Mechanical Deterioration of Concrete**, 2002
9. Chandra, K., **Interface Cracks: Fracture Mechanics Studies leading towards Safety Assessment of Dams**, May 1996.
8. Červenka, J., **Discrete Crack Modeling in Concrete Structures**, 1994.
7. Reich, R., **On the Marriage of Fracture Mechanics and Mixed Finite Element Methods: An Application to Concrete Dams**, 1993.
6. Prinari, A., **Flow Processes in Nonlinear Material Modelling Synthesis and Homogenization**, 1990.
5. Gamal-El-Din, **Fractal Dimensions and Fracture Properties of Cracked Concrete**, 1990.
4. Ayari, M., **Static and Dynamic Fracture Mechanics of Concrete Gravity Dams**, 1988
3. Sikiotis, E., **Innovative Techniques in Structural Optimization**, 1987

M.S.:

35. Yuichiro Gakuhari **Sensitivity and Uncertainty Analyses of a Dam with AAR**
34. Graff, D. **Shear Strength of AAR Affected Concrete**, 2017
33. Spark R. **Shear Strength Deterioration due to ASR**, 2016
32. Prusinski, K. **Pushover Analysis of a Bridge Pier**, 2015
31. Sonavane, T. **Analysis of Arches**, 2014
30. Georg, R. **Historical Analysis of Arches and Modern Shells**, 2014
29. Stanko, Scott **Contributions to Real Time Hybrid Simulation Modeling**, 2012.
28. Segura, Christopher **Hybrid Simulation; Modeling and Testing**, 2011.
27. Basbolat, E. **Post-Processor to the Mercury Software for Hybrid Simulation**, Dec. 2010.
26. Nasr, K. **Coupled Fracture and Combustion in Solid Rocket Propellants**, May 2010.
25. Perotti, L. **Alkali Aggregate Reactions in Concrete Dams**, Politecnico di Milano, June 2004.
24. Ruolo, Dora **Interface Crack Joints Under Cyclic Loads**, Politecnico di Milano, Jan. 2004
23. Chang, P., **Finite Element/Fracture Mechanics Simulation of Heterogeneous Materials**, 2002.
22. Gillan, Chad **Centrifuge Testing of Concrete Dams**, Aug. 2002
21. Puatatsananon, Wiwat **Probabilistic Fracture Mechanics**, Aug. 1998
20. Hansen, Eric, **Rate Deterioration Investigation of Bridge Decks Based on Diffusion/Fracture Mechanics Numerical Study**, Aug. 1997.
19. Fox, Kristen, **Fracture Mechanics Analyses of Anchor Bolts**, Aug. 1996.

18. Ostrander, Keith, **Applications of Fiber Optics in the Strain Measurement of Structures**, Aug. 1996.
17. Shinmura, A., **Fluid Fracture Interaction in Pressurized Reinforced Concrete Vessels**, 1995
16. Roh, Y., **Numerical Simulation of Fluid Flows in Cracked Concrete**, 1995
15. Winkler, L. **Development of a Workbench of Mechanics, Materials and Structures Experiment**, 1994
14. Hermanrud, J. (CS), **Development of a Three Dimensional Finite Element Post-Processor**, 1993
13. Wigner, W., **Three Dimensional Fracture Mechanics Analysis of an Arch Dam**, 1993.
12. Dewey, R. **Uplift Modelling for Fracture Mechanics Analysis of Concrete Gravity Dams**, 1993.
11. Waggoner, F., **Centrifuge Testing of Concrete Gravity Dams**, M.S. Aug., 1992.
10. Ryan, J., **Effect of Bi-Axial Confinements on Fracture Properties of Concrete, Laboratory and Field Tests**.
9. Broz, J. **Experimental Fracture Mechanics of Concrete Dams**, 1989.
8. Commander, B., **An Improved Method of Bridge Evaluation: Comparison of Field Test Results with Computer Analysis**, 1989.
7. Dambowy, J., **A Knowledge Based Expert System for the ACI Building Code**, 1989.
6. Doshi, S., **Knowledge Based Expert System for Reinforced Concrete Design Checking**, 1987.
5. Jones, M., **A Prototype Hybrid Expert System for Structural Design**, 1987.
4. Sikiotis, E., **Computer Graphics Aided Design of Reinforced Concrete Frames**, 1983.
3. Flango, R., **Graphical PreProcessor for Steel and Concrete Orthogonal Building Frames**, 1983.
2. Murad., M., **Partially Prestressed Concrete Beam Optimization**, 1983
1. Schwemmer, S., **Numerical Evaluation of the Quarter Point Singular Element**, 1983

Foreign Jury Member

1. Andreea Carpiuc-Prisacari (2016) (PhD Candidate; Ecole Normale Supérieure de Cachan (France), *Experimental database with full-field measurements for mixed-mode crack propagation in concrete: comparison between experimental and numerical results*.
2. Kharazi, M. PhD Candidate; Ecole Normale Supérieure de Cachan (France); Rapporteur of her PhD Thesis *Une méthodologie de modélisation pour l'évaluation de l'étanchéité des enceintes de confinement des centrales nucléaires* (A Model for the permeability assessment of nuclear reactor confinement vessel), 2014
3. Raguenau, Frederic *These d'habilitation a la Recherche*, France, Oct. 2006.
4. Berthet-Rambaud, Philippe, *Structures Rigides Soumises aux Avalanches et Chutes de Blocs: Modélisation du Comportement Mécanique et Caractérisation de l'Interaction "Aléa-Ouvrage"*, Doctoral Thesis, Université de Grenoble, July 2004.

5. Bournazel, Jean Pierre, *Contribution a l'Etude du Caractere Thermomecanique de la Maturation du Beton*, Doctoral Thesis, Ecole Normale Superieure, Cachan, July 1992.
 6. Jouhari, M., *Dynamic Crack Growth with Internal Uplift Pressures*, Ecole Nationale des Ponts et Chaussees, Paris, France, 1992.
-

Lecture Notes Manuscripts

1. [Structural Engineering; Analysis & Design](#), 664 pages
2. [Structural Concepts and Systems for Architects](#), 265 pages
3. [Reinforced Concrete](#) 175 pages
4. [Computer Literacy for Undergraduates](#), 233 pages
5. [Finite Element Analysis of Frames](#), 280 pages
6. [Finite Element Analysis](#), 280 pages
7. [Advanced Mechanics of Materials](#), 280 pages
8. [Fracture Mechanics](#), 474 pages

Those notes can be downloaded from my personal web page <http://civil.colorado.edu/~saouma/Lecture-Notes>

Technical Reports

Over 100 Technical Reports written to sponsors.

Software Development

Mercury An Optimized Nonlinear Finite Element Code for Real Time Hybrid Simulation.

MERLIN 3D Nonlinear Finite Element Program, (1991-Present), Funded by Electric Power Research Institute (EPRI), and Tokyo Electric Power Service Company (TEPSCO).

Spider , a general purpose Windows/Open-GL based finite element graphical postprocessor. (1991-Present), Funded by Electric Power Research Institute (EPRI), and Tokyo Electric Power Service Company (TEPSCO).

KumoNoSu a general purpose 3D finite element generator particularly suited for cracked structures, reinforced concrete, and dam structures, (1999-present), Funded by Tokyo Electric Power Service Company (TEPSCO).

Beaver Program for the automation of the layout of double curvature arch dams

PARSIFAL (Particle Simulator for Analysis), a 2D/3D generator for heterogeneous materials with particle collision detection,(2002-Present), Funded by National Science Foundation

SIMSAR (Simulation of Silica Aggregate Reactions) in concrete, (2002-2003), Funded by Swiss Dam Safety Agency.

CDAP (Concrete Deterioration Analysis Program), coupled nonlinear multiphysics simulation of heat, moisture, chloride and carbon diffusion in concrete, (2002-Present), Funded by National Science Foundation.

Society Membership

1. Fellow and President (2013-2016) of the International Association for Fracture Mechanics of Concrete and Structures (FRAMCOS)
 2. (Founding member) Swiss Society of Living Organ Donors (*Association Suisse des Donneurs Vivants d'Organe*)
 3. American Concrete Institute
-

Committee Member

1. ACI 349 Concrete Nuclear Structures
 2. ACI 446 Fracture mechanics of Concrete
 3. ACI-ASCE Committee 447, Finite Element Analysis of Reinforced Concrete Structures.
 4. RILEM TC-259-ISR Committee; Prognosis of Deterioration and Loss of Serviceability in Structures Affected by Alkali-Silica Reactions (Chair).
 5. RILEM TC-258-AAA Avoiding alkali aggregate reactions in concrete - Performance based concept
 6. Member International Association of Fracture Mechanics of Concrete Structures (IA-FramCoS), President.
-

Reviewer for

1. National Science Foundation
2. American Concrete Institute
3. ASCE, J. of Engineering Mechanics
4. ASCE J. of Structural Engineering
5. ASCE J. of Engineering Materials
6. ASME Journal of Applied Mechanics
7. International Journal of Solids and Structures
8. International J. of Numerical Methods in Engineering
9. Journal of the American Ceramic Society

10. Journal of Earthquake Engineering and Structural Dynamics
 11. Cement and Concrete Research
 12. Int. Journal of Fracture Mechanics
 13. Engineering Fracture Mechanics
 14. National Science and Engineering Research Council, Canada
 15. Italian Ministry of Research and University (MIUR)
 16. European Journal of Earthquake Engineering
 17. European Journal of Mechanics
 18. Indian Society of Earthquake Technology Journal
 19. Swiss National Research Council
-

Session Chairman

1. Chairman session “Structural applications and sustainability: Nuclear structures and storages”, International Conference on Numerical Modeling Strategies for Sustainable Concrete Structures (SSCS), 2012 in Aix en Provence, France;
2. Chairman Plenary Lecture session (P. Rossi), International Conference on Numerical Modeling Strategies for Sustainable Concrete Structures (SSCS), 2012 in Aix en Provence, France;
3. Chairman of the “Thermal and vapor effects and cracking” session in the Conference on Concrete Structures Under Severe Conditions (CONSEC07), Tours, June 2007.
4. 39th US Japan Joint Panel Meeting on Wind and Seismic Effects (by Invitation only), Tsukuba, Japan, 2007.
5. Co-Chairman, WG-3 “Dissemination of Knowledge, Education and Training in a Distributed Environment”, *2nd World Forum on Collaborative Research in Earthquake Engineering An Invitational Workshop*, Ispra, March 2007.
6. Chairman, Session 4, CONSEC 04 Fourth International Conference on Concrete under Severe Conditions of Environment and Loading, Seoul, June 2004
7. Chairman, Session 8, Size Effect, Fracture Mechanics of Concrete Structures, Cachan May, 2001.
8. Chairman Session VIII, , Europe-US Workshop on Fracture and Damage in Quasibrittle Structures, Prague Sept. 1994.
9. Chairman, Session 2-B, International Conference on Fracture Mechanics of Concrete Structures, Breckenridge, CO, June 1992.
10. Chairman, Session on Fracture of Dams, ACI Convention, 1991.
11. Chairman, Session II, International Workshop on Application of Fracture Mechanics to Dam Engineering, Lucarno Switzerland, Sept. 1990.

12. Chairman, Session Xb, Int. Conf. on Computer Aided Analysis and Design of Concrete Structures, Zell-Am-See, Austria, April 1990.
 13. Chairman, Session H2, Fracture and Strain Softening I, 8th Int. Conf. on Structural Mechanics in Reactor Technology, Brussels, August 1985.
 14. Chairman, Process Zone Session, International Conference on Fracture Mechanics of Concrete and Rock, Vienna, July 1988.
-

Conference Advisory Panels

1. Member of the Scientific Committee for CONSEC 2016 (Concrete under Severe Conditions).
2. International Conference on Numerical Modeling Strategies for Sustainable Concrete Structures (SSCS), 2012 in Aix en Provence, France; Member of the scientific Committee.
3. FramCos-8, Toledo (Spain) 2013, Member of Scientific Board.
4. FramCos-7, Seoul 2010, Member of Scientific Board.
5. Fifth International Conference on Concrete under Severe Conditions Environment and Loading, Tours, France, (2007) Member of the Scientific Committee.
6. FramCos-6, Cagliari 2007, Member of Scientific Board.
7. ICFXI International Conference on Fracture mechanics, Torino, 2005.
8. CONSEC 04 Fourth International Conference on Concrete under Severe Conditions of Environment and Loading, Seoul, June 2004
9. Third International Conference on Fracture Mechanics of Concrete Structures (FRAMCOS-3), Gifu Japan, Oct. 1998.
10. Fracture Mechanics for Hydroelectric Power Systems Symposium, Vancouver September 1-2, 1994
11. International Workshop on Dam Fracture and Damage, Chambéry, France, March 16-18, 1994, **Co-Organizer** with Mazars and Bourdarot.
12. International Workshop on Size Effect in Concrete Structures, Sendai, Japan, Oct. 31-Nov. 2, 1993.
13. International Conference on Computational Contact Mechanics, Southampton, UK, Sept. 1993.
14. International Conference on *Fracture Mechanics of Concrete Structures*, Coordinator, Breckendridge, CO 1992.
15. International Conference on *Dam Fracture*, **Co-Organizer** with R. Dungar, Boulder CO, Sept. 11-13, 1991. 100 Participants from 18 countries.
16. International Workshop on *Application of Fracture Mechanics to Dam Engineering*, **Co-Organizer** with R. Dungar and F. Whittmann, Lucarno Switzerland, Sept. 17-18, 1990.
17. International Conference on *Micromechanics of Failure of Quasi-Brittle Materials*, New-Mexico, June 1990.
18. Second International Conference on *Computer Aided Analysis and Design of Concrete Structures*, Zell Am See (Austria), April 1990.
19. International Conference on *Fracture of Rock and Concrete*, Houston, June 1987.

Host for External Visitors

1. Antoine Tixier, Ecole Normale Supérieure de Cachan, February-July 2010
2. Etienne Burdet, Ecole Normale Supérieure de Cachan, April-July 2009.
3. Gregory Lebon, Ecole Normale Supérieure de Cachan, April-July 2006.
4. Al-Mahaidi, Riadh, Monash University Australia, 9 months, 2000-2001.
5. Linner, Jens, Chalmers University, 2 months 1995.
6. Slovik, V., ETH, Zurich, 2 years, 1992-94
7. Dave Dollar, US Bureau of Reclamation, Denver (1991-1992, part time)
8. Plizzari, G., University of Brescia/ISMES, Italy, Research Associate, 12 Months, 1991-1992
9. Thiel, F., Ecole Central/Framatome, Paris, France, VSN, 16 months, 1991-1992.
10. Brühwiler, E., ETH Zurich, Switzerland, Research Associate 2 years, 1989-1990.
11. Kim, I., Pusan University, S. Korea, Sabbatic leave, 1 year, 1988.

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