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UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

State-of-the-Art Reactor Consequence Analyses (SOARCA)

ACRS Regulatory Policy and Practices
Sub-Committee Closed Meeting
July 10, 2007

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ACRS Subcommittee Closed Meeting

Agenda

- Sequence Selection - Initial Findings
- Preliminary Accident Progression Insights
- Structural Analyses
- Emergency Preparedness
- Latent Cancer Fatality Dose Response Model

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Preliminary Accident Sequence Selection

Richard Sherry

Peach Bottom Internal Event Sequence Groups

Sequence Group	CDF (per year)	Dominant Cutsets
1	**Mid 10^{-7}**	Reactor transients and failures of HPCI/RCIC (pump/hardware failures, DC power failures) and RCS depressurization (power switch failure, DC power failure, or operator error).
2	**Low 10^{-7}**	Reactor transients with 2 or more stuck-open SRVs and the failure of LPI (operator error, hardware failures).
3	High 10^{-8}	Loss of vital AC Bus 'E12' with failure of SPC/SDC (operator error, hardware failures), operators fail to recover PCS, containment failure (due to initiator failing CVS), and late injection (containment failure). **HPCI/RCIC and RCS depressurization are successful.**
4	Mid 10[illegible]	Reactor transients with failure of RPS (ATWS).
5	Mid 10[illegible]	Inadvertent open relief valve with failure of PCS (due to initiator), CRD (pump failure, operator error) and failure of LPI/Alternate injection (operator error). **HPCI/RCIC are successful.**
6	Low 10[illegible]	SLOCA with failure of PCS (due to initiator) and operator failure to start/control late injection. **HPCI/RCIC and SPC are successful.**
7	Low 10[illegible]	Loss of offsite power and failures of HPCI/RCIC (pump/hardware failures, operator error) and LPI/alternate injection (operator error). **RCS depressurization is successful.**
8	Low 10[illegible]	Station blackout (FTR, TM, FTS, CCF) with failure of operators to restore power to a vital bus prior to battery depletion (2 hours).
9	Low 10[illegible]	Loss of offsite power and failures of SPC (operator error) and LPI/alternate injection (operator error). **HPCI/RCIC and RCS depressurization are successful.**
10	Low 10[illegible]	Loss of offsite power and failures of SPC (operator error) and RCS depressurization (operator error). **HPCI/RCIC are successful.**
Total CDF =	Low 10^{-6}	The dominant sequence groups account for >90% of the total CDF.

Peach Bottom Dominant External Sequence Group Summary Containment Systems Status

EE-1 – EE (Seismic) Initiated Long Term SBO

Representative Frequency: 1E-6 to 5E-6/RY

Sequence Summary: LOOP and SBO occurs due to a seismic or internal fire event; HPCI available initially until loss of room cooling and/or battery depletion renders it inoperable; containment cooling functions are inoperable; containment is isolated; recovery of offsite power is not expected during the mission time.

SYSTEM STATUS SUMMARY		
System/Function	Status	Notes
PCS	Not Available	Loss of AC Power
ADS	Available	
SRVs	Not Failed	
HPCI	Available	
RCIC	Not Available	Seismic Initiator
CRD	Not Available	Loss of AC Power
SPC	Not Available	Loss of AC Power
Containment Spray.	Not Available	Loss of AC Power
LPCI	Not Available	Loss of AC Power
LPCS	Not Available	Loss of AC Power
Containment Vent	Not Available	
SDC	Not Available	Loss of AC Power

Surry Internal Event Sequence Groups

Sequence Group	CDF (per year)	Dominant Cutsets [illegible]
1	High 10^{-7}	Loss of offsite power with EDG/SWS unavailabilities cause a loss of RCP seal cooling, subsequent failure of RCP seals (due to Stage 1 and/or Stage 2 binding/popping or o-ring extrusion), and the failure of HPI. **Operators fail to restore offsite power within 2 hours. The dominant sequence in this group indicates a RCP seal leak rate of 182 gpm that will initiate within 13 minutes of the loss of seal cooling.**
2	Mid 10^{-7}	SGTR with operators failing to isolate the faulted SG or cooldown and depressurize the reactor and failing to initiate long term heat removal (SGTR Procedure ECA 3.1/3.2). **SPAR Model assumes that operators fail to refill the RWST given the previous operator failures.**
3	Mid 10^{-7}	ISLOCA (non-recoverable) from the LPI pipe.
4	Mid 10^{-7}	Station blackout (FTR dominant) with failure of operators to recover power to a vital bus prior to battery depletion (4 hours).
5	Low 10^{-7}	Reactor transient with failure of RPS (ATWS). **Most of this sequence group's CDF is due to an ATWS with failure to limit RCS pressure <3200 psi.**
6	Low 10^{-7}	ISLOCA from the RHR letdown line (non-recoverable or operators fail to recover). **This ISLOCA sequence does not bypass containment.**
7	Low 10^{-7}	Station blackout (FTR dominant) cause a loss of RCP seal cooling, subsequent failure of RCP seals (Stage 2 binding/popping). **Operators fail to restore power to a vital bus within 4 hours.**
8	Mid 10[illegible]	Reactor transients with AFW unavailabilities lead to failure of all feedwater and feed and bleed.
9	Mid 10[illegible]	MLOCA with failure of HPR.
10	Mid 10[illegible]	SLOCA with RHR/CSR unavailable.
11	[illegible]	SLOCA with failure of HPI and secondary side cooling.
12	[illegible]	Station blackout (FTR dominant) with operator failure to cooldown RCS to <1720 psi within two hours causes a loss of RCP seal cooling, subsequent failure of RCP seals (Stages 1 and 2 o-ring extrusion). **Operators fail to restore power to a vital bus within 2 hours.**
13	Low 10[illegible]	SGTR with RHR failures (operator and hardware) and operator failure to refill CST.
Total CDF	**Low 10^{-6}**	**The dominant sequence groups account for ~93% of the total CDF**

Surry Dominant Internal Sequence Group Summary Containment Systems Status

IE-1 – Steam Generator Tube Rupture (SGTR)

Representative Frequency: 5E-7/RY

Sequence Summary: SGTR with operators failing to isolate the faulted SG or cooldown and depressurize the reactor and failing to initiate long term heat removal. Operators fail to refill the RWST given the previous operator failures.

SYSTEM STATUS SUMMARY		
System/Function	Status	Notes
HPI	Available Until RWST Depleted	
LPI	Available Until RWST Depleted	
HPR	Not Available	No Water in Containment Sump
LPR	Not Available	No Water in Containment Sump
PORVs	Available	
AFW	Available	
Containment Spray Inject.	Available Until RWST Depleted	
Containment Spray Recirc.	Not Available	No Water in Containment Sump
Cont. Spray HX	Not Available	No Water in Containment Sump
Fan Coolers	Not Available	
Accumulators	Available	

Surry Dominant Internal Sequence Group Summary Containment Systems Status

IE-2 – Interfacing Systems LOCA (Low Pressure Injection System)

Representative Frequency: 7E-7/RY

Sequence Summary: Failure of two check valves in series in the discharge path of the LPI system. Rupture of LPI low pressure piping. Inability to isolate rupture location. Failure of injection upon RWST depletion.

SYSTEM STATUS SUMMARY		
System/Function	Status	Notes
HPI	Available Until RWST Depleted	
LPI	Failed by rupture of LPI piping	
HPR	Not Available	No Water in Containment Sump
LPR	Not Available	No Water in Containment Sump
PORVs	Available	
AFW	Available	
Containment Spray Inject.	Available Until RWST Depleted	
Containment Spray Recirc.	Not Available	No Water in Containment Sump
Cont. Spray HX	Not Available	No Water in Containment Sump
Fan Coolers	Not Available	
Accumulators	Available	

Surry Dominant External Sequence Group Summary Containment Systems Status

EE-1 – EE (Seismic/Flooding) Initiated Long Term SBO

Representative Frequency: 1E-5 to 2E-5/RY

Sequence Summary: LOOP and SBO occurs due to an internal flooding or seismic event; TDAFW pump available initially. RCP seal LOCA may occur; containment cooling functions are inoperable; late core damage occurs; containment is isolated; recovery of offsite power is not expected during the mission time.

SYSTEM STATUS SUMMARY		
System/Function	Status	Notes
HPI	Not Available	
LPI	Not Available	
HPR	Not Available	
LPR	Not Available	
PORVs	Available	
AFW	TDAFW Available Early	Until loss of DC power
Containment Spray Inject.	Not Available	
Containment Spray Recirc.	Not Available	
Cont. Spray HX	Not Available	
Fan Coolers	Not Available	
Accumulators	Available	

Surry Dominant External Sequence Group Summary Containment Systems Status

EE-2 – EE (Seismic/Flooding) Initiated Short Term SBO

Representative Frequency: 1E-6 to 2E-6/RY

Sequence Summary: LOOP and SBO occurs due to an internal flooding, seismic or internal fire event; ATWS or failure of AFW system causes early core damage; containment cooling functions are inoperable; containment is isolated; recovery of offsite power is not expected during the mission time.

SYSTEM STATUS SUMMARY		
System/Function	Status	Notes
HPI	Not Available	
LPI	Not Available	
HPR	Not Available	
LPR	Not Available	
PORVs	Available	
AFW	Not Available	
Containment Spray Inject.	Not Available	
Containment Spray Recirc.	Not Available	
Cont. Spray HX	Not Available	
Fan Coolers	Not Available	
Accumulators	Available	

Sequence Selection Summary Peach Bottom and Surry

- Total IE CDFs in low to mid 10^{-6} range for both Surry and Peach Bottom
- External event initiated sequences have estimated CDFs that are greater than internally initiated sequences

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Preliminary Accident Progression Insights

Jason Schaperow

Peach Bottom – Sequences

- Internal events
  - None $(<10^{-6})$; ISLOCA~10^{-10}
- External events
  - Long-term station blackout

Long-term Station Blackout

(Peach Bottom)

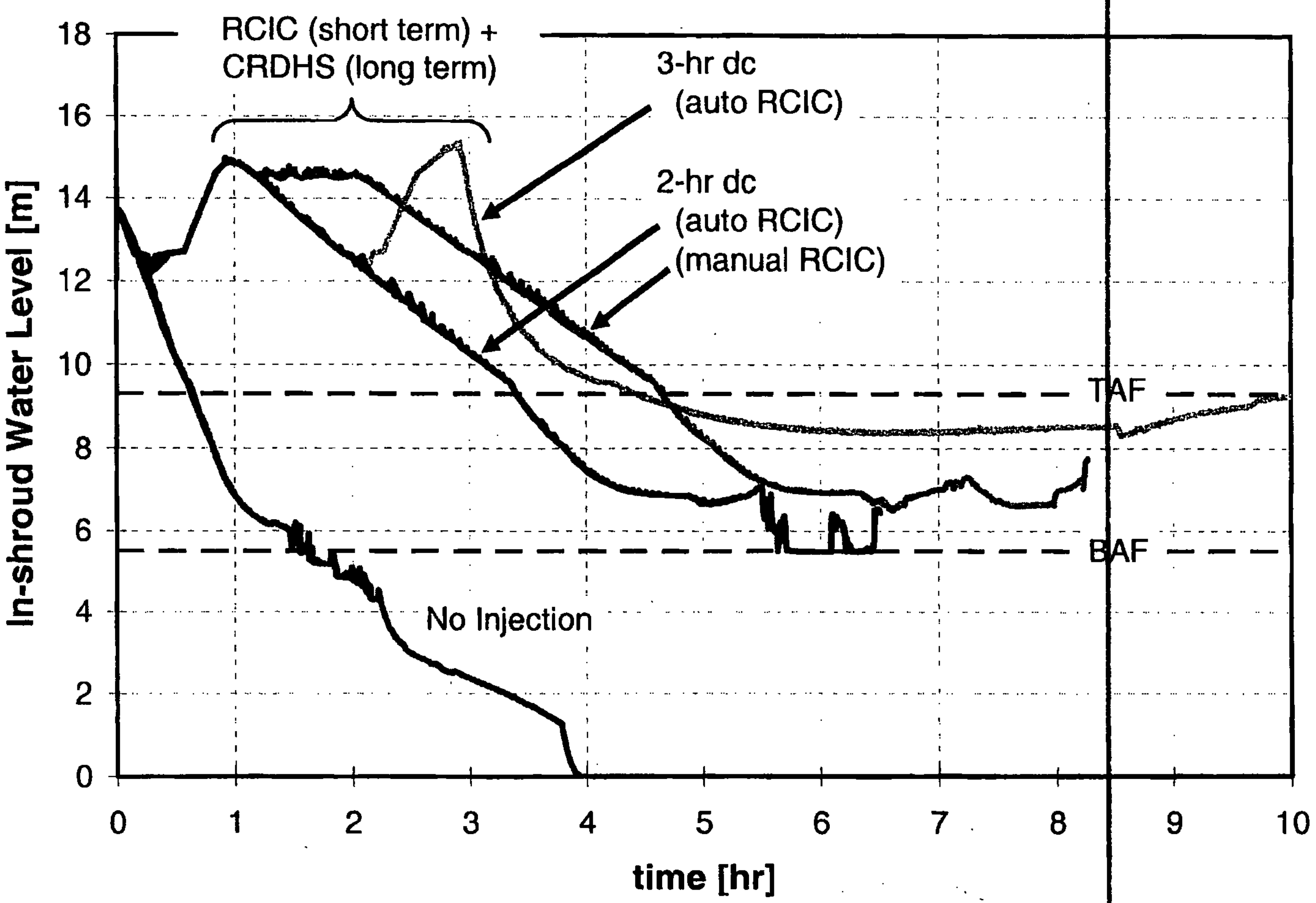
- AC power fails
- High pressure injection available via HPCI (turbine-driven system) until battery depletion
- Event chronology affected by battery life
  - Battery needed to hold SRV open and to control injection
  - Battery life depends on age of batteries and effectiveness of load shedding (2 to 8 hrs w/o load shed)
- Options for mitigation
  - Manual operation of HPCI after battery depletion
  - Use portable generator to hold SRV open after battery depletion
  - Inject with portable pump (500 gpm at 250 psi)
- Mitigation to prevent core damage appears feasible

Preliminary MELCOR Examination of Accident Progression and PRA Success Criteria

(Peach Bottom)

- Loss of vital AC bus E-12 (initially identified as risk-important, later judged to be below the 10^{-6}/ry CDF threshold)
  - Loss of AC power to DC inverters
  - Available: Turbine-driven systems, CRDHS, SRV, LPI
  - EOPs direct operators to maintain level with RCIC and begin controlled depressurization
  - Event chronology affected by battery life
- MELCOR analysis of CRD effectiveness
  - Detailed T/H analyses of specific cutsets reveal margins to core damage and substantial margins on vessel failure
  - Not a significant "release" sequence as suggested by simplified PRA criterion
- Additional available mitigation
  - Increased CRD flow (140 gpm) , SLC injection (50 gpm)
  - Manual control of RCIC
  - EDMG portable generator and pump

MELCOR Analysis of CRD Effectiveness



Preliminary Insight
(Peach Bottom)

- Scenarios initially identified involve loss of AC power to key plant equipment
- Scenarios evolve slowly
  - Availability of DC power extends time to onset of core damage
  - Battery lifetime is an important assumption
- Mitigation may prevent core damage
  - PRA success criteria appear conservative with respect to effectiveness of CRDHS
    - Best-estimate calculations will likely demonstrate outcome does not lead to core damage
  - Manual intervention with installed and portable equipment could prevent or limit extent of core damage

Surry – Sequences

- Internal events
  - Low head injection ISLOCA
  - Spontaneous SGTR
- External events
  - Long-term station blackout
  - Short-term station blackout

Low head injection ISLOCA
(Surry)

- Low-head-injection inboard isolation check valves (2) disc failure
  - Check valves in 6" pipe with a venturi.
- Exposure of low pressure piping in Safeguards Building to RCS pressure assumed to result in leak outside containment
- Mitigation
  - High head injection is available, 3 pumps at 150 gpm/pump
  - Leak location may be underwater (scrubbing)
- Mitigation using installed equipment appears sufficient to prevent core damage, PRA appears to not credit operator actions in the long term
- Portable generator and pumps available, if needed

Spontaneous SGTR
(Surry)

- Operators fail to diagnose tube rupture and follow procedure resulting in pumping the RWST inventory into the RCS and out through the ruptured tube
- Timing associated with this scenario is long
  - 14 hrs to deplete RWST, assuming 450 gpm injection
  - Have cross-tie to other unit's RWST
- Mitigation
  - Additional crews of operators, TSC, EOF, and NRC Ops Center
  - All plant systems are available
  - Once RCS pressure drops sufficiently (AFW, RHR)
- Mitigation appears to be sufficient to prevent core damage, PRA appears to not credit operator actions in the long term
- Portable generator and pumps available, if needed

Long-term Station Blackout

(Surry)

- AC power fails
- TD-AFW removes decay heat until RCS water level drops due to RCP seal leakage (preventing adequate convection of heat from core to SGs)
- TD-AFW
  - Battery used to indicate SG level and control TD-AFW
  - Licensee PRA has a conservative estimate of 8 hours for battery life – requested licensee provide realistic estimate
  - Once battery depleted, manually control TD-AFW and restore level indication with portable generator
- RCP seal leakage
  - Leakage estimated at 21 gpm/pump
  - Increased leakage possible when seals subjected to high temperatures – research planned to estimate seal failure timing
  - Make up for leakage with portable pump and restore level indication with portable generator
- Mitigation to prevent core damage appears feasible

Short-term Station Blackout
(Surry)

- AC and DC power fails
- Flooding/fire
  - TD-AFW automatically starts and runs at design speed
    - Operators take manual control to prevent SG overfill
  - Make up for RCP leakage with portable pump
- Seismic
  - Direct mechanical failure of TD-AFW
    - Limiting scenario in terms of timing
  - Evaluating availability of portable pumps and portable generator

Preliminary Insight
(Surry)

- Scenarios identified have long times until core damage and release to the environment
  - Fastest scenario identified is seismic-induced loss of AC and DC power with direct mechanical failure of TD-AFW
- Mitigation may prevent core damage for some scenarios
  - PRA success criteria for preventing core damage appear conservative with respect to crediting installed equipment and operator actions
  - Time to deploy portable equipment appears sufficient to prevent core damage when installed equipment not available

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Structural Analyses

Ata Istar

OBJECTIVE

Perform Structural Evaluation of Containments to Determine the following:

- Functional Failure Pressure - Leakage
- Structural Failure Pressure - Rupture
- Develop Leakage Rate and/or Area as a Function of Internal Pressure

Peach Bottom (Mark I – Steel)

Background:

- Considerable Variation in Predicting Failure Pressure Levels and Locations in Numerous Studies were Performed Previously
- Failure Pressure Varies between 195 to 86 psig at various Temperature Levels
- Failure Locations:
  - Drywell Shell Melt-Through
  - Wet Well Rapture
  - Equipment Hatch Leakage
  - Bellow Failure
  - Penetrations Failure
  - Seismic Stabilizer Punch-Through of Drywell Shell
  - Drywell Head Flange Leakage

Peach Bottom (Mark I – Steel)

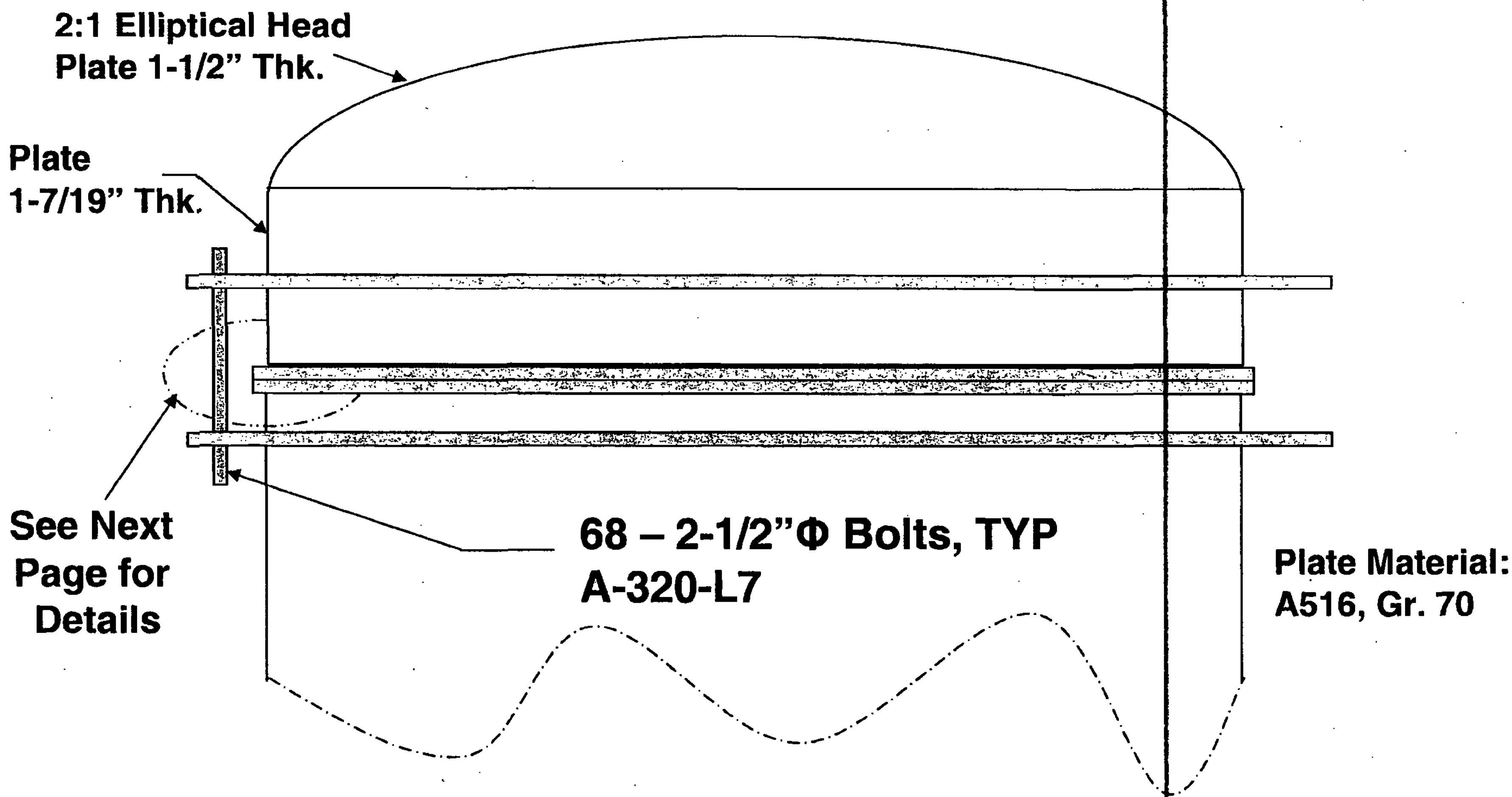
Approach:

- Review/Reevaluate Major Failure Criteria Based on the 25 Years of Research and Testing Carried out at SNL and other Reports

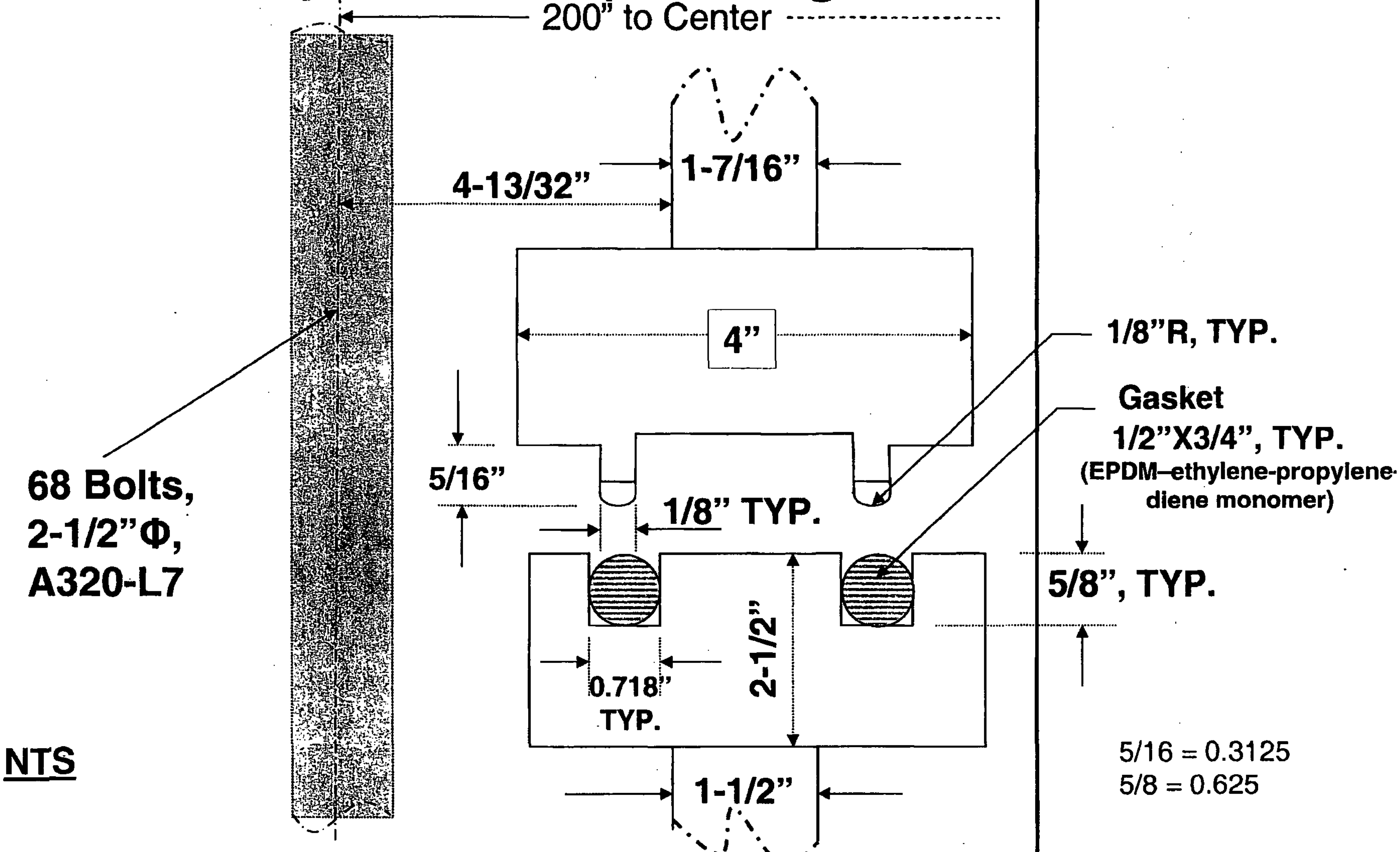
Result:

- Based on the Plant Specific Information The Most Dominant Containment Cause for Leakage is Determined to be at Drywell Head Flange

Dry-Well Top Flange Assembly



Dry-Well Top Flange Detail

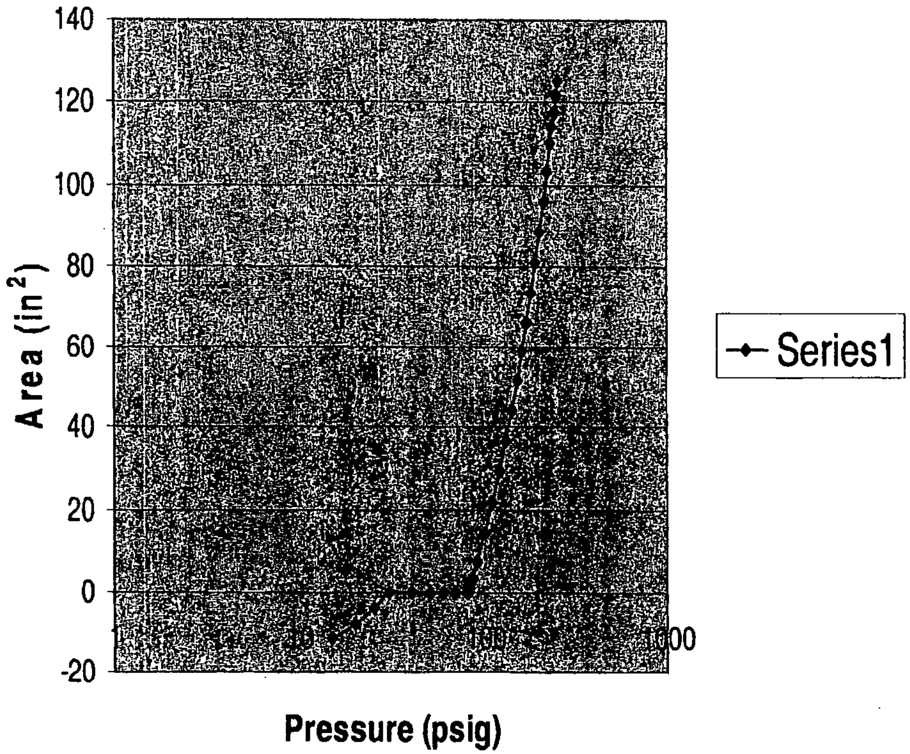


NTS

5/16 = 0.3125
5/8 = 0.625

Result

Pressure vs. Area of Leakage at Peach Bottom (Mark I) Containtment



P (psig)	Area of Leakage (in²)	Bolt Elasticity
10	0.00	Elastic
15	0.00	Elastic
20	0.00	Elastic
25	0.00	Elastic
30	0.00	Elastic
40	0.00	Elastic, gasket
50	0.00	Elastic, gasket
60	0.00	Elastic, gasket
70	0.00	Elastic, gasket
80	0.00	Elastic, gasket
81	0.46	Elastic
82	1.20	Elastic
83	1.94	Elastic
84	2.68	Elastic
85	3.41	Elastic
90	7.10	Elastic
100	14.46	Elastic
120	29.24	Elastic

5% Relaxation of Pre-load

P_d=56psig

Surry (PWR – Reinforced Concrete)

<u>Approach</u>:

- Research of 25 years of Analyses and Testing on Reinforced Concrete Containment Support the Hypothesis of "Leak-Before-Break" Failure Mode for Reinforced Concrete Containment Structures

  Therefore, it is Expected that the Range of Pressure Needed for Catastrophic Rupture/Burst can never be Reached, since Leakage should Prevent Catastrophic Rupture/Burst

Surry
(PWR – Reinforced Concrete)

Approach cont.:

- General Behavior of Concrete Containment under Gradual Increasing Internal Pressure:
  - first, Cracking of Containment Concrete
  - second, Yielding of Liner then Tearing, and Path(s) for Leakage is/are Created
  - third, Yielding of Hoop-Reinforcement, and Enlarging
  - finally, Reinforced Concrete Containments Structures are Predicted to have Significant Leakage (Rupture Like) once the Global Strain Levels are Reached on the order of 1% to 2%

1:6 Scale Reinforced Concrete Model Evaluation per NUREG/CR-5121

Approach cont.:

- Following Simplified Approach was Used to Determine Behavior of the Existing Reinforced Concrete PWR Containments in the USA. Results of Simplified Approach are quite Consistent with Detailed Analytical Analyses Performed:

$$P_{fail} = (A_{hoop} * S_{rebar@2\%} + A_{liner} * S_{liner@2\%}) / R$$
$$P_{yield} = (A_{hoop} * S_{rebar} + A_{liner} * S_{liner}) / R$$

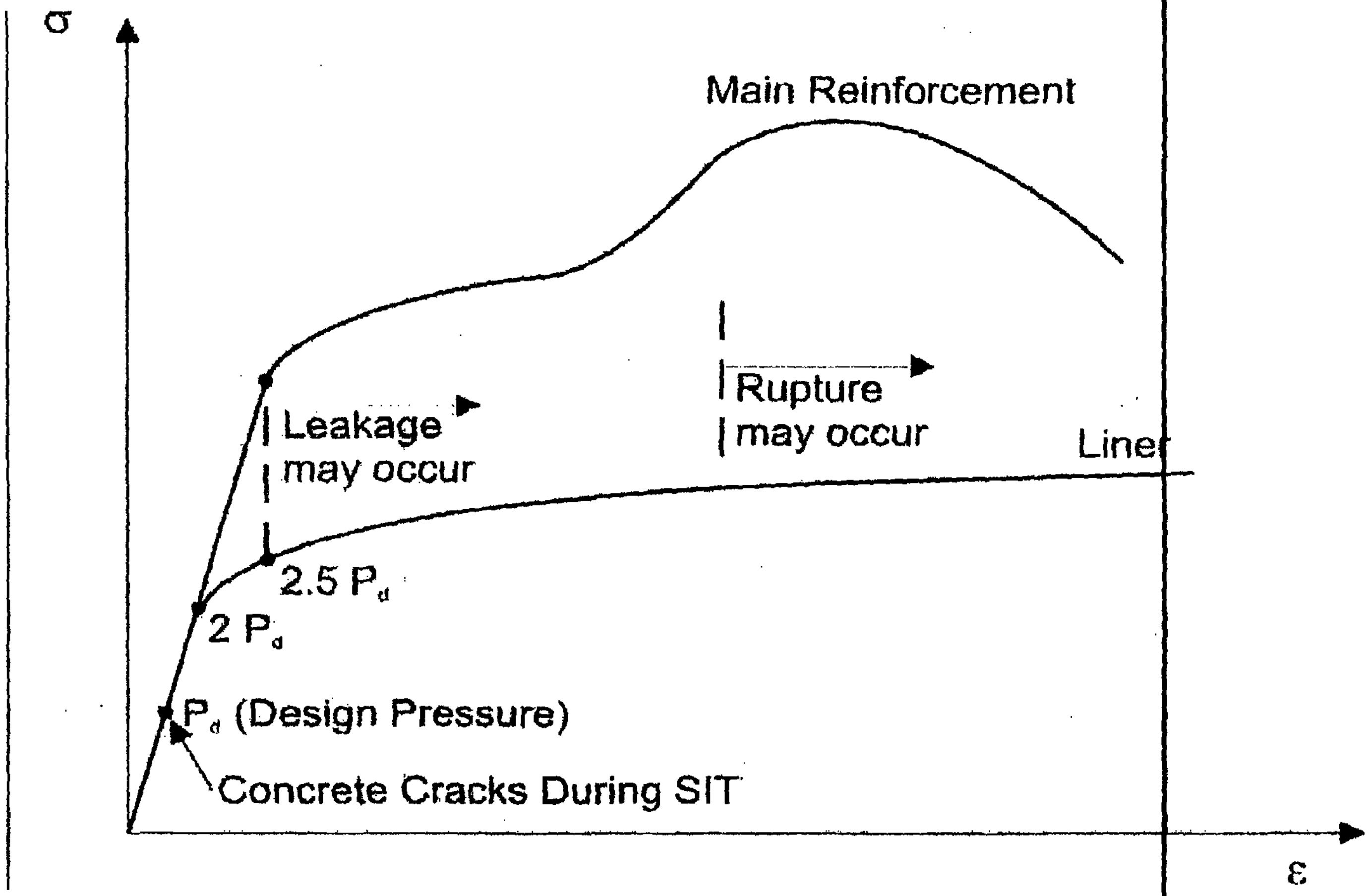
Where:

P_{fail} = Containment failure pressure,
P_{yield} = Containment pressure at which hoop rebars and liner plate yield,
A_{hoop} = Area of the hoop rebars,
A_{liner} = Area of the liner plate,
Y_{rebar} = Yield stress of the rebar,
Y_{liner} = Yield stress of the liner plate,
$S_{rebar@2\%}$ = Stress in the rebar at 2% strain,
$S_{liner@2\%}$ = Stress in the liner at 2% strain,
R = Radius of the containment.

Comparison of 1:6 Scale Reinforced Concrete Model Evaluation per NUREG/CR-5121

Source	Pressure at Rebar+Liner (psig)	Pressure at 2% Strain (psig)
Round Robin Analysis (Max)	138	185
Round Robin Analysis (Min)	120	128
Round Robin Analysis (Ave)	126	156
Test Data	120	145
[redacted]		

1:6 Scale Reinforced Concrete Model Evaluation per NUREG/CR-5121



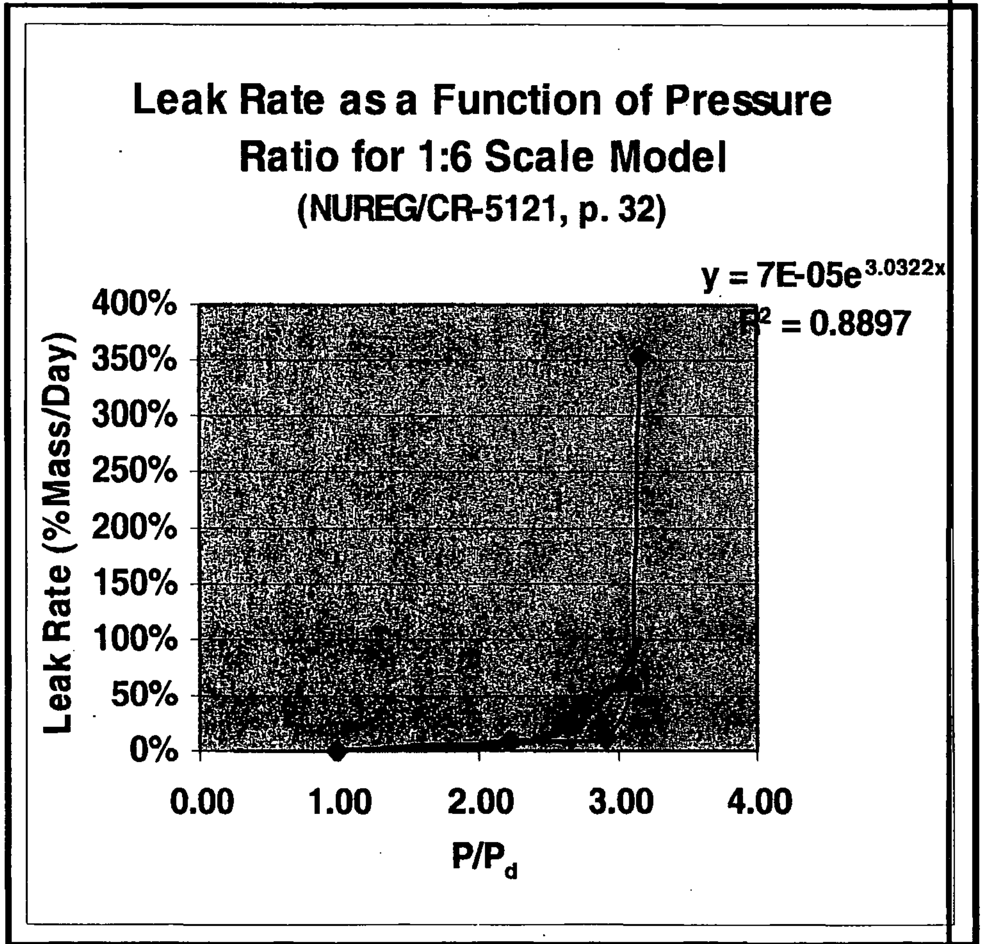
1:6 Scale Reinforced Concrete Model Evaluation per NUREG/CR-5121

Relating Internal Pressure Levels of 1:6 Scale Model of Concrete Containment Structure to Leak Rates Measured during Testing.

$V = 10{,}890\ ft^3$

P (psig)	P/P_d	Leak Rate (% Mass / Day)	Leak Rate (SCFM)	Leak Rate (% Vol. / Day)
37	**0.80**	**0.0%**	**0.0**	**0.00%**
46	**1.00**	**0.14%**	**0.04**	**0.55%**
135	**2.93**	**10%**	**6**	**87%**
140	**3.04**	**13%**	**10**	**130%**
142	**3.09**	**62%**	**49**	**653%**
144	**3.13**	**243%**	**199**	**2,446%**
145	**3.15**	**352%**	**285**	**3,765%**

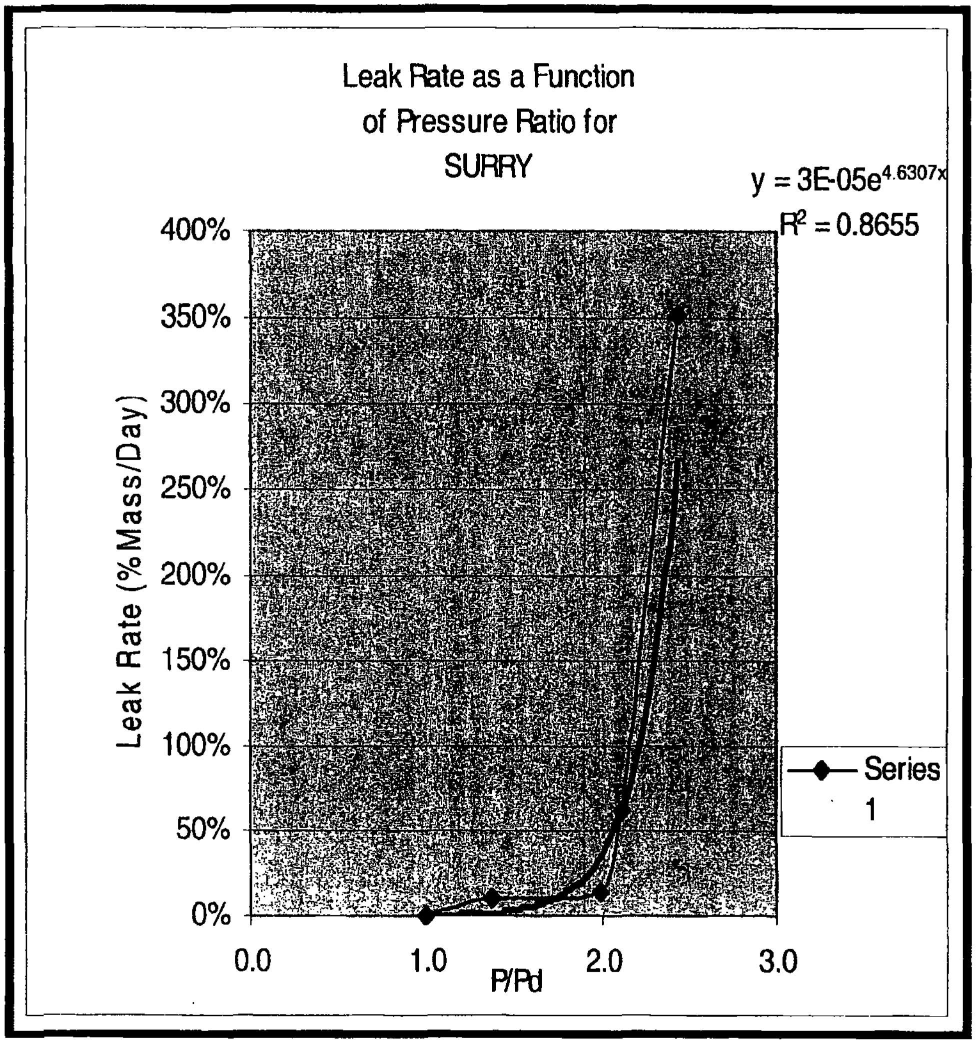
1:6 Scale Reinforced Concrete Model Evaluation per NUREG/CR-5121



Evaluation of Selected Reinforced Concrete Containment Structures

	[redacted]	Diablo Canyon	Salem	Seabrook	Surry
Containment Radius Inside R_c (ft)	[redacted]	**70.00**	**70.00**	**70.00**	63.00
Containment Volume V_c (ft^3)	[redacted]	**2.63E+06**	**2.62E+06**	**2.70E+06**	1.80E+06
Density ρ – N_2 or air (#/ft^3)	[redacted]	**0.0752**	**0.0752**	**0.0752**	0.0752
Atmospheric Pressure P_a (psia)	[redacted]	**14.70**	**14.70**	**14.70**	14.70
Liner Plate Thickness t_L (inch)	[redacted]	**0.375**	**0.375**	**0.375**	0.375
% of Liner Plate $\rho_L = t_L / t_c$	[redacted]	**0.0089**	**0.0069**	**0.0069**	0.0069
Containment Shell Wall Thick t_c (inch)	[redacted]	**42.00**	**54.00**	**54.00**	54.00
Hoop Rebar Area A_r (in^2/ft)	[redacted]	**14.12**	**15.644**	**20.364**	18.777
% of Hoop Rebar $\rho_H = A_r / t_c$	[redacted]	**0.028**	**0.024**	**0.031**	0.029
% of Total Steel $\rho_T = \rho_L + \rho_H$	[redacted]	**0.037**	**0.031**	**0.038**	0.036
Modulus of Elas. of Liner & Rebar E (psi)	3.00E+07	3.00E+07	3.00E+07	3.00E+07	2.80E+07
Containment Design Pressure P_d (psig)	[redacted]	**47.00**	**47.00**	**65.00**	60.00
Liner Plate Yield Strength $S_{y,L}$ (psi)	5.00E+04	5.00E+04	5.00E+04	5.00E+04	3.20E+04
Rebar Yield Strength $S_{y,r}$ (psi)	7.00E+04	7.00E+04	7.00E+04	7.00E+04	5.00E+04
Rebar Strength @ 2%Strain $S_{2\%}$ (psi)	7.50E+04	7.50E+04	7.50E+04	7.50E+04	5.40E+04

Surry (PWR – Reinforced Concrete)



SURRY		
Pressure	P/P_d	$LR_{\%Mass/Day}$
$P = P_d$ = 60 psig	1.00	0.14%
Liner @ $S_{y\text{-}L}$	1.37	10%
Rebar @ $S_{y\text{-}r}$	1.99	13%
2% Strain	2.13	62%
145 psig	2.42	352%

FOLLOW-UP CONSIDERATIONS

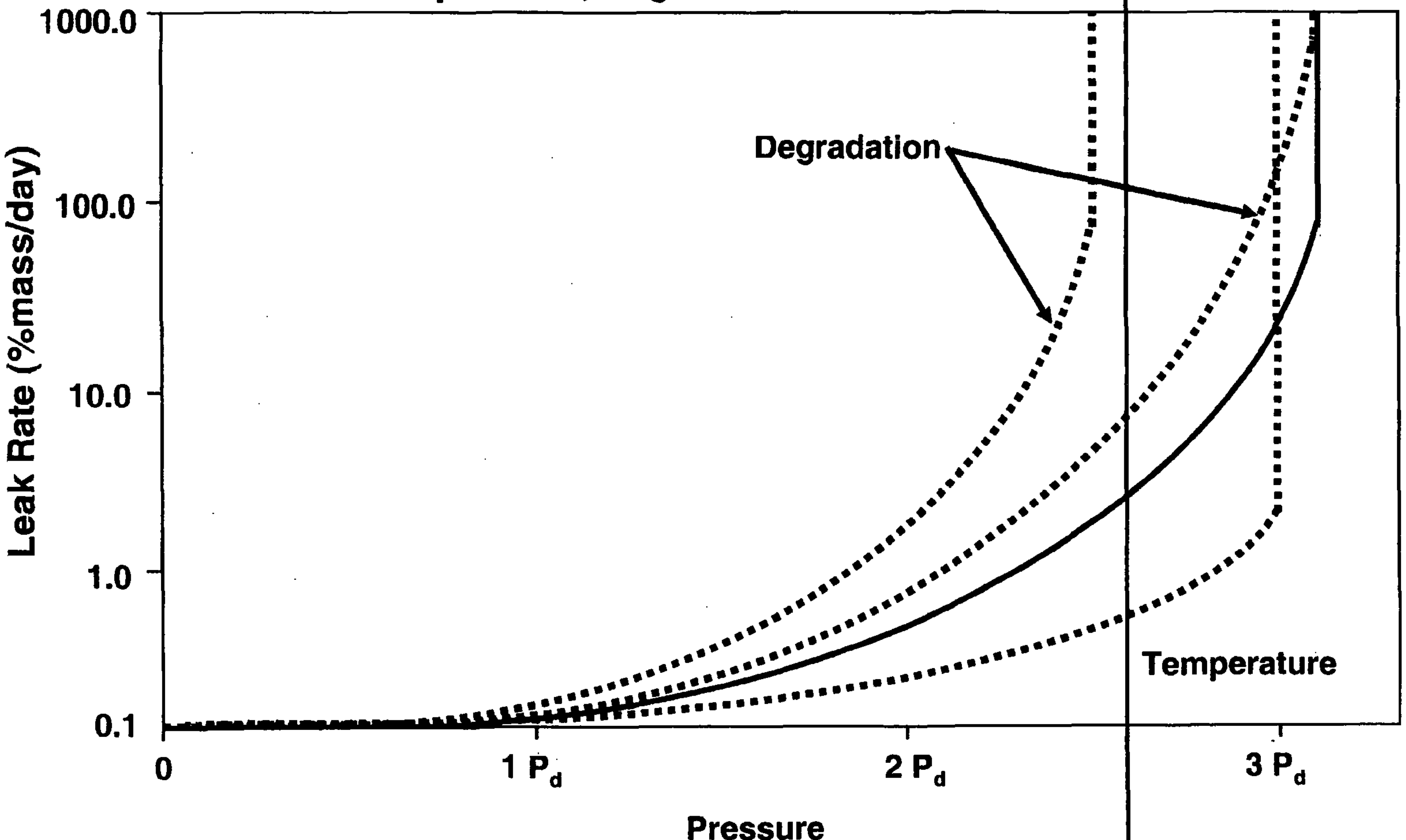
Other Potential Effects that are <u>not</u> well defined are to be Incorporated for "Containment Performance / Capacity" Evaluations by Adhering to sound Engineering Judgments:

- Predicting Structural Capacity Band (±)
- Predicting Effects of Temperature Extremes (>400^{0}F)
- Predicting Effects of Degradation (e.g.; corrosion)
- Predicting Effects of Aging (e.g.; radiation effect)
- Effects of Original Construction Defects (if any)

FOLLOW-UP CONSIDERATIONS

(SNL Performance Model Presentation, June 2004)

Effects of Temperature, Degradation:



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Emergency Preparedness

Joseph Jones

Peach Bottom

- Preliminary model developed
- Based on Long Term Station Black Out scenario
- General Emergency is declared about 2 hours after loss of all A/C power
  - Evacuation starts at General Emergency

Peach Bottom

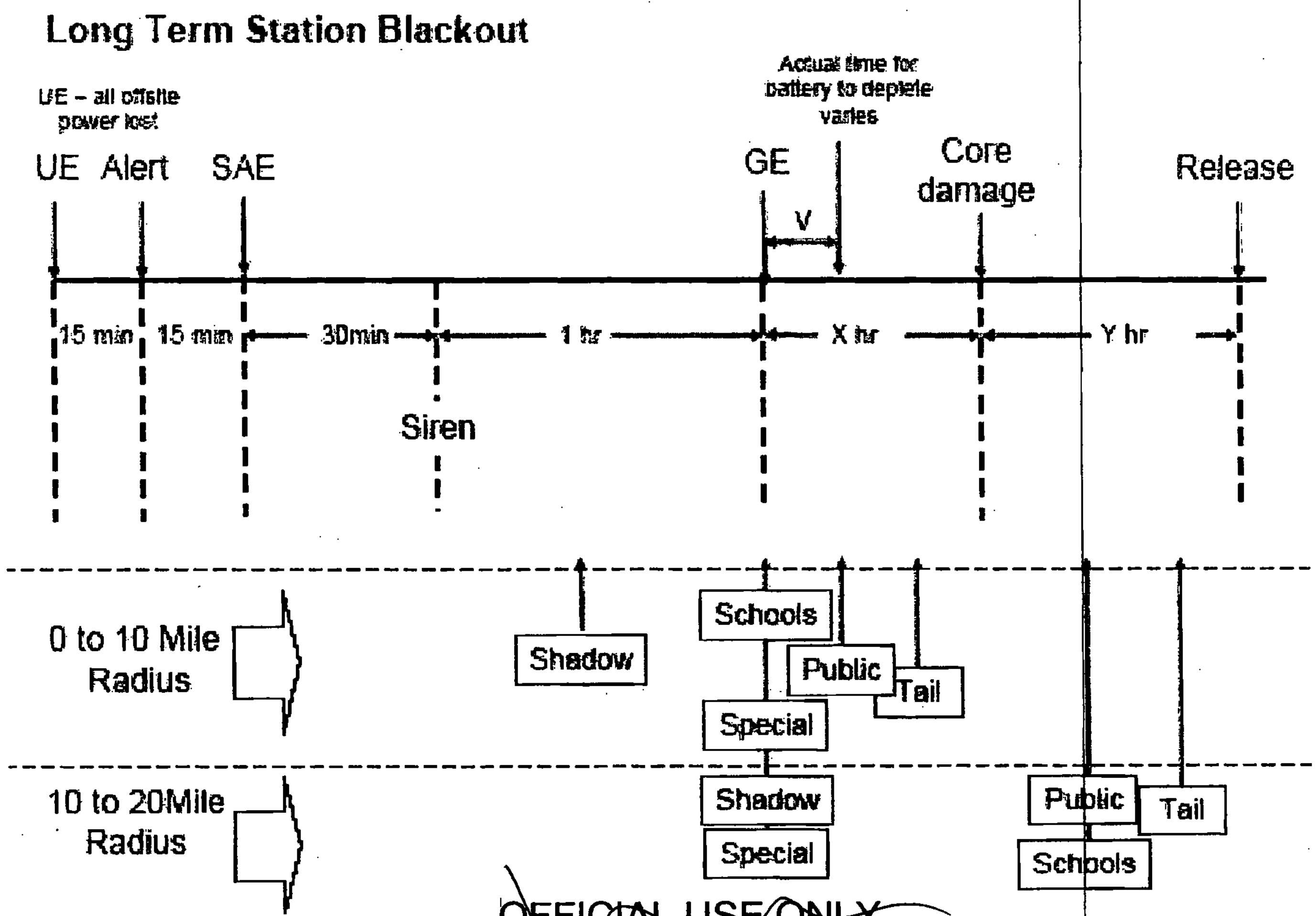
- Modeling evacuation within emergency planning zone (EPZ) based on evacuation time estimate report
  - Delay times and speed of evacuating cohorts
- SNL using the OREMs code to model evacuation in the 10-20 mile area
  - Estimate delay times for ad hoc evacuation
  - Estimate travel speed based on OREMs analysis

Peach Bottom

- Identified 6 cohorts
  - Identified characteristics for WinMACCS
- Early precautionary actions at Site Area Emergency are not taken in PA (atypical)
  - Maryland follows PA lead.

Event Sequence

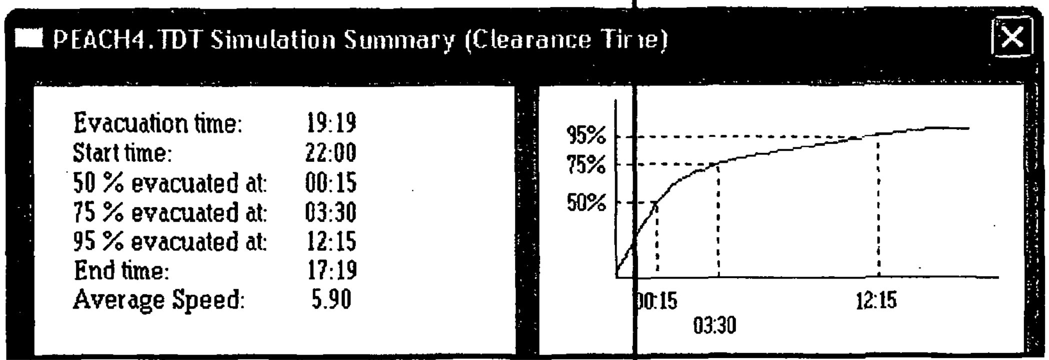
Cohort movement with respect to EALs



Peach Bottom Populations and ETEs

Region	Population	Non-Evacuating	Evacuated	Number of Vehicles
0-10	71,362	357	71,005	40,574
10-20	392,257	1,961	390,296	223,026
Total	**463,619**	**2,288**	**461,301**	**263,600**

- Evacuation Times
  - EPZ: 0-10 miles,
    - 6.5 hours (from licensee ETE)
  - 0-20 miles
    - 19:19 hours (draft)



Typical distribution for evacuation time

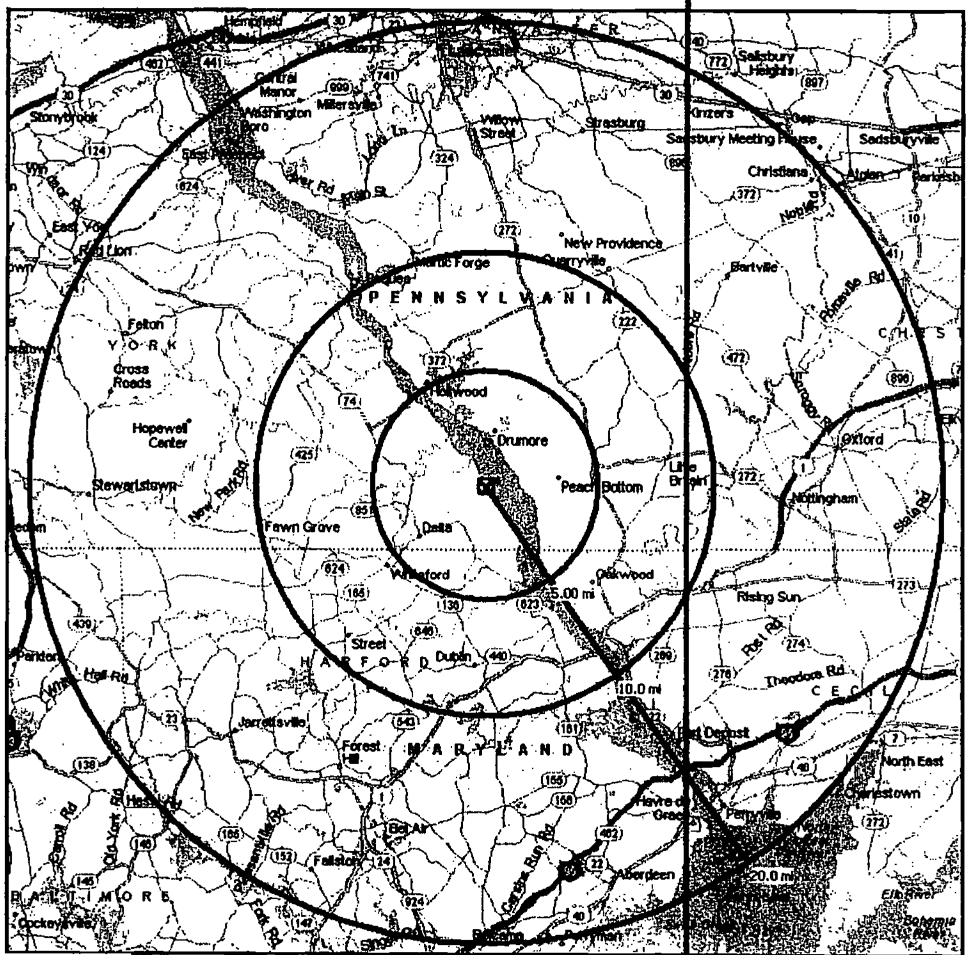
- Total evacuation time 19 hours, 19 minutes
- Start time 11 pm (22:00)
- End time 5:19 pm (17:19)
- Avg. Speed – not used

Cohort Descriptions and Parameters

Cohort	Region	Delay to Shelter (hr)	Delay to Evacuation (hr)	Population	Load Factor	Number of Vehicles
Schools	0-10	1.0	0.0	12,215	40	305 buses
	10-20	2.5	10.0	66,694	1.75	38,111
Shadow	0-10	0.0	0.5	7,136	1.75	4,078
	10-20	0.0	1.0	39,226	1.75	22,415
Special Needs	0-10	0.0	1.0	400	1.75	229
	10-20	0.0	1.0	2,196	1.75	1,255
Public	0-10	0.5	2.0	46,631	1.75	26,646
	10-20	2.5	10.0	258,645	1.75	147,797
Tail	0-10	4.0	0.0	4,623	1.75	2,642
	10-20	0.0	14.0	23,535	1.75	13,449
Non-Evacuating	0-10	--	--	357	--	204
	10-20	--	--	1,961	--	--

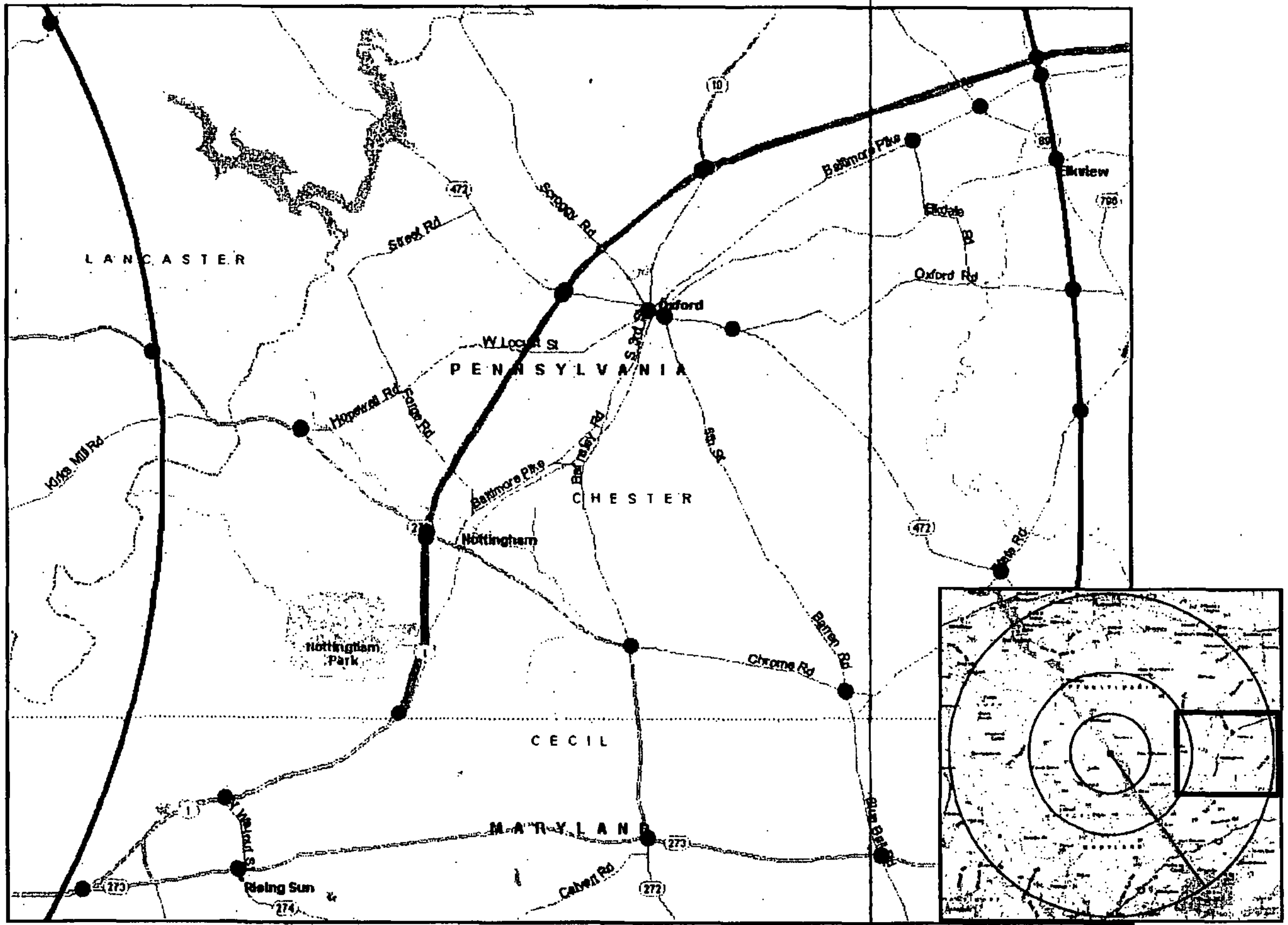
Peach Bottom 0-20 Miles

- Evacuation Time Estimate (ETE) for 0 – 10 miles is provided by the licensee.
- ETE for 10 – 20 is developed



Peach Bottom Roadway Network

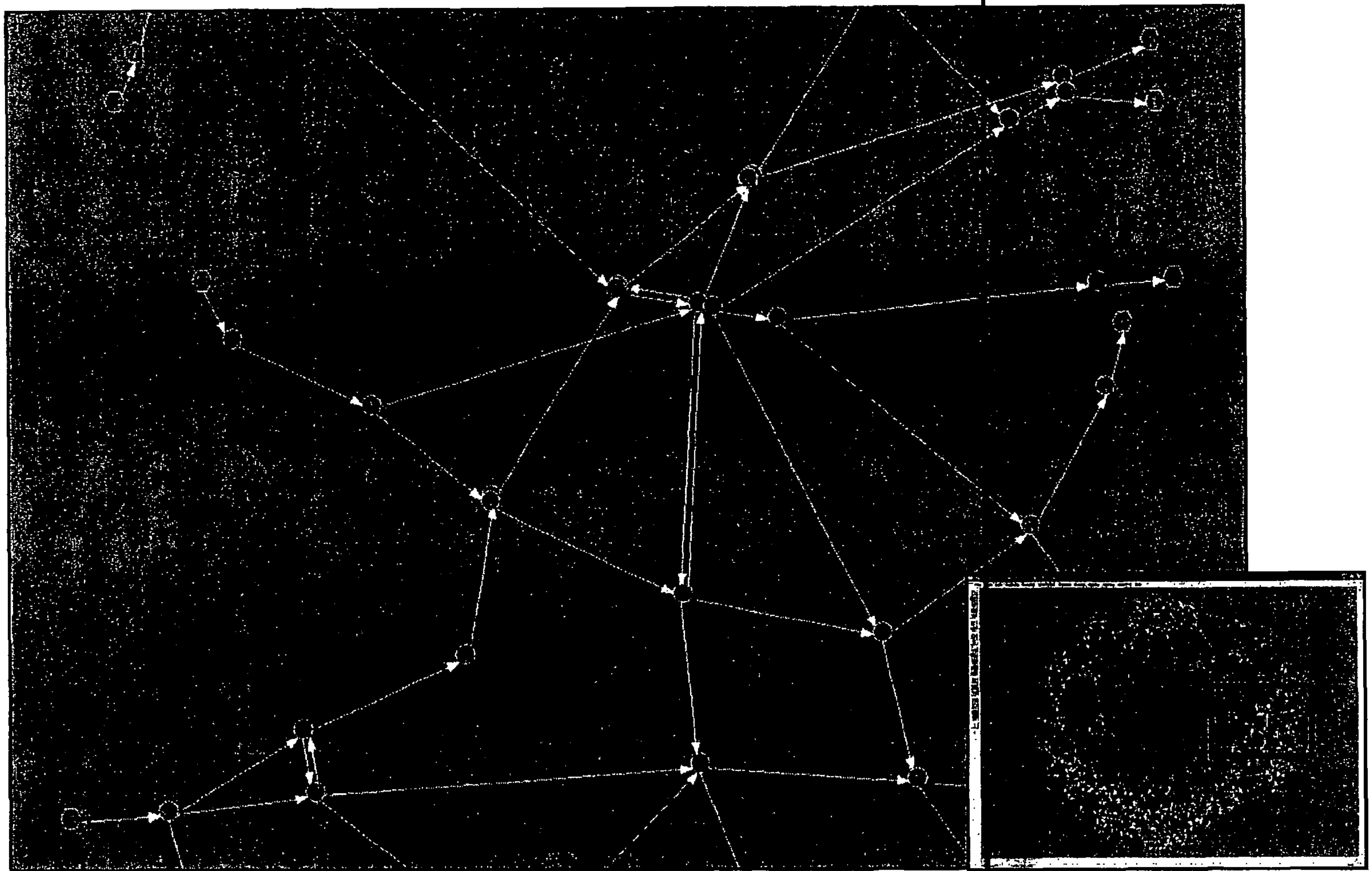
To develop the OREMS model, nodes are created at selected intersections



Map detail

Peach Bottom Nodal Network

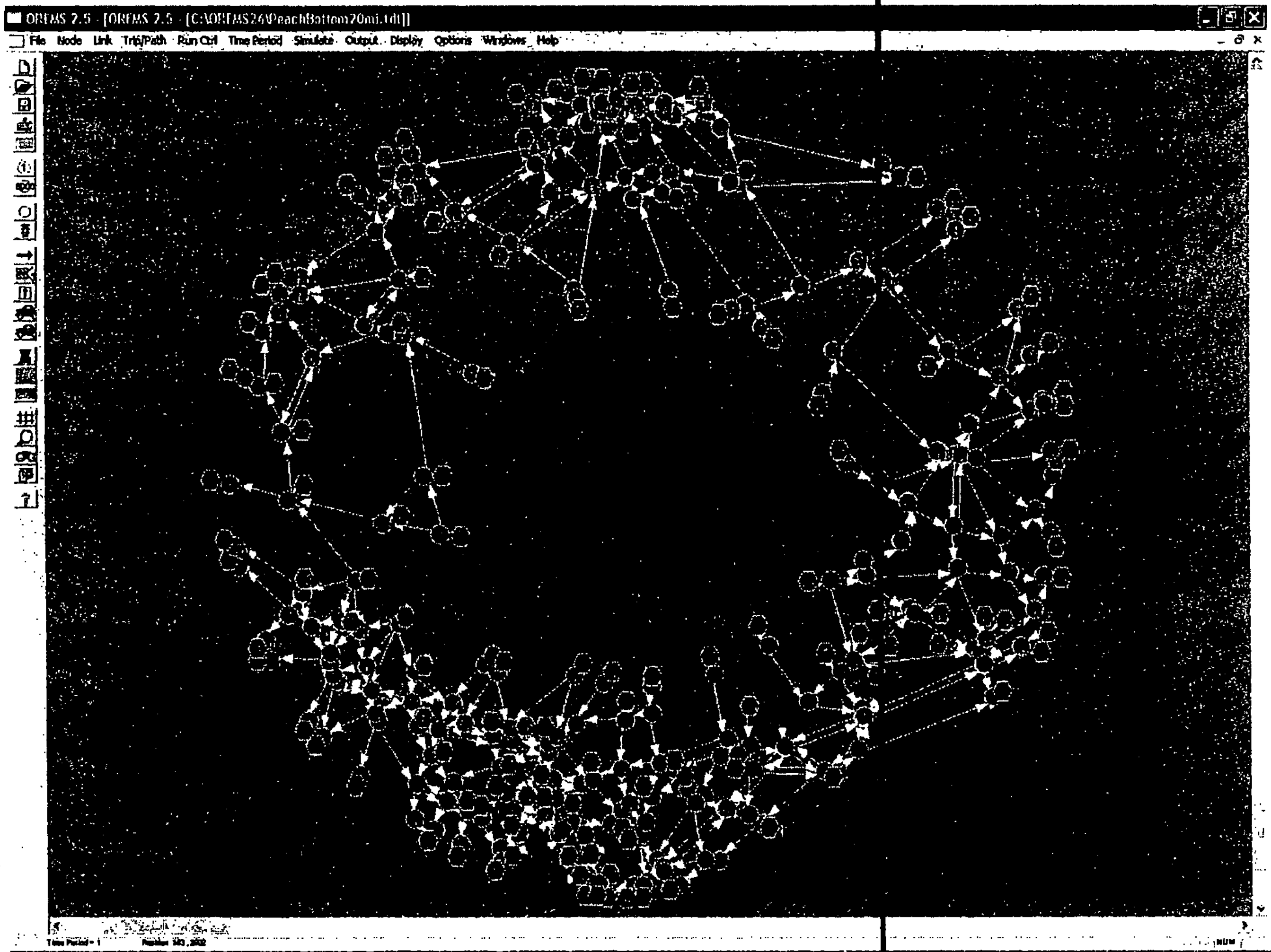
Example of node layout



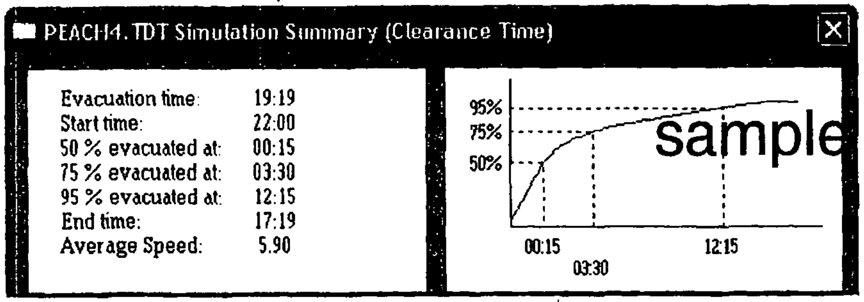
OREMS detail

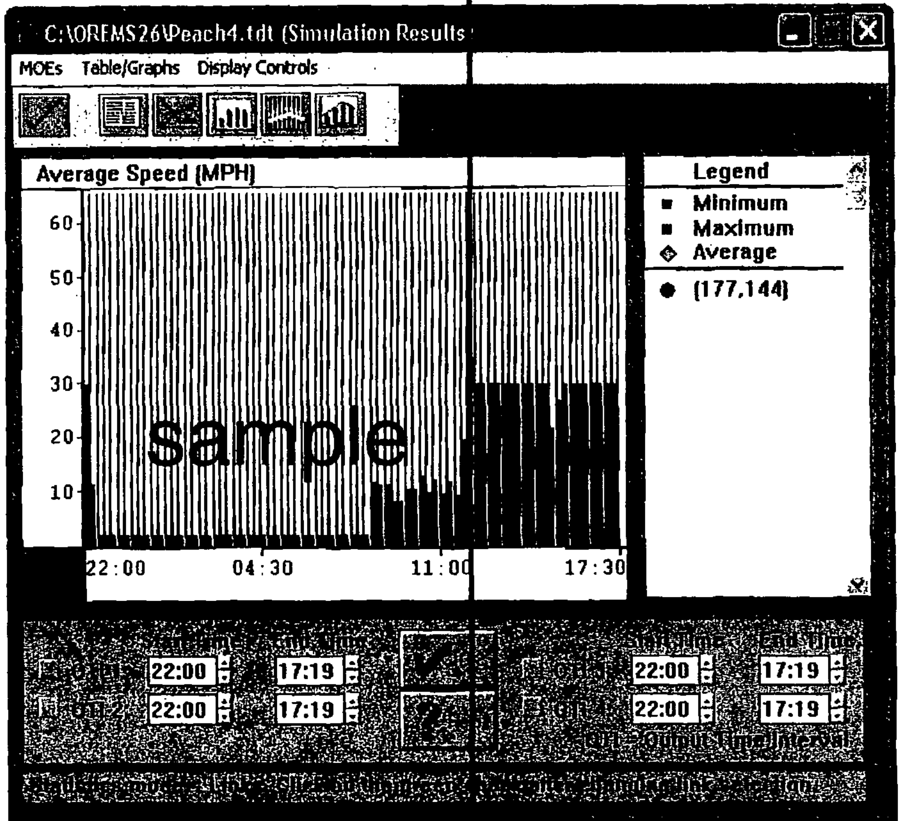
Peach Bottom Nodal Network

- Nodal network is representative of the roadway network within the 10-20 mile zone



Modeling Output



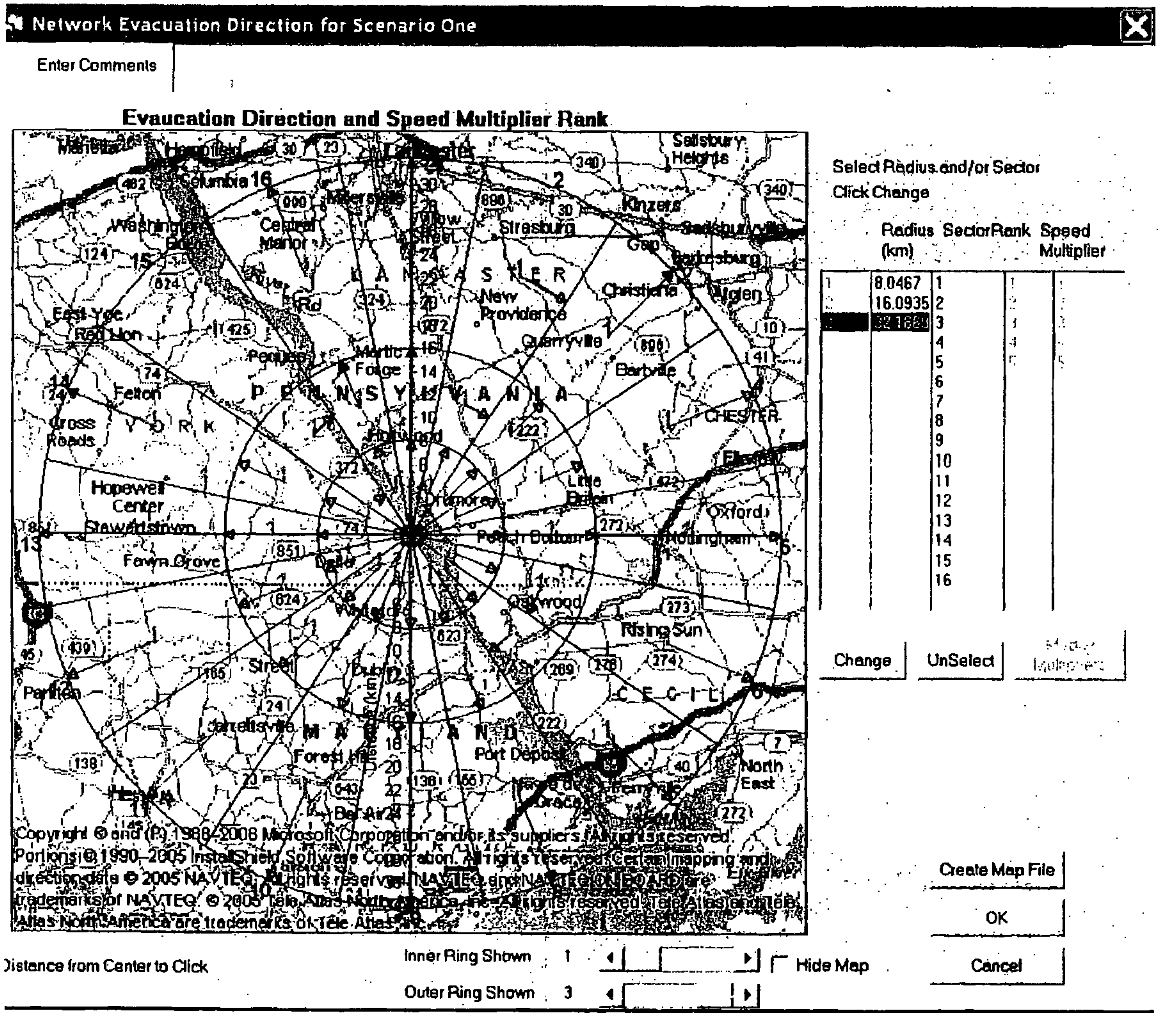


- Data is used to populate WinMACCS vehicular movement

Peach Bottom

- WinMACCS has options for angular resolution, rather than 16 sectors can use 32, 48 or 64
  - Reduces overestimate of population dose on sector center line

Peach Bottom WinMACCS



- WinMACCS vehicle direction and speed input for:
  - 32 grid elements
  - 15 rings
- Simulates realistic vehicular movement

EP Modeling

- Expect to fine tune model as experience running WinMACCS is gained
- Will learn from effort and move on to model Surry

SOARCA

Latent Cancer Fatality Dose Response Model

Jocelyn Mitchell

Latent Cancer Fatality Dose Response Model

- Initially proposed to use a range of dose thresholds from 0 to 5 rem.
  - Will not facilitate a common understanding
  - Leaves the interpretation of the results to the reader
- Options considered:
  - Range of dose thresholds
  - Probabilistic distribution of dose thresholds
  - Point value
- Recommend to Commission using 5 rem in a year/10 rem in a lifetime
  - Health Physics Society recommendation
  - Detectable Limit