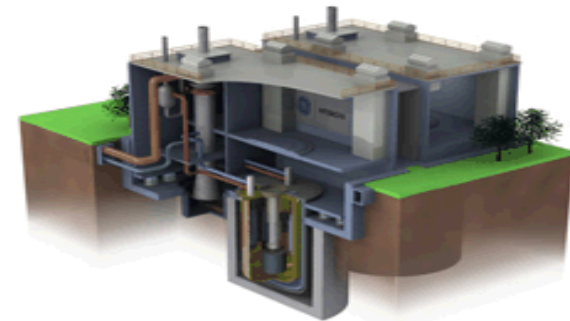


Exceptional service in the national interest



Developing Generic Plant Models For Reactor Safety Analyses

Bryan Rubio, STARS Summer Intern

Risk and Reliability Analysis/Security System Analysis



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Presentation Outline

- Introduction and Background
- Developing Generic Plant Models for Reactor Safety Analyses
- Formatting Plant Model Data
- Summary and Future Work
- Acknowledgements

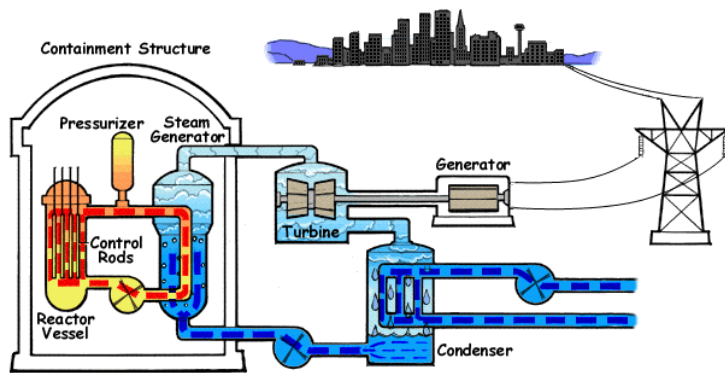
Introduction and Background

- Generic Plant Models for Reactor Safety Analyses
- Reactor Technologies
 - Light-Water Reactor
 - Sodium Cooled Reactor
- Probability Risk Assessment
 - Event Trees and Fault Trees
- SAPHIRE (PRA Modeling and Analysis)

Reactor Technologies

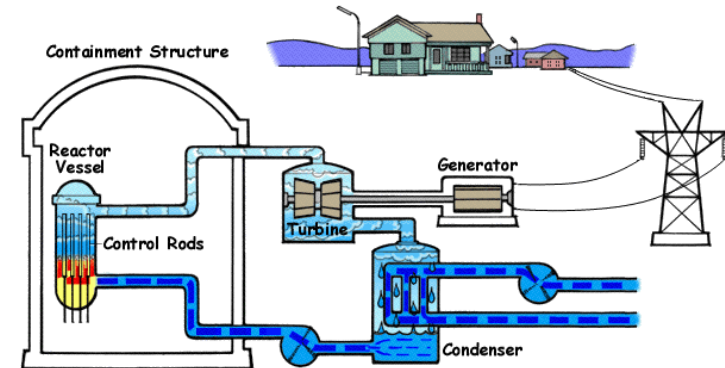
- Commercial Power Reactors
 - Use Nuclear Fission to Produce Energy (Uranium-235)
 - 104 Commercial Reactors in the United States
- Design Types
 - Light-Water Reactors
 - Pressurized Water Reactors (PWR)
 - Boiling Water Reactors (BWR)
 - Sodium-Cooled Fast Reactors

Reactor Technologies



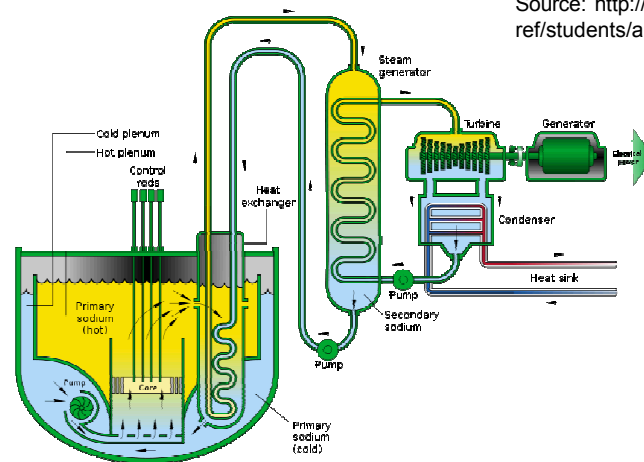
PWR

Source: <http://www.nrc.gov/reading-rm/basic-ref/students/animated-pwr.html>



BWR

Source: <http://www.nrc.gov/reading-rm/basic-ref/students/animated-bwr.html>



SFR

Source: <http://www.inl.gov/research/sodium-cooled-fast-reactor/>

Probabilistic Risk Assessment (PRA)

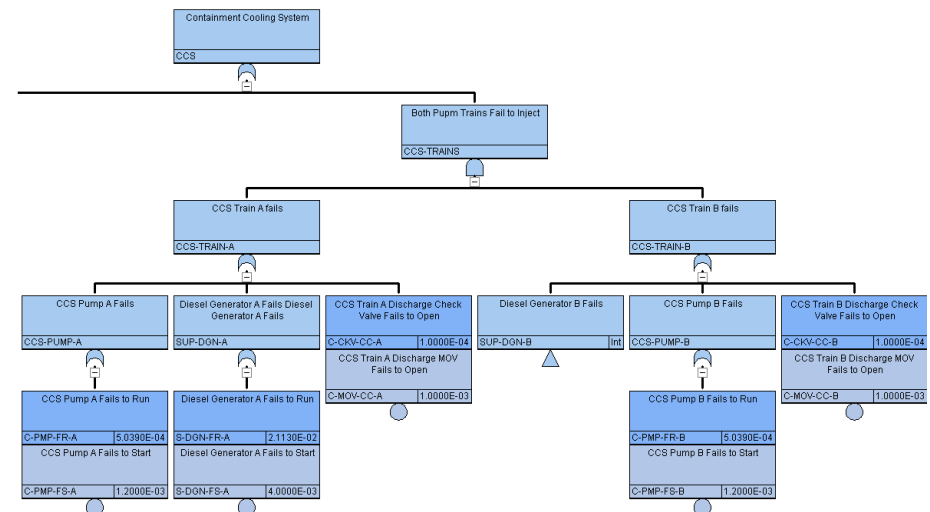
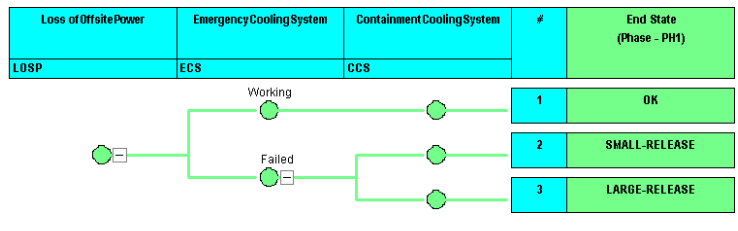
- Structured and Analytical Approach to Assess Risk
 - Measured in two quantities magnitude (severity) and likelihood (probability).
 - PRA is for the purpose of supporting a decision
- Answers Three Basic Questions
 - What can go wrong?
 - What and how severe are the potential consequences?
 - How likely are these consequences to occur?

Event Trees and Fault Trees

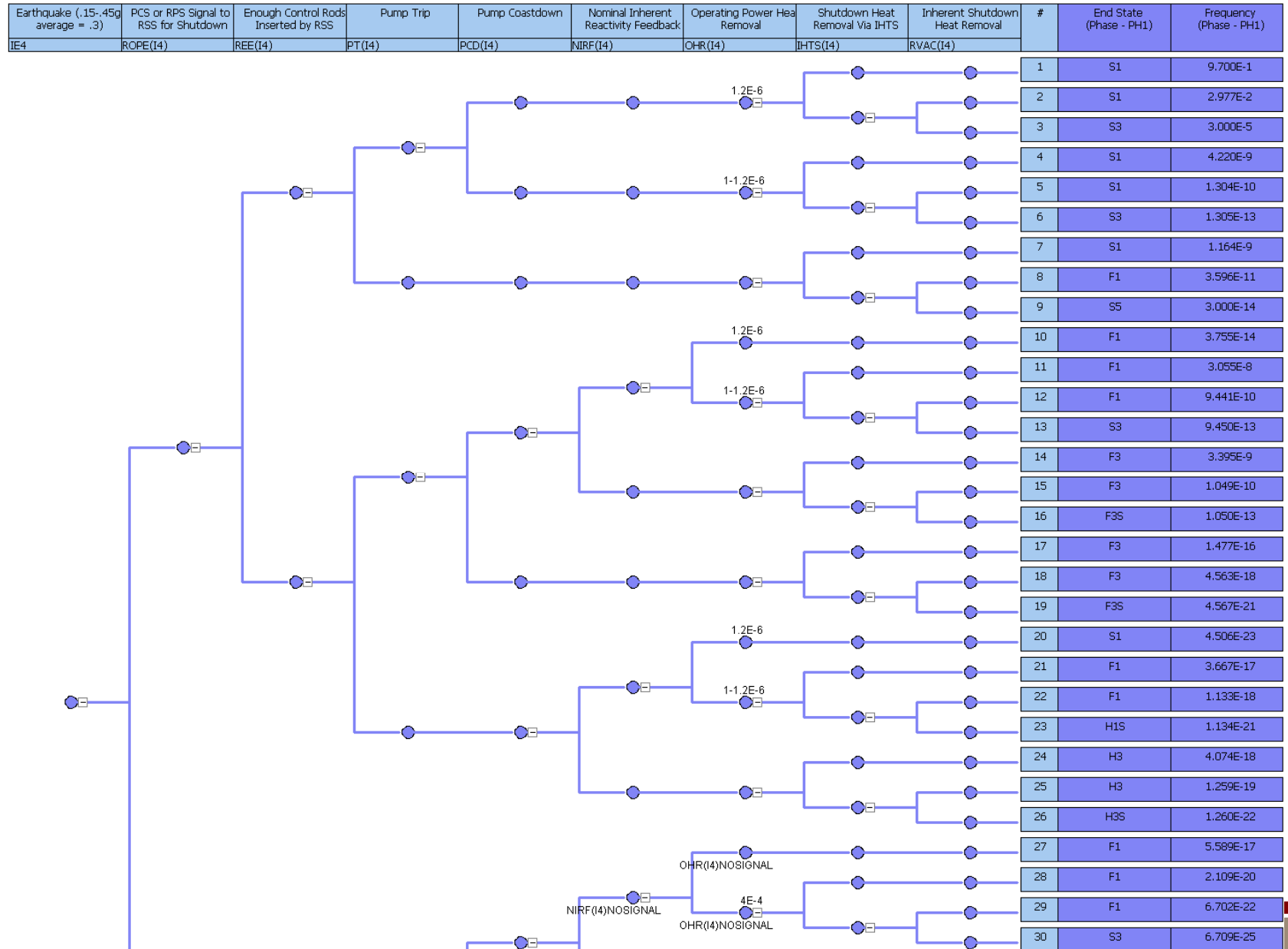
- Event Trees
 - Illustrate Accident Sequences
 - Initiating Events (i.e. Earthquakes)
 - Top Events (Systems)
 - Success or Failure
- Fault Trees
 - Relate events that interact to produce other events by using simple logical relationships and create a structure that represent the system
 - Top Events
 - Logic Gates
 - Basic Events

SAPHIRE (Modeling and Analyses)

- Systems Analysis Programs for Hands on Integrated Reliability Evaluations
- Developed for U.S. Nuclear Regulatory Commission (NRC)
- Probabilistic Risk and Reliability
 - Modeling Event Trees and Fault Trees
 - Analyses



Event Tree



Fault Tree

A4-90

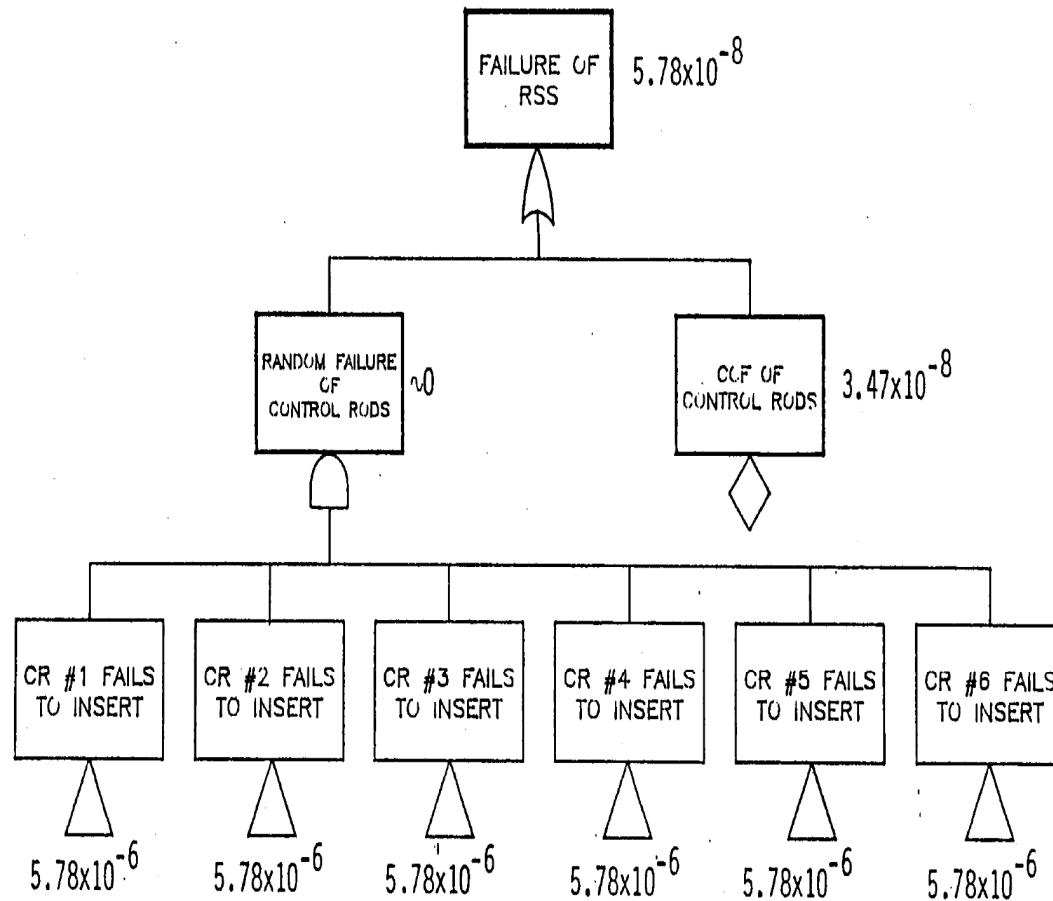


Figure A4.2-30 FAULT TREE FOR RSS FAILURE FOR SEISMICLY INDUCED SHUTDOWN INITIATOR (.3g)

Formatting SAPHIRE Data

```

import java.io.*;
public class Parse{
    public static void main(String[] args)throws IOException{
        Scanner myFileReader = new Scanner(new File("Events Damaged by Flood and Fire Modified.csv"));
        FileWriter myWriter = new FileWriter(new File("EventsDamagedByFloodandFireformatted.txt"));
        Scanner myScan;
        while(myFileReader.hasNextLine()){
            String myString = myFileReader.nextLine();
            myScan = new Scanner(myString);
            myScan.useDelimiter(",");
            String output1 = myScan.next();
            output1 += ", 1,OR\n ";
            output1 += myScan.next();
            while(myScan.hasNext()){
                String temp = myScan.next();
                if(!temp.equals("")){
                    output1+= ", " + temp;
                }
            }
            output1 += "\n^EOS\n";
            myWriter.write(output1);
        }
        myWriter.flush();
        myWriter.close();
        myFileReader.close();
    }
}

```

```

AFMPR2A-MDP02A, 1,OR
  100-A06C, 100-A07C, 100-A10A, 100-A20A, 100-A22A, 100-A24A
^EOS
AFMPR2B-MDP02B, 1,OR
  100-A06D, 100-A07D, 100-A10B, 100-A20B, 100-A22B, 100-A24B
^EOS
AFMPS2A-MDP02A, 1,OR
  055-A18A, 078-A15C, 078-A20A
^EOS
AFMPS2B-MDP02B, 1,OR
  055-A18B, 078-A15D, 078-A20B
^EOS
AFSVO1A-0036, 1,OR
  078-A15C
^EOS
AFSVO1B-0037, 1,OR
  078-A15D
^EOS
AFSVO2A-0035, 1,OR
  078-A20A
^EOS

```

```

078-A15D
^EOS
CAMVC-S-013, 1,OR
  137-A31D
^EOS
CCHEM3B-HE3B, 1,OR
  100-D02
^EOS
CCHEY01A-HE01A, 1,OR
  100-D01
^EOS
CCHEY01B-HE01B, 1,OR
  100-D02
^EOS
CCHEY02A-HE02A, 1,OR
  100-D01
^EOS
CCHEY02B-HE02B, 1,OR
  100-D02
^EOS
CCHEY03A-HE03A, 1,OR

```

Acknowledgements

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