Meeting with NRC

RISK-INFORMED Anticipated Transient Without SCRAM (ATWS) MODEL

January 24, 2001

Meeting Agenda

- Introductions
- Meeting Objectives & Need for Change - Bob Bryan, TVA, WOG Chairman
- Background, Status, and Plans for WOG Risk Informed ATWS Program - Jerry Andre, Westinghouse
- Policy Issue Discussion - Jerry Andre, Westinghouse
- Pilot Plant Application - Dan Redden (Exelon)
- Summary - Bob Bryan, TVA

Follow-on Session

- Exelon Interim Licensing Approach - Dan Redden, Exelon

Meeting Objectives

- Communicate the need for resolution of ATWS issues
- Communicate the status and plans for the WOG RI ATWS program and pilot application
- Discuss and resolve risk-informed ATWS policy issues
- Communicate Exelon Nuclear Interim Licensing approach for Byron and Braidwood Stations

Importance of Changing Current Restrictions Regarding ATWS

- The UET limit effectively places additional constraints on design Moderator Temperature Coefficient
- To ensure the UET limit is met, cores are designed with more burnable absorbers and higher leakage loading patterns
- Design constraints require higher enrichments and more fuel assemblies
- These limitations can cost up to $0.5 Million per Fuel Cycle

Background

ATWS Rule Analysis

- SECY-83-293 provides basis for ATWS Rule
  - Based on generic deterministic analysis
  - Risk-based approach with 1E-05/yr ATWS Core Damage Frequency (CDF) limit
  - MTC represented core response to an ATWS event in the risk model
- Generic analysis supporting ATWS Rule based on:
  - Best estimate type conditions
  - Peak ATWS pressure less than 3200 psig
  - MTC initial condition set at a level not to be exceeded at full power for at least 95% of the cycle

Background

ATWS Rule Analysis (Cont'd)

- Focus on MTC limits core designs relative to Positive MTC
- Limitations not consistent with ATWS contribution to plant risk

Background

WCAP-11992: ATWS Rule Administration Process

- Developed in 1988 to address NRC questions on Positive MTC (PMTC) and ATWS events
- Risk-based approach using 1E-05/yr Core Damage Frequency (CDF) as a limitation (consistent with SECY-83-293)
- Model accounts for plant parameters important to plant response following an ATWS event
- Uses Unfavorable Exposure Time (UET) concept
- Provided to the NRC for information

Background

Commonwealth Edison's Submittal

- Commonwealth Edison referenced WCAP-11992 in 1994 for a license amendment request to allow part-power PMTC
- NRC would not approve the submittal since the WCAP was not formally reviewed and approved
- WCAP-11992 then formally submitted by the WOG
- NRC issued letter rejecting the approach (July, 1997) but indicating much of the technical information was sound
- NRC found the UET approach acceptable to show "a similar level of assurance of the effectiveness of reactivity feedback"
- Byron/Braidwood have UET requirements in Technical Specifications

Background

NRC's Comments on WCAP-11992

- Using a numerical criterion of 1E-05/yr on CDF is not consistent with the NRC's current direction with Risk- Informed regulation
- Potential for ATWS-induced Steam Generator Tube Rupture not addressed
- No explicit link between MTC and risk provided
- Limitations exist regarding analytical completeness and treatment of uncertainties associated with parameters important to ATWS risk

Background

WOG's RI ATWS Program: Objectives

- Develop approach and model for a Risk-Informed ATWS analysis
  - Applicable to all WOG plants
  - Evaluate design changes, and licensing and plant operability issues
  - Evaluate the effect of MTC on ATWS risk
- Address NRC concerns with the WCAP-11992 approach
- Eliminate MTC and UET restrictions associated with ATWS based on Risk-Informed ATWS analysis
- Includes generic evaluations, and plant specific application and submittal

Background

WOG's RI ATWS Program: Status

- Developed generic RI ATWS PRA model to address NRC issues with WCAP-11992 model (Spring 2000)
- Consistent with approach described in RG 1.174
  - Impact on CDF and Large Early Release Frequency (LERF)
  - Address impact on defense-in-depth and safety margins
- Based on WCAP-11992 model
- Maintained UET approach to link risk-informed model to deterministic analysis

Background

WOG's RI ATWS Program: Status (Continued)

- Revisit previous assumptions regarding plant and operator response to an ATWS event
- Updated and modified ATWS event tree, system models, and operator action analyses as necessary
- Evaluated ATWS model with UETs for three core designs
  - Low, medium, and high reactivity core designs
  - Low reactivity core less than or equal to 5% UET
  - Medium and high reactivity cores greater than 5% UETs
  - These UET values correspond to a configuration with no rod insertion, no blocked Pressurizer Power Operated Relief Valves, and all Aux Feedwater

RI ATWS Model and Generic Results

RI ATWS Model (Cont'd)

- Updates provided to the following models and parameters
  - Initiating Event frequency
  - RPS unavailability (NUREG/CR-5500, 12/98)
  - Control rods fail to drop (NUREG/CR-5500, 12/98)
  - Manual and automatic control rod insertion
  - AMSAC to trip the turbine and start AFW
  - Limited ESFAS credit (for control rod insertion failure only)
  - Pressure relief availability
  - Operator action credit: trip reactor via RPS or MG sets
  - Auxiliary feedwater availability

RI ATWS Model and Generic Results

ATWS Core Damage Frequency Results Summary

Rod Insertion = 0.5; PORVs Blocked: 1 @ 20%, 2 @ 5%
UET: 5% (low reactivity core), 36% (high reactivity core)
for conditions of no RI, all AFW, all PORVs available

Core	ATWS CDF (/yr)	CDF Increase Over Low Reactivity Core
Low Reactivity Core	6.5E-08	NA
High Reactivity Core	1.7E-07	1.1E-07

RI ATWS Model and Generic Results

ATWS Core Damage Frequency Results Summary

- CDF while operating in an unfavorable configuration

  CDF (ATWS) = 3E-06/yr
- Time allowed in this configuration (to maintain Incremental Conditional Core Damage Probability <5E-07, consistent with RG 1.177) = 1460 hours per year
- ATWS contribution to plant risk is very small
- Impact on plant risk of moving to a high reactivity core is very small

Policy Issue Discussion

Specific issues raised by the NRC at previous meetings

- December 1998 meeting: How will plants be regulated with regard to ATWS under the RI approach?
- August 2000 meeting: Staff technical members indicated that even if RG 1.174 criteria are met, there could be overriding deterministic arguments that guide their final decision.
- August 2000 meeting: Several staff technical members indicated that they are not comfortable trading off a reduction in a "natural" barrier for one controlled by procedures.

Policy Issue Discussion

WOG Approach to Policy Issues

- Regulatory Guide 1.174 is applicable
  - Meets RG 1.174 risk criteria
  - No impact on Safety Margins
  - Small impact on Defense in Depth, no significant impact on plant safety
- Due to very small impact on risk, no additional regulatory limitations are required

Pilot Plant Application

- Current Requirement: Byron and Braidwood Technical Specification 5.6.5.b.5 limits ATWS Unfavorable Exposure Time (UET) to <5% for each fuel cycle
- Byron and Braidwood to request Interim Amendment Request (follow on discussion)
- WOG is preparing Risk Informed ATWS WCAP
- Byron and Braidwood will submit Amendment Request to delete Technical Specification 5.6.5.b.5 using ATWS WCAP as the basis for the change

Summary

- Changes are required to resolve considerable burden on licensees regarding UET and Fuel Management
- WOG developed a Risk Informed ATWS approach to address NRC concerns with WCAP-11992
- Risk Informed Policy Issues have been addressed
- Byron and Braidwood will be the pilot plants for the WOG Risk Informed ATWS Program
- Schedule - Amendment Requests
  - Exelon submit Pilot Plant Technical Specification Change request estimated 4th quarter, 2001

Exelon Nuclear Interim Licensing Approach

- Current Requirement: Byron and Braidwood Technical Specification 5.6.5.b.5 limits ATWS Unfavorable Exposure Time (UET) to <5% for each fuel cycle
- The Byron/Braidwood Specific UET assumes that Rod Control System is not available for ATWS
- No other fuel design or operating restrictions beyond standard Technical Specifications regarding ATWS mitigation functions

Exelon Nuclear Interim Licensing Approach

- The UET limit effectively places additional constraints on design Moderator Temperature Coefficient
- To ensure the UET limit is met, cores are designed with more burnable absorbers and higher leakage loading patterns

Exelon Nuclear Interim Licensing Approach

- Design constraints require higher enrichments and more fuel assemblies
- Cost of approximately $0.5 million per fuel cycle are incurred after Byron and Braidwood Power Uprate implementation (May 2001)

Exelon Nuclear Interim Licensing Approach

- Exelon Goals
  - Eliminate 5% UET requirement from TS
  - No reload design constraint based on ATWS

Exelon Nuclear Interim Licensing Approach

Interim Technical Specification Change Request:

- Replace current "5% UET" design limit with requirement to control ATWS Risk Significant Functions when the core conditions are Unfavorable.
- Functions include
  - ATWS Mitigation System Actuation Circuit (AMSAC)
  - Pressurizer Power Operated Relief Valves (PORVs)
  - Control Rod Insertion
  - Auxiliary Feedwater

Exelon Nuclear Interim Licensing Approach

Basis for Interim Technical Specification Change Request:

- The current UET definition (no available Rod insertion) will determine when the cycle is unfavorable
- The controls over ATWS Risk Significant Functions will reasonably assure the availability of Control Rod insertion and the other ATWS mitigating functions
- With all ATWS mitigating functions available, the 3200 psi limit will be met without any MTC constraints beyond technical specifications.

Exelon Nuclear Interim Licensing Approach

Description of Administrative Controls

- Byron/Braidwood Technical Requirement Manual, Appendix T contains a Configuration Risk Management Program (CRMP)
  - The CRMP provides proceduralized process to assess/manage configuration risk prior to and during performance of maintenance activities that remove SSCs from service
  - The CRMP currently used for managing risk associated with 14 day allowed outage time for Emergency Diesel Generator.

Exelon Nuclear Interim Licensing Approach

Description of Administrative Controls

- Program exists to calculate UET on cycle specific basis.
  - The burnup window corresponding to an "unfavorable" condition will be calculated for each cycle
  - The UET calc will assume Rod Insertion not available (most limiting single failure)
- With core conditions unfavorable, program will limit discretionary maintenance on key ATWS mitigating functions via CRMP

Summary of Interim Approach

- Exelon Nuclear interim technical specification change request will allow ATWS risk to be managed without current UET design restriction
- Byron and Braidwood will be the pilot plants for the WOG Risk Informed ATWS Program
- Schedule - Amendment Requests
  - Exelon submit Interim Technical Specification Change request in Spring, 2001
  - Exelon submit Pilot Plant Technical Specification Change request estimated 4th quarter 2001