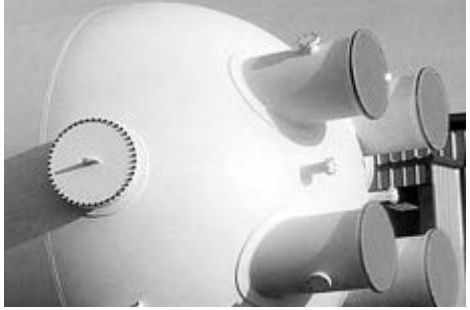
Nuclear Division



Curtiss-Wright Risk and Safety for NPP Decommissioning

Who am I?

ウディ・エプシュタイン

Woody Epstein

取締役・リスク＆セイフティ

アジア太平洋代表

四国八十八ヶ所巡り

国立大学法人 ***東京工業大学***

客員研究員

原子核工学専攻 二ノ方研究室

大学院理工学**研究科 (2010 – 2012)**

Japan Experience

- 13 years in Japan
- Nuclear risk and safety assessments
- Risk Assessment of the Abandoned Chemical Weapons in China
- Preliminary Safety Assessment of the Mitsubishi Regional Jet
- Operations Manager for the IAEA Mission to Onagawa
- Main interests: Natural Hazard Risks and Risk Communication
- Member of the JANSI Technical Review Committee
- Member of the AESJ Risk Assessment Technical Committee

The Risk Cycle

Accident Analyses

- Event Analysis
- Accident Reconstruction
- Lessons Learned

What can go wrong?

- Fire
- Explosion
- **Flood**
- Maintenance/Operations
- **Earthquake**
- Typhoon
- **Tsunami**
- Chemical/Oil Releases
- Terrorism
- Scheduling Delays
- Business Interruption

How Likely Is it?

- Risk Models
- Economic/Cost Models
- Environmental Models
- Natural Hazard Models
- Spills, dispersion, explosion …

ACCIDENT!

What is the financial exposure?

¥ $

What are the consequences?

- To Populations;
- To Workers;
- To the environment;
- To political and social groups.

How much will it cost?

- Repair, replacement costs;
- Health costs;
- Outage and downtime;
- Lost business …
- **PML, probable maximum loss calculations;**

"Prepare for the unexpected"
-- Kanamori Hirō, 1995

CURTISS-WRIGHT

It all started on
the sands of Kitty Hawk
over 100 years ago….

…Today, Publicly Traded (CW)
$3.3B Value

Curtiss-Wright Experience in Japan Since 3.11

- Fire Protection
  - Sendai NPP
  - Genkai NPP
  - Shimane NPP
  - Tsuruga NPP
- Earthquake Hazards
  - PFDHA at the Tsuruga NPP
  - Active Fault Studies at Higashidori and Tsuruga
  - Sesimic design for Taisei for the Sinop NPP in Turkey
- High Wind and Tornado Hazard
  - Genkai NPP
- Plant Process Computers
  - Fukushima Daiichi and Daini

Scientech Products and Services

Mobile Technology

Security Screening / Access Control

Advanced Lab. QA / QC

Regulatory and Information Services

RAPID (Virtual Inventory)

Plant Process Computers

Control Systems

Equipment Reliability

Thermal Performance

Plant Monitoring Real Time Data Acquisition

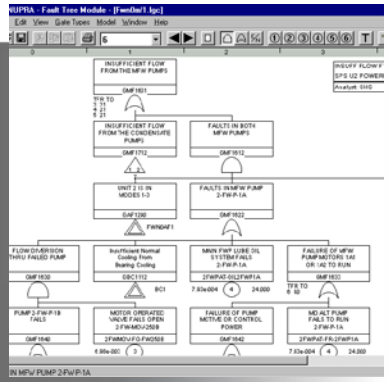
Probabilistic Risk Assessment (PRA)

Human Reliability Analysis

Fire Protection Updates

Seismic PRA

On Line Safety Monitors



Safety and Risk

Analog Instrumentation

Reverse Engineering and Replacement

Obsolescence Programs, Parts, Databases

Power Supplies

Electrical and I&C Products

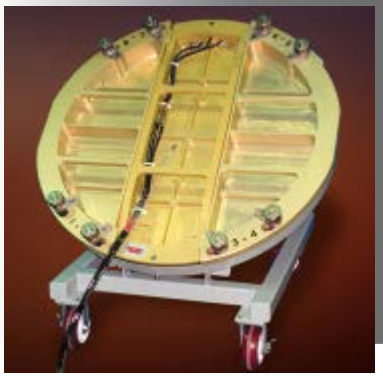
Scientech Products and Services

Advanced Remote Systems

Remote Acquisition Manipulator Systems

BOP Heat Exchanger Services including Data Management, Acquisition, Tube Repair, and Condition Assessment

Qualification and Certification Training



Nozzle Dams and Steam Generator Servicing Equipment

Fuel Handling Equipment Upgrades

Reactor/CRD Servicing Equipment

Outage & Maintenance Services

Plugs and Seals

NETCO SNAP-IN® Neutron Absorbing Rack Inserts

Badger Testing for In-situ Measurement of B^{10}

NETCO Pinsert Neutron Absorbing Fuel Bundle Inserts

Criticality, Thermal and Shielding Analyses

Fully Encoded Phased Array Ultrasonic Testing

NDE Services include UT, MT, PT, ET, VT

NDE and Quality Training Programs

Quality Control Inspection Services

Neutron Absorber Solutions

Advanced NDE Solutions

- Strategic and detailed technical advice;
- Safety management and QA;
- Regulatory/licensing expertise;
- Worker safety;
- Quantitative Risk Assessment (QRA);
- Integrated hazard/risk informed approach to decommissioning;
- Business interruption and probable maximum loss calculations.

What can go wrong, how likely is it, what are the consequences?

Quantitative Risk Assessment (QRA)

- Plant Accidents
- Earthquake, Flood, Fire
- Terrorism
- Radioactive Release
- Emergency Response
- Human Performance

Curtiss-Wright is the internationally recognized leader in the development and application of quantitative risk assessment (QRA) methods to nuclear power and fuel facilities. Our capabilities are founded on more than 30 years of experience in developing and applying these methods in support of the nuclear industry in the U.S., Europe, Korea, UAE and Japan, as well as advising governmental regulatory agencies.

Areas of Support

- Risk management
- Nuclear engineering
- Safety cases
- Asset integrity management
- Programme management
- Training

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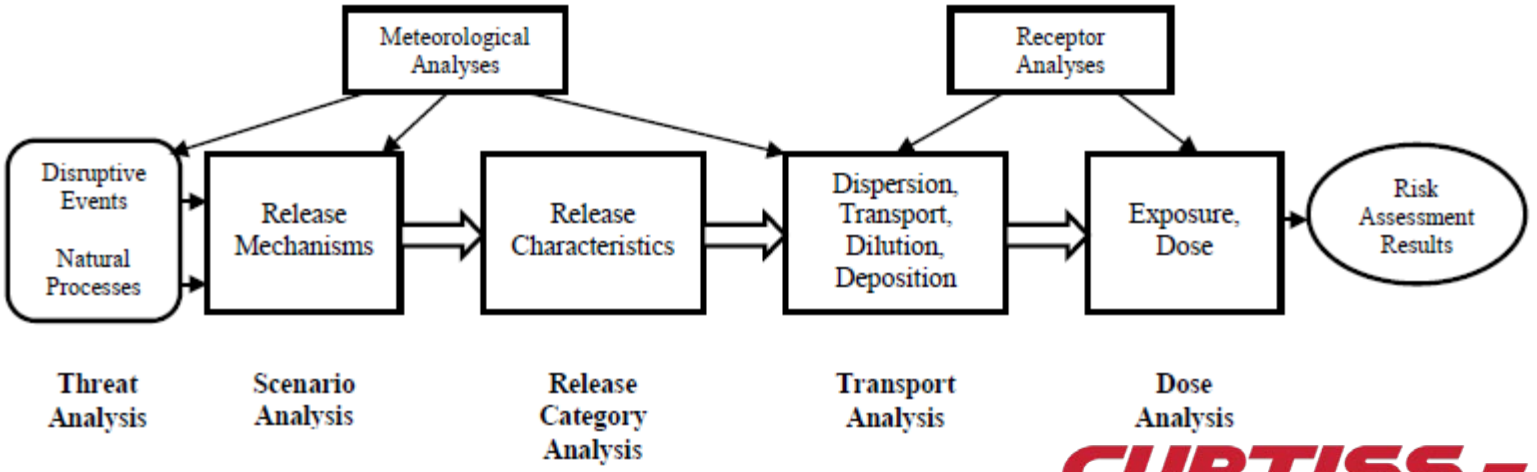
The QRA of the New York State Radioactive Waste Disposal Facility



Leaders of the IAEA Mission to Onagawa

IAEA: Onagawa plant passed the 3/11 test

Kazuaki Nagata
STAFF WRITER

Although the Great East Japan Earthquake devastated the Fukushima No. 1 nuclear power plant, in Miyagi Prefecture the Onagawa atomic plant, which was also hit by strong shaking and tsunami but safely shut down, was "remarkably undamaged," experts from the International Atomic Energy Agency said Friday.

Given an earthquake of this magnitude, "we would have expected the plant to have more damage, and that was not the case," Sujit Samaddar, who led the 19-member team, told reporters in Tokyo, wrapping up their two-week on-site probe.

From the visual investigation this time, the IAEA team did not find any trace that cooling pipes or other critical equipment were damaged from the quake and caused a loss of coolant to keep cooling fuel rods at the Onagawa plant, said Samaddar, who heads the IAEA International Seismic Safety Centre.

The IAEA team came to Japan for a two-week mission to check the effects of the magnitude 9.0 March 11, 2011, temblor on the Onagawa plant, which has three reactors and is located on the Pacific coast about 120 km north of the Fukushima plant.

Whether the quake damaged pipes and cooling systems at Fukushima No. 1, which sufferred three meltdowns, has been hotly debated since a Diet-appointed investigation panel suggest this possibility, despite denials from Tokyo Electric Power Co.

Samaddar stressed that while his team did not find any trace of such damage, its investigation did not cover everything in great detail. He said the team only visually checked samples of the equipment, since time was limited.

Asked what were the differences between Tepco's Fukushima plant and Tohoku Electric Co.'s Onagawa facility, Samaddar said various factors and data need to be scrutinized, so it will take time to find an answer.

The Great East Japan Earthquake reached a level weak 6 on the Japanese seismic scale to 7 at the Onagawa plant and tsunami of about 13 meters high followed.

Samaddar said there was minor damage from the quake, including cracks in the turbine buildings, but none of the damage would have led to a nuclear calamity, like Fukushima.

The team visited the Onagawa plant and investigated structural elements of the plant and the systems for keeping the reactors safe as well as interviewed plant engineers.

The data and experience collected from this investigation will be added to the IAEA database to help improve safety of nuclear power plants worldwide.

Earthquake and Tsunami Margin Assessments

CURTISS-WRIGHT

The Quantitative Risk Assessment of the Abandoned Chemical Weapons in China

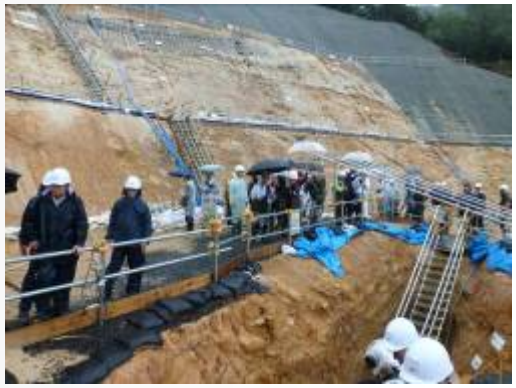
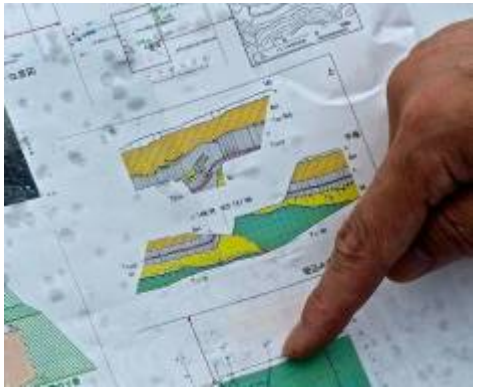
Performed for the ACW Cabinet Office of Japan 2003 - 2007

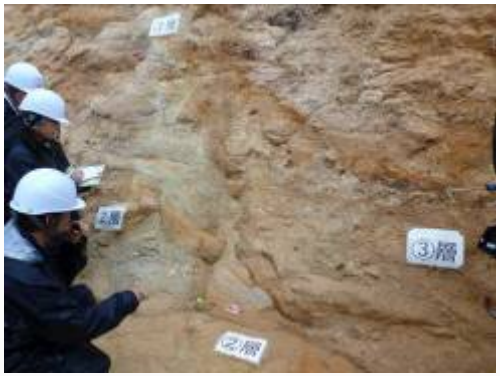
CURTISS-WRIGHT

Independent Investigation and Review for Active Faults

At the request of the Japan Atomic Power Company and the Tōhoku Electric Power Company, we assembled an expert team of geologists, seismologists, earthquake engineers, and risk assessment professionals. Our investigation included:

- field investigations of all excavation trenches
- field investigations of the surrounding geographic areas
- aerial reconnaissance and review of 3-D maps
- interviews with outside experts and researchers
- examinations of the drilling cores
- interviews with utility geologists
- reviews of NRA and utility reports
- studies of earthquake sources

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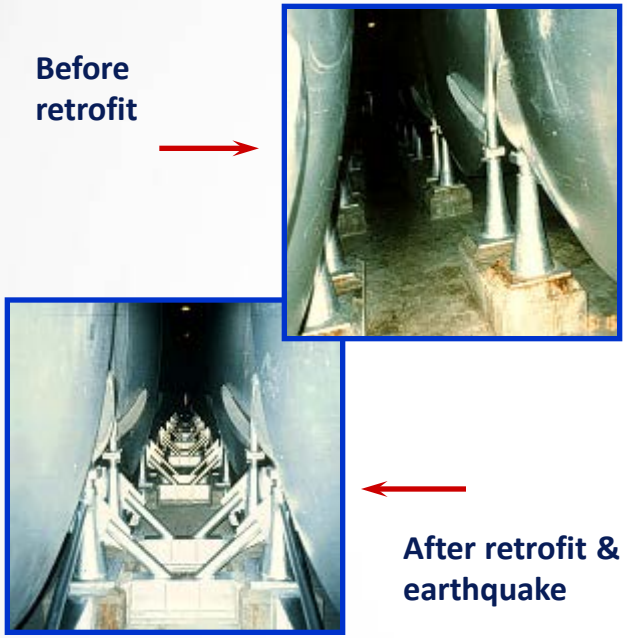
Earthquake Loss Prevention for Tanks

Anheuser-Busch - Brewery, California



Similar (non-AB) facility after Kobe earthquake

- Anheuser-Busch estimated that the total loss would have been $750 million to $1 billion
  - $350 M of direct property damage
  - BI loss of over $400 M

Total cost of retrofitting was only $10 M (>75:1 Benefit/Cost Ratio)

CURTISS-WRIGHT

Fire Analyses

U.S. NUCLEAR REGULATORY COMMISSION May 2001

REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

REGULATORY GUIDE 1.191
(Draft was DG-1069)

FIRE PROTECTION PROGRAM FOR NUCLEAR POWER PLANTS DURING DECOMMISSIONING AND PERMANENT SHUTDOWN

A. INTRODUCTION

- Fire Compliance Assessment
- Safe Shutdown Analysis
- Fire Hazards Analysis (Including FCTs)
- Fire Protection Program Development
- NRA FP Rule Section 1 Compliance Evaluations
- Fire Protection Engineer Evaluations
- Plant Modification Reviews
- Fire Protection and Safe Shutdown Procedures
- Training and Development

Natural Hazard Analyses

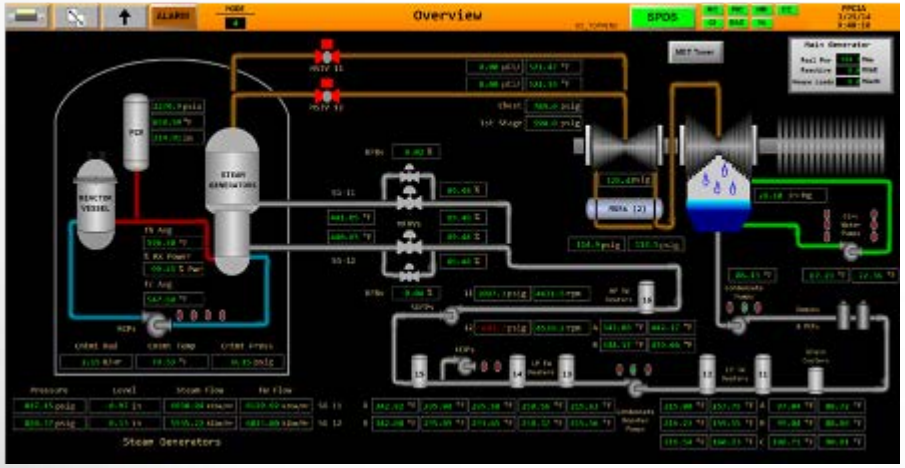
- Screening analysis
- Seismic capability walkdowns
- Seismic input motion
  - Deaggregation of hazard
  - Rock outcrop time histories
- Seismic SSI analysis
  - Develop Building models based on structural Drawings
  - Develop building response and ISRS
  - Probabilistic SSI analysis

- Seismic fragility analysis
  - Building structures fragilities
  - Equipment fragility analysis
  - Piping systems fragility analysis
- Wind and tornado Analysis
- Deterministic analysis
  - Structural integrity evaluation
  - Equipment integrity analysis
- Flooding Analysis

Plant Process Monitoring and Control Systems

Plant Process Systems

- Plant Process Computer
- Safety Parameter Display System
- Radiation Monitoring & Control Systems
- Annunciator System
- Reactor Control Instrumentation
- Steam Generator Water Level Control
- Spent Fuel Pool Level & Temperature Control



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"Such an event is probable because many things should happen contrary to probability."

-- Agathon as quoted in Aristotle's Poetics