# A Short History of Open PSA

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It was in Osaka, seven years ago, on the first evening of the late autumn rains. After a hard day at PSAM, my head ached.
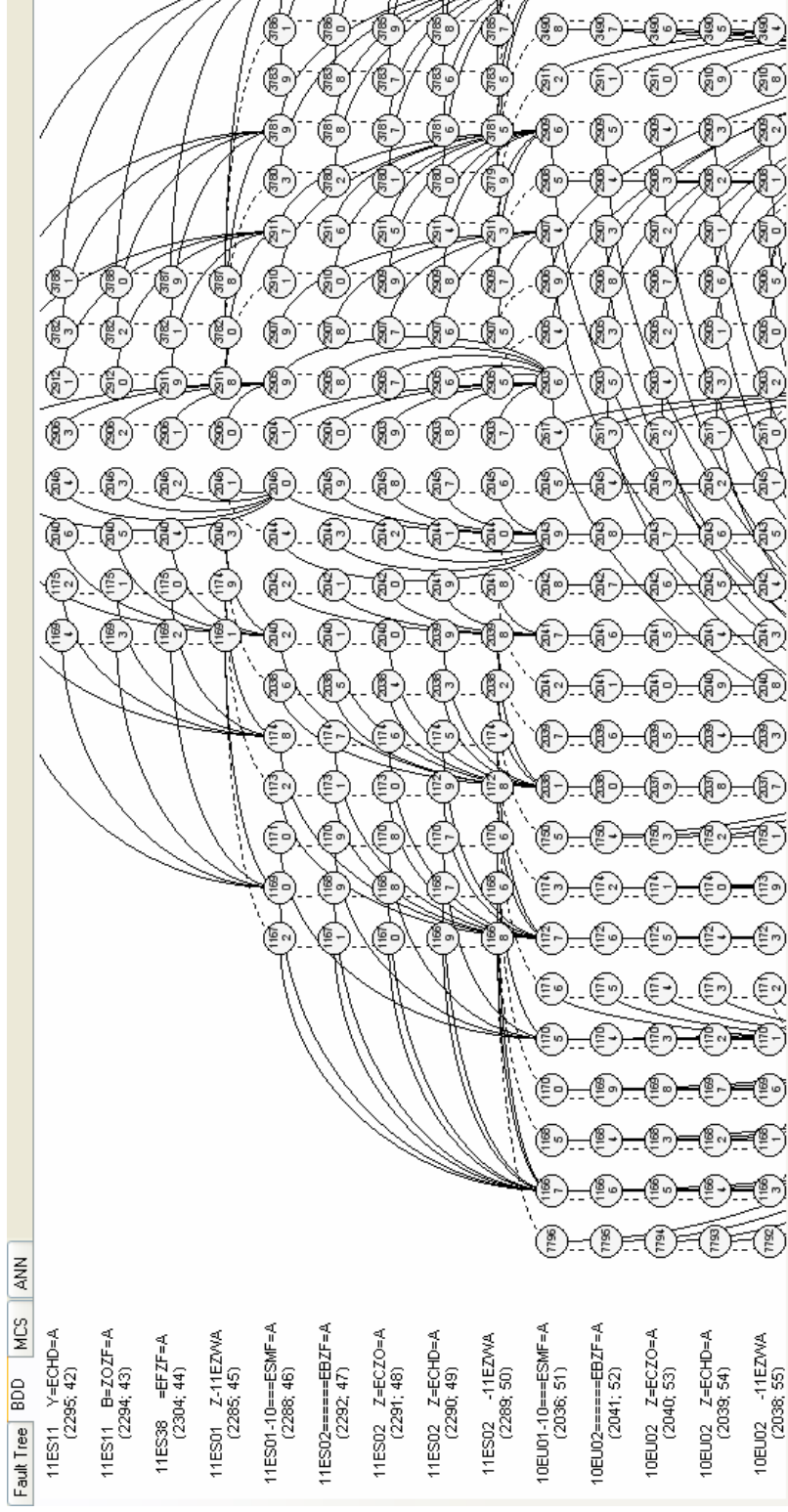
I sat in a small yakatori joint in Kita Shinchi, nursing a sake, when a guy wandered in and ordered a shochu straight up. From the look of his shoes, I knew he was French. I soon found out that we had more in common than just Japanese booze and chopsticks.

# La BDD

- La BDD complexity, she is not related to the number of prime implicants of the encoded formula

- Zee petite BDD here, she encodes a total of $10^9$ cutsets
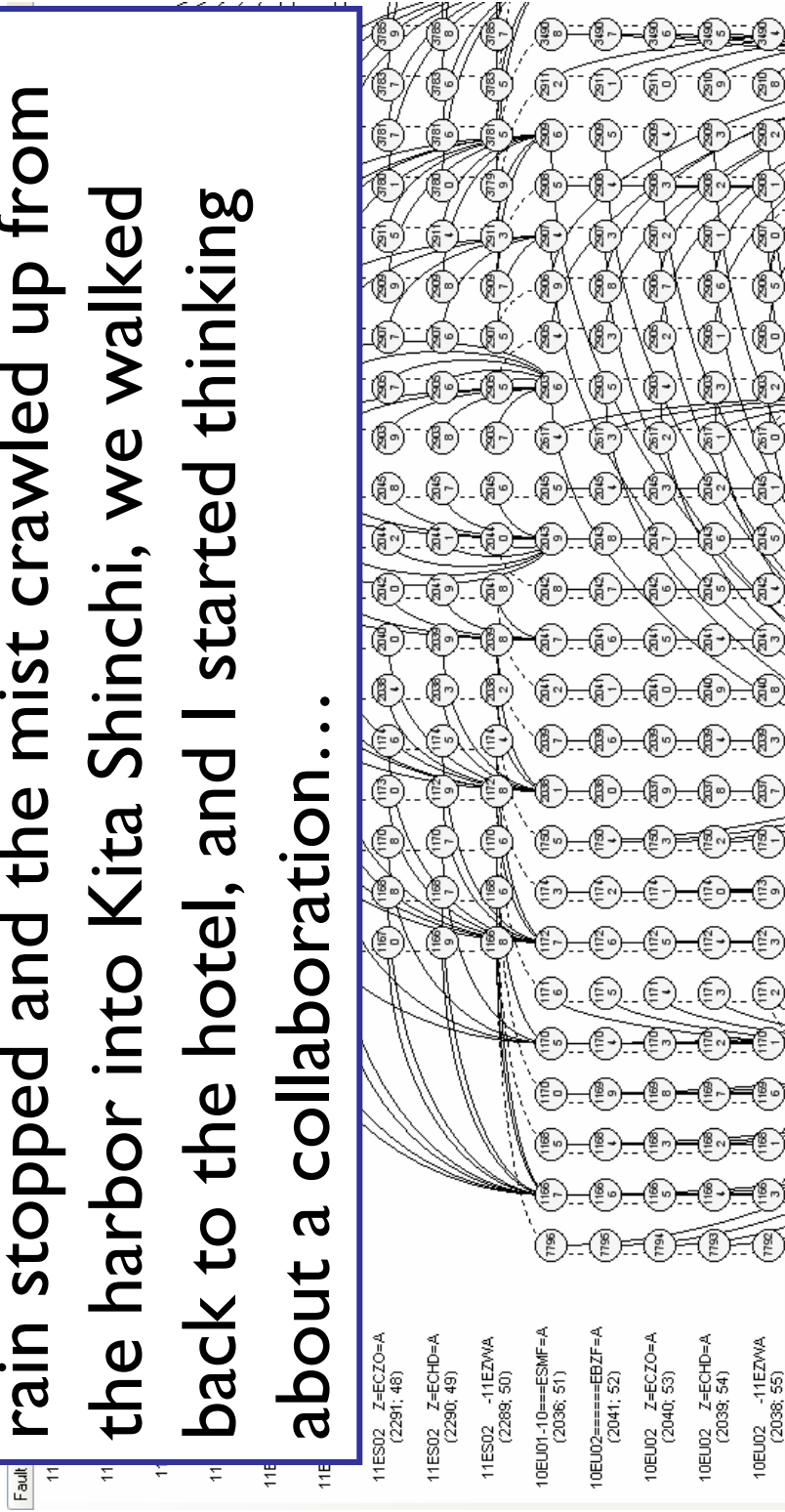
# La BDD

- La BDD complexity, she is not related to the number of prime implicants of the encoded formula

- Zee...

> This guy talked about BDD like most of the French guys I know talk about wine and women: with passion and conviction. I knew he was going to have an up-hill fight with it, but for a big boy, he moved fast like a middle weight.

# La BDD



- La BDD complexity, she is not related to the number of prime implicants of the encoded formula

- Zed...

We talked late into the night. And as the rain stopped and the mist crawled up from the harbor into Kita Shinchi, we walked back to the hotel, and I started thinking about a collaboration…

# La BDD

- La BDD complexity, she is not related to the number of prime implicants of the encoded formula

- Zee... We talked late into the night.   And as the rain stopped ...ed from the harbor throu... walked back to the h... thinking about joining ...he road ....

We began BDD investigations and software projects all over the world. But our interests took an unexpected turn when we saw other issues which needed to be addressed …

- Quality assurance by comparison;
- Peer review of algorithms;
- Portability of the models between different software;
- Clarity of the models;
- Correct uncertainty and importance calculations;

- Assurance of model completeness as quantified;
- Model access by new PRA software;
- Formal verification of calculation methods;
- A universal format for industry data.

# So what have we been doing to bring these benefits into existence?

- Quality assurance by comparison;
- Peer review of algorithms;
- Portability of the models between different software;
- Clarity of the models;
- Correct uncertainty and importance calculations;

- Assurance of model completeness as quantified;
- Model access by specialized PRA software;
- Formal verification of calculation methods;
- A universal format for industry data.

**ABS Consulting**

**Kernkraftwerk Gösgen**

arboost

## Workshop Announcement

## Next Generation PSA Software, Declarative Modeling, and Model Representation Standards

June 12th, 2007

Kernkraftwerk Gösgen-Daeniken, Switzerland

**Call for Participation:** To meet and discuss efforts, visions, and future needs with regards to software, PSA analysts, and model representations in large, safety critical PSA. All attendees are encouraged to present ideas, work-in-progress, research, and production systems, especially in the following areas:

- Quantification Methods;
- User Interfaces;
- Declarative Modeling;
- Standard Model Representations;
- PSA Visualization;
- PSA Software Architectures;
- New Algorithms;
- Modeling Styles and their Effects on Clarity and Quantification;
- PSA Software Verification, Benchmarks, and Quality Assurance.

**How to Participate:** Please fill out the attached form and eMail to Steve Epstein at sepstein@absconsulting.com as soon as possible. Please put the word "Workshop" in the subject line. We will make every effort to make time for anyone who wants to talk, make a presentation, or make a demonstration. We would like to make this an open forum for the exchange of ideas.

**Organizers:** This workshop is organized by ABS Consulting, ARBoost Technologies, and hosted by Kernkraftwerk Gösgen. Please do not hesitate to contact any of the following members of the organizing committee if you have any questions:

Steve Epstein    sepstein@absconsulting.com
Antoine Rauzy    Antoine.rauzy@arboost.com
Don Wakefield    dwakefield@absconsulting.com

# We created the Open PSA Initiative

EdF
AREVA
KAERI
PSI
RelconScandpower
IAEA

Gesellschaft für Anlagen-und Reaktorsicherheit
AXPO/NOK
KKL
ABS Tokyo
ABS Irvine
ARBoost Technologies
Empresarios Agrupados
KKG

Swiss Federal Institute of Technology (ETH)
BKW FMB
UTT
RISA

Instituto de Investigacion Tecnologica.Universidad Comillas Madrid

We wrote a Statement of
Purpose and created a web site
to share ideas.

"We hope to provide an open and transparent public forum to disseminate information, independently review new ideas, and spread the word. We want to emphasize an openness which will lead to methods and software with higher quality, lead to better understanding of PSA models, encourage peer review, and allow the transportability of models and methods." --- from www.open-psa.org

Open Initiative for Next Generation PSA Software

**ABS Consulting**

**Technical Working Group Meeting #1**
**Standard Representation Format for PSA Models**

July 19th, 2007
Electricité de France

département Management du Risque Industriel, Paris

**Call for Participation:** In response to the "next steps forward" charge given by the Open Initiative, the first working group meeting for the Standard Representation Format for PSA Models will begin discussions. Dr. Antoine Rauzy will be the session chairman. Participation is open to anyone in the international PSA community.

**How to Participate:** Please fill out the attached form and eMail to Antoine Rauzy at antoine.rauzy@arboost.com as soon as possible. Please put the word "Working Group" in the subject line. We will make every effort to make room for anyone who wants to participate. This is an open technical forum for the exchange of ideas.

**Meeting Location:** The workshop will be held at Electricité de France, at the département Management du Risque Industriel, which is located in Clamart, a banlieu (suburb) of Paris, about 25 minutes from Porte d'Orléans, the terminus of Metro line #4. For location information: http://www.edf.fr/41341i/Home-fr/Research--Development/The-scientific-community/Access-to-EDF-RD-sites.html If you do not know Paris well, there will be a meeting place in Montparnasse at the café of the restaurant Le Dôme (Metro Vavin) at 08h30, and at Porte d'Orléans at 09h15.

# Resilience Engineering

## Welcome to the Resilience Engineering Network

**Welcome**

**Purpose of the R.E.N.**

**How to Register a Node**

**Registration Form**

### Resilience Engineering

The term Resilience Engineering represents a new way of thinking about safety. Whereas conventional risk management approaches are based on hindsight and emphasise error tabulation and calculation of failure probabilities, Resilience Engineering looks for ways to enhance the ability of organisations to create processes that are robust yet flexible, to monitor and revise risk models, and to use resources proactively in the face of disruptions or ongoing production and economic pressures. In Resilience Engineering failures do not stand for a breakdown or malfunctioning of normal system functions, but rather represent the converse of the adaptations necessary to cope with the real world complexity. Individuals and organisations must always adjust their performance to the current conditions; and because resources and time are finite it is inevitable that such adjustments are approximate. Success has been ascribed to the ability of groups, individuals, and organisations to anticipate the changing shape of risk before damage occurs; failure is simply the temporary or permanent absence of that.

### The Resilience Engineering Network

The Resilience Engineering Network (R.E.N.) is an open organisation of people and places that are engaged in the development and application of Resilience Engineering. Any dedicated activity on resilience engineering can join the network, as a resilience engineering node (see below). While it is in the nature of a network, that there is no center and that all nodes are equally important, the node in Sophia Antipolis will for practical reasons serve as a host node for information about the network and also provide the basic administration facilities. The URL for the Sophia Antipolis node is <www.resilience-engineering.org>.

Open Initiative for Next Generation PSA

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TECHNOLOGIES

EPRI | ELECTRIC POWER
RESEARCH INSTITUTE

ABS Consulting

## Workshop Announcement
## Next Generation PSA Software and Model Representation Standards

October 3rd, 2007

EPRI, Washington D.C., USA

**Call for Participation:** To meet and discuss efforts, visions, and future needs with regards to software, PSA analysts, and model representations in large, safety critical PSA. All attendees are encouraged to present ideas, work-in-progress, research, and production systems, especially in the following areas:

- Quantification Methods and Algorithms;
- User Interfaces and results presentation;
- Declarative Modeling;
- Standard Model Representations;
- Data and Results Visualization;
- PSA Software Architectures;

- Risk Assessment of Human Actions;
- Modeling Styles and their Effects on Clarity and Quantification;
- Uncertainty and Importance;
- PSA Software Verification, Benchmarks, and Quality Assurance.

**How to Participate:** Registration must be done on the EPRI website (www.epri.com). As well, please fill out the attached Intention to Participate form and eMail to Steve Epstein at sepstein@absconsulting.com as soon as possible. Please put the word "EPRI Workshop" in the subject line. We will make every effort to make room for anyone who wants to talk, make a presentation, or make a demonstration. This is an open forum for the exchange of ideas.

**Organizers:** This workshop is organized by ABS Consulting, ARBoost Technologies, and EPRI, the Electrical Power Research Institute. Please do not hesitate to contact any of the following members of the organizing committee if you have any questions:

Steve Epstein     sepstein@absconsulting.com
Antoine Ranzy     Antoine.ranzy@arboost.com
Ken Canavan     kcanavan@epri.com

# Open Initiative for Next Generation of Probabilistic Safety Assessement

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## Welcome to Open-PSA website

**Next Events**
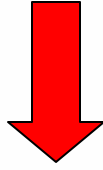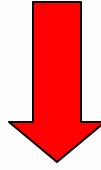
**1st US Open-PSA Workshop, Washington DC, 10/03/2007**

- Directions and Area Hotels
- Open PSA at EPRI Workshop Registration Form
- Open PSA DC Workshop Bulletin
- Open PSA Full Cover Letter

**The Japan Open-PSA Workshop on November 13th and 14th**
Details about this event will be available on October 1st.

**Year-end Open PSA Meeting at the IAEA on December 6th and 7th**
Details about this event will be available on October 10th.

**Who are we ?**

The Open Initiative for Next Generation of

# A Standard PSA Model Representation Format
## Scope and Needs Statement for ASME

**Scope:** We propose that an independent international standard format be created to represent computerized PSA models and industry data in digital fiorm. We propose that an ASME subgroup be created to (1) create a prototype Standard Model Representation Format (**SMRF**), (2) present examples in the prototype format, and (3) deliver a report as to the efficacy of the prototype in addressing the "Needs" statement, below.

**Needs:** Over the last 5 years, new calculation techniques, such as BDD, have been extensively studied in nuclear PSA, and research efforts made in the direction of "next generation" PSA software and "declarative modeling", which try to present a more informative view of the actual systems, components, and interactions which the model represents.

The concern of these studies has been to end the use of approximations: numerical approximations for which we do not know the error factors, and modeling approximations which leave out perhaps critical elements of the actual plant.

From all these investigations, some alarming issues related to large nuclear PSA models have been raised, which we feel need to be addressed before we put new calculation engines or next generation user interfaces into place. We believe that to address these issues enumerated below, a **SMRF** for PSA models, a representation which is independent of all PSA software, must be in place. Each software would retain their own internal representation for a model; but each software would also be able to share models and industry data by means of the SMRF.

1. **Quality assurance of calculations:** at the moment, a model built with one software, such as CAFTA, cannot be simply quantified with another software, such as SAPHIRE or RiskSpectrum, and visa versa; there are too many software dependent features used by modelers to make inter-calculation comparisons a one-step process. A standard representation will allow models to be quantified by several calculation engines, therefore quality assuring results in a strong way.

2. **Over reliance on numerical approximations and truncation:** while this cannot be solved directly by a standard representation, as new calculation engines are completed, a standard representation will allow new engines to be snapped into new (or existing) user interfaces without changing the model or user interface software.

3. **Portability of the models between different software:** at the moment, models are essentially non-portable between calculation engines, as pointed out above. We would like to emphasize here that a standard representation would allow complete, whole models to be shared right now between software; the onus will be on each software to correctly interpret the model representation. We have

# ASME Proposal

## Create an Open Standards Working Group

- make a preliminary design for a PRA software architecture;

- create a structured modeling grammar;

- choose a model representation format;

- use the grammar and representation to define a standard model format;

- show examples with large existing PRAs.

# What we can do NOW

## An Example Test Case of the Idea

- APL uses RiskSpectrum;
- Most other models are made with CAFTA;
- NRC would like to review easily both model types with Saphire;
- create a prototype representation format;
- create model closures using the format;
- attempt to exchange models using the format.

# What Can You Do?

## Support the Open PSA Initiative

- not "owned" by any one company;
- quantification research and verification;
- standard format guardians;
- measure degree of standardization;
  - software
  - models
- provide a pool of professionals for
  - software testing;
  - benchmarking;
  - algorithm peer review;
- solicit membership;
- manpower support from industry;
- internships for universities.