ARKANSAS NUCLEAR ONE
APPENDIX R
REGULATORY CONFERENCE

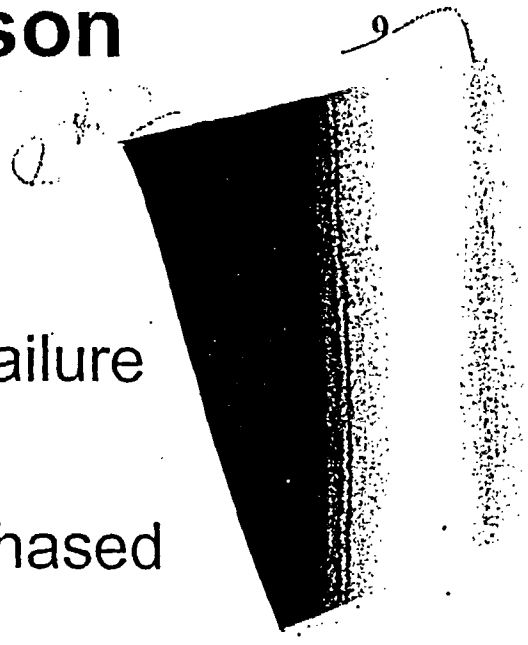
July 10, 2003

OPENING REMARKS

Craig Anderson

Vice President, ANO

Risk Assessment Comparison



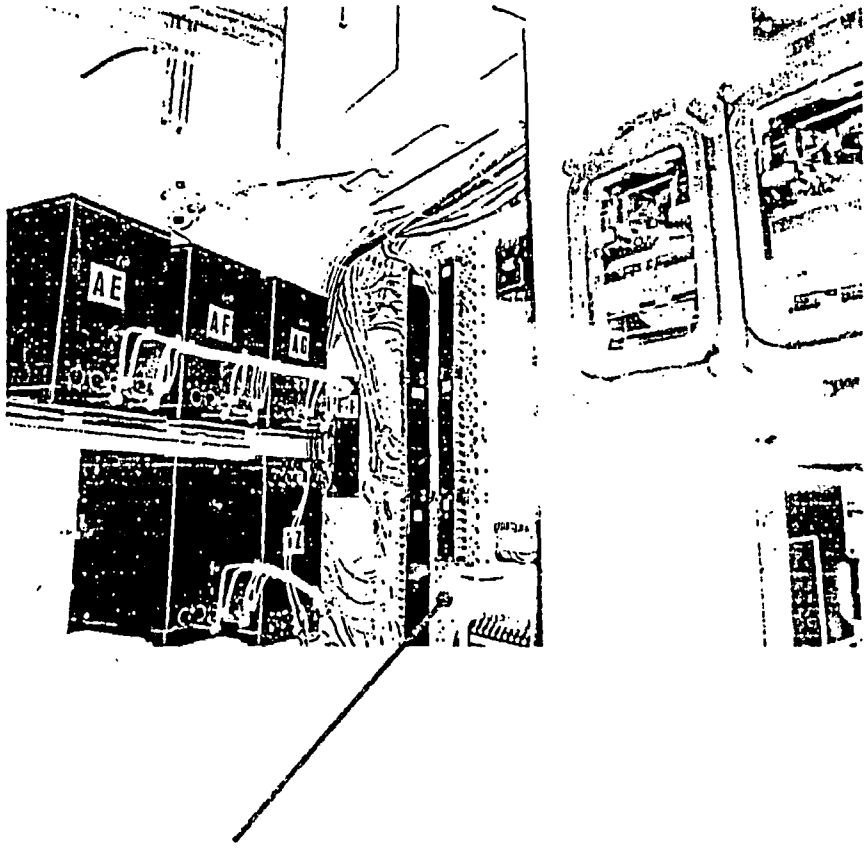
NRC

- 425° F cable failure temperature
- Zone wide prompt damage
- Generic HRA
  - Based on zone wide prompt damage
  - Included LOOP
- Greater than Green finding

ANO

- 700° F cable failure temperature
- Limited time phased damage
- Plant specific HRA
  - Scenario specific operator actions evaluated
  - No LOOP
- Green finding

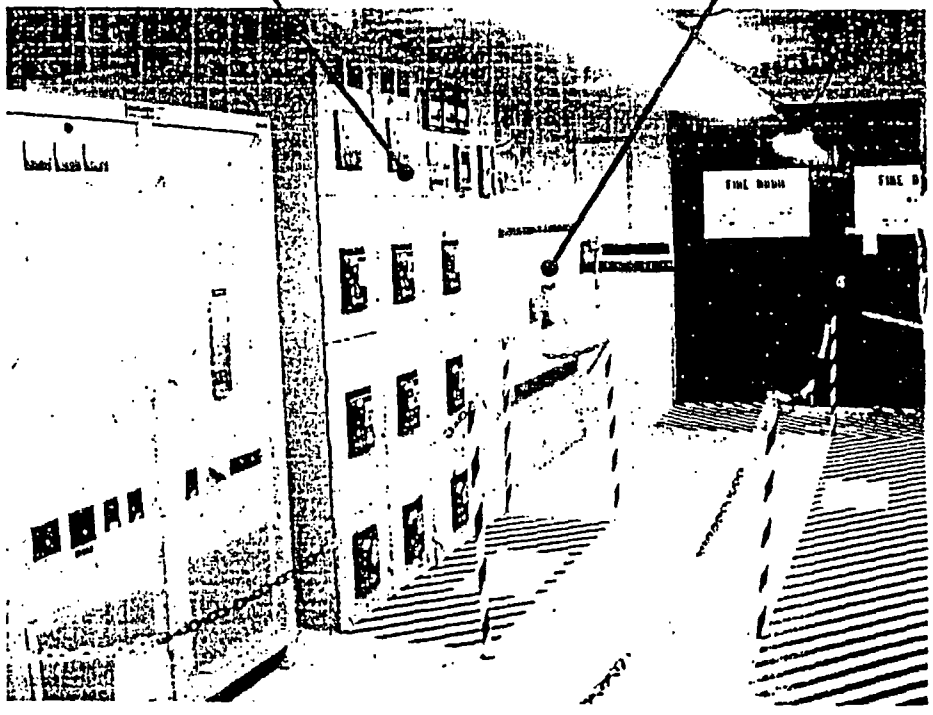
Unit 1 4KV Switchgear Room (fire zone 99M)



Typical ANO switchgear cabinet wiring, control cubicle

99M - south view

(no construction 0.1)

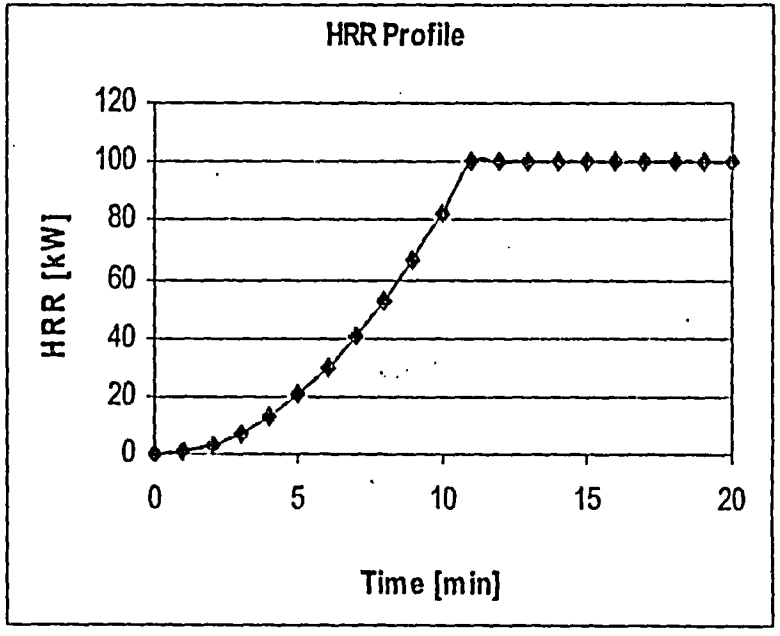


Fire Scenario Selection: General Approach

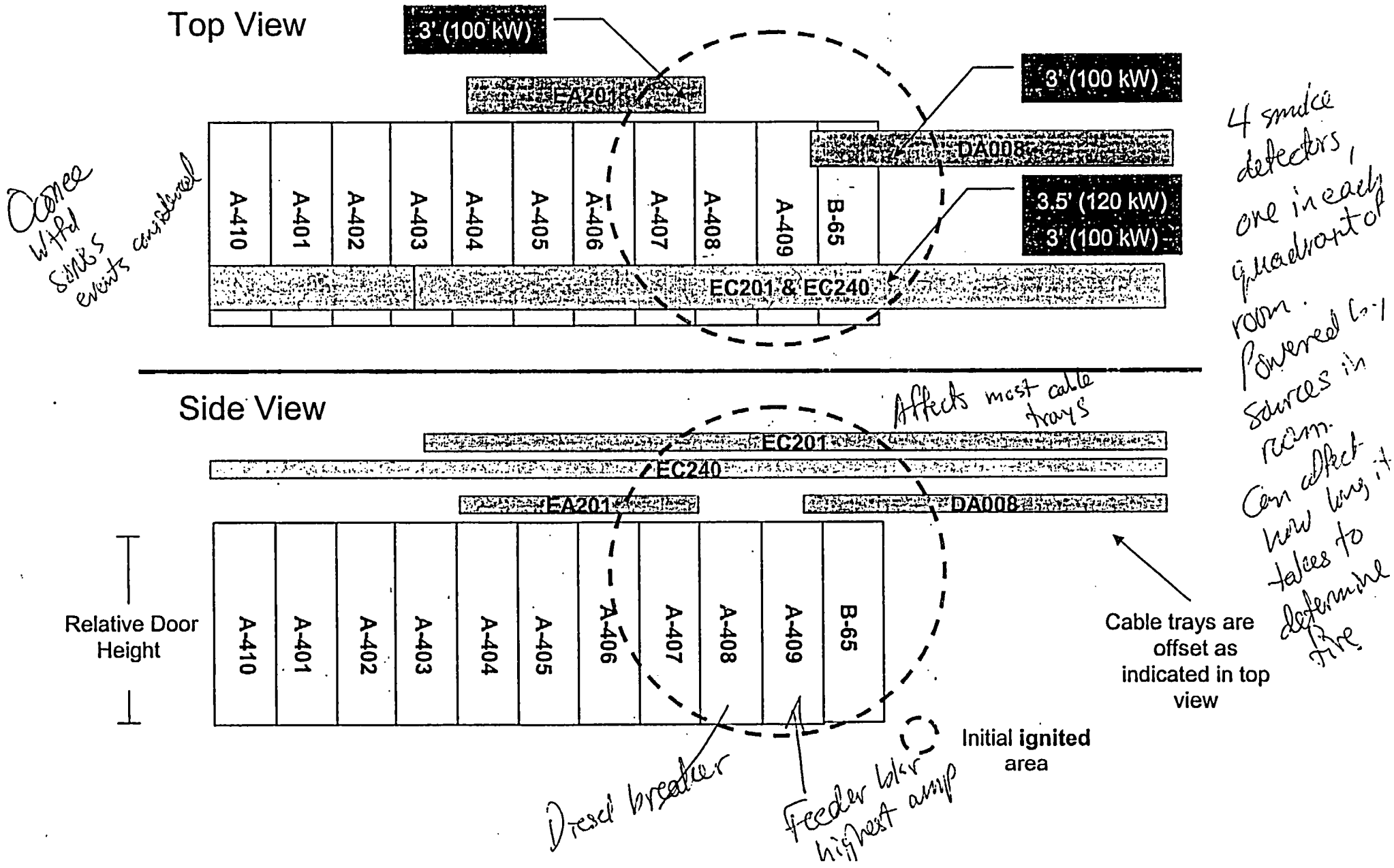
- Three distinct fire scenario classifications:
  - An electrical fire (non-energetic) in any of the electrical cabinets in the room
    - Fire may spread in the cable trays, but requires considerable time
    - Circuit damage/failures follow a time-phased sequence with first damage after 10 minutes
  - A high energy arcing fault switchgear fire that may initiate secondary fire
    - The event has an initial (immediate) pressure phase that causes damage to targets and ignites exposed cables in the vicinity
    - The fire may continue in the switchgear and grow within the ignited combustibles (e.g., cable trays) in the vicinity
    - There is an initial/immediate circuit damage/failure followed by potential time-phased circuit damage/failures
  - A transient fire that may spread into cable trays
    - A transient fire between B55 and B56 was selected as the maximum expected scenario due to its potential for extent and timing of damage
    - Circuit damage/failures follow a time-phased sequence with first damage after 10 minutes

Fire Characterization

- Electrical cabinet fires
  - The heat release rate data profile is based on the best available fire test data
    - Sandia National Lab (NUREG/CR-4527, 87/88) and VTT (Valtion Teknillinen Tutkimuskeskus, 94/96) in Finland
    - Same test used in the NRC SDP analysis
  - The ANO HRR is based on the highest peak of ST5 (unqualified, open 110 KBTU loading) and all qualified, vertical cabinets (excluding PCT6 and test 23 with 1.5 MBTU loading)
    - The NRC HRR is based on test 23 (qualified, open 1.47 MBTU loading) and test 24 (unqualified, open, 1.44 MBTU)
  - Time-to-peak is based on the average
  - Tests are based on control panels
  - The switchgear, MCC's and load centers are enclosed with sealed penetrations
- Used for scenarios 1a, 2 - 5



Fire Characterization (cont.)
ZOI of the High-energy Switchgear Arcing Fire



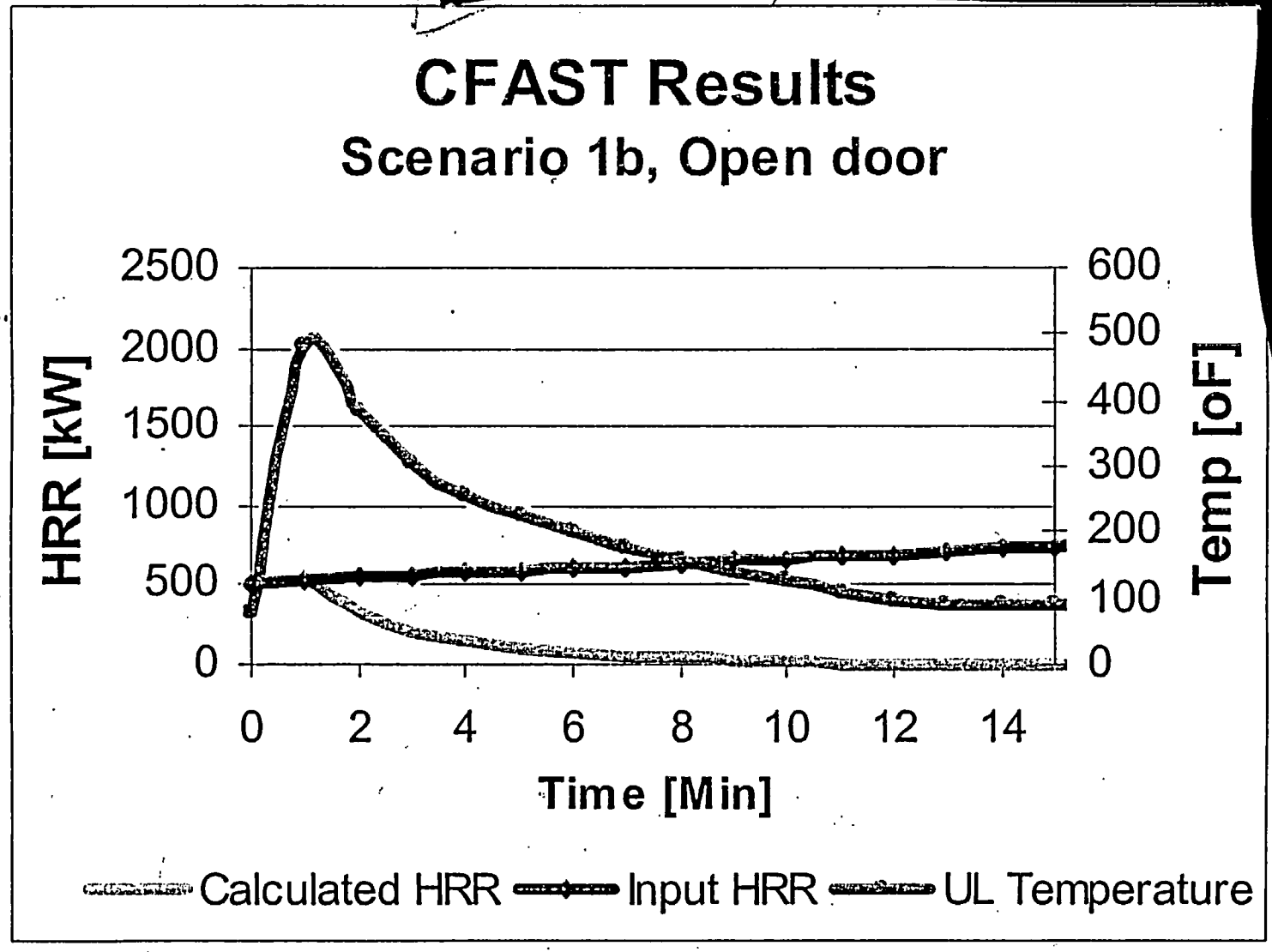
Annex with 5 events considered

4 smoke detectors, one in each quadrant of room. Powered by sources in room. Can affect how long it takes to determine fire

Results

Heat release rate for cable trays single ~~stacked~~ tray vs. 3 stacked trays.

Propagation rate depends on cable type. most similar thermoplastic.

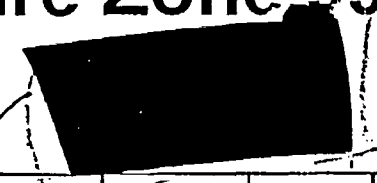


Results (cont.)

- The limiting fire scenario, one that can generate a damaging HGL, is not credible
  - The non-suppression probability by the brigade for very long duration cable fires (100 minutes for the high-energy switchgear event) is 0.01 (per EPRI Fire PRA Guide)
  - Fuel depletion, cables ignited earlier have burned out
  - Parts of the cable trays are coated with flamastics which both delays ignition and slows propagation of cable fires
  - Continued growth of the non-piloted cable fire for a long time is not likely. (Tests reported in NUREG/CR-5387 state that cable fires, "spreading horizontally only as it progressed from level to level")

- **Maximum expected fire is a high-energy switchgear fire**
- **No credible fire reaches 700°F in this room (limiting fire scenario)**

Results:
Frequency of Fire Scenarios in Fire Zone 99M



ANO SDP Analysis Results

Scenario	Source	Generic Frequency	WFI (location weighting factor)	Wis (ignition source weighting factor)	Floor area ratio (transient fires)	Severity Factor	Ratio of HE event for a severe switchgear fire	Pns by plant personnel or fire watch	Pns by fire brigade	Results
1a	Fire in the A4 switchgear. Nominal value, 100 KW fire	1.50E-02	2.50E-01	5.88E-01	1.00E+00	1.20E-01	2.50E-01	1.00E+00	1.00E+00	6.62E-05
1b	High energy arcing fault in any of the A4 switchgear breaker cubicles	1.50E-02	2.50E-01	5.88E-01	1.00E+00	1.20E-01	7.50E-01	1.00E+00	1.00E+00	1.99E-04
2	Fire in the B55 MCC. Nominal 100 KW fire. Fires in Inverter Y28 are bounded by this scenario.	1.50E-02	2.50E-01	5.88E-02	1.00E+00	1.20E-01	1.00E+00	1.00E+00	1.00E+00	2.65E-05
3	Fire in the B56 MCC. Nominal 100 KW fire	1.50E-02	2.50E-01	5.88E-02	1.00E+00	1.20E-01	1.00E+00	1.00E+00	1.00E+00	2.65E-05
4	Fire in the Y22 Inverter. Base case, 100 KW fire. Fires in Y24 and Y 25 are bounded by this scenario.	1.50E-02	2.50E-01	5.88E-02	1.00E+00	1.20E-01	1.00E+00	1.00E+00	5.00E-01	1.32E-05
5	Fire in the Load Center B6. 100KW nominal HRR.	1.50E-02	2.50E-01	5.88E-02	1.00E+00	1.20E-01	1.00E+00	1.00E+00	2.00E-01	5.29E-08
6a	Transient fire in areas of the room where cable trays are exposed to a floor-based fire. Nominal Value of 150KW.	3.60E-02	2.00E+00	1.80E-02	1.00E-01	1.00E+00	1.00E+00	5.00E-01	1.00E+00	6.48E-05
6b	Cable fire caused by welding and cutting in areas of the room where cable trays are exposed to a floor-based fire. Nominal Value of 150KW.	1.30E-03	2.00E+00	2.00E-02	1.00E-01	1.00E+00	1.00E+00	5.00E-02	1.00E+00	2.60E-07

NRC SDP Analysis Results (May 15, 2003 Supplemental Letter Page 25)

Source	Frequency
Electrical cabinets	2.3E-04
Transformers	1.6E-05
Ventilation Subsystems	4.4E-06

Key Systems Affected in the Risk-Significance Determination (Fire Zone 99M)

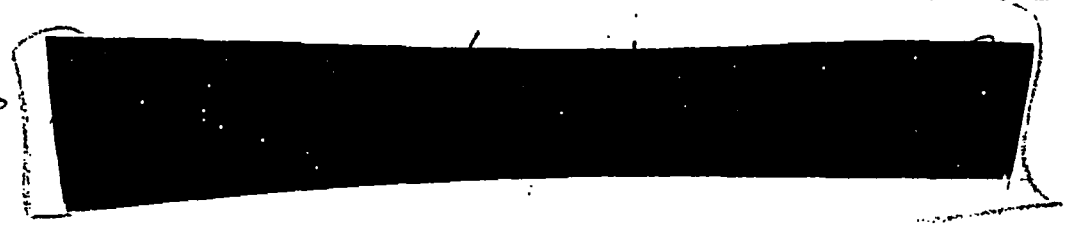
- The following systems/trains are directly failed due to fire induced power losses of A4 and B6
  - One train and the swing pump of service water
  - One train and the swing pump of HPI (makeup)
  - The A4 associated diesel is no longer usable

Circuit Analysis

- Detailed circuit analysis performed on zone 99M
- Investigation of cables located in the trays and conduits associated with the target sets
- Analysis showed no loss of offsite power associated with zone 99M
  - NRC evaluation did use loss of offsite power
- Analysis of associated failure modes for affected cables
- Failures unrelated to safe shutdown also examined to provide accurate portrayal of the risk caused by the fire

Summary of Procedural Guidance

#	Key Action	Previous Procedures	New Procedure
1	Starting EFW P-7A manually and positioning associated valves	The previous procedures discuss this in great detail. Spurious and false indicators are not mentioned which could delay operator response.	Discussion in new procedure includes functional indicators.
2	Controlling EFW (A or B) to prevent overfill	Previous procedures discuss this local or control room action.	Lack of adequate and correct indication is directly discussed in the new procedure which makes this action more likely in the new procedure.
3	Local closing of bus A3 switchgear for P-7B and HPI A (e.g., inverter fires)	This action not explicitly discussed in the normal operating procedures but is discussed in Alternate Shutdown.	The new procedure explicitly addresses locally closing these breakers.
4	Starting HPI Makeup	Discussed in previous procedures. The timing of this action depends on when letdown is isolated.	The new procedure addresses the possibility of starting the HPI pump locally.
5	Isolation of letdown to avoid needing HPI (Makeup) sooner	In both the previous and new procedures, this action is discussed and can be performed in the control room.	In both the previous and new procedures, this action is discussed and can be performed in the control room.
6	Switch to recirculation long-term cooling	In both the previous and new procedures, this action is discussed and can be performed in the control room.	In both the previous and new procedures, this action is discussed and can be performed in the control room.



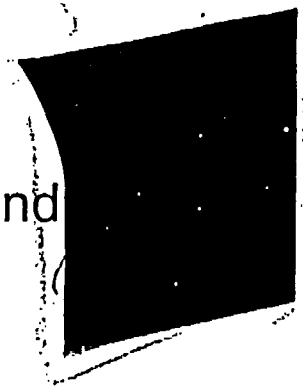
Simulator Scenario for Zone 99M

- Fire damage chosen to provide HRA information for multiple operator actions
  - Fire model beginning with an A4 switchgear fire
  - Fire propagated throughout zone causing wide-spread cable damage
  - Damage for scenario extends beyond credible fires
- Realistic control room communication challenges
  - Fire brigade leader communication
    - Timelines based on actual fire drill
    - Included need to contact local fire department
  - In plant auxiliary operator used for operator actions
    - Radio and telephone communications used

May not be trained/qualified. This happened during simulator runs, but operator succeeded

EPRI Calculator

- Industry sponsored method provides a process for book keeping HRA evaluations
- Addresses HRA requirements in ASME PRA Standard 2002
- Includes several methods for quantification
  - Industry and NRC sponsored
  - Generic data quantitatively differentiate human error probabilities (HEP's) for key characteristics of procedures and man machine interface
- HRA analyst judgment is still required



380 Reels Thermoplastic
3800 Thermoset

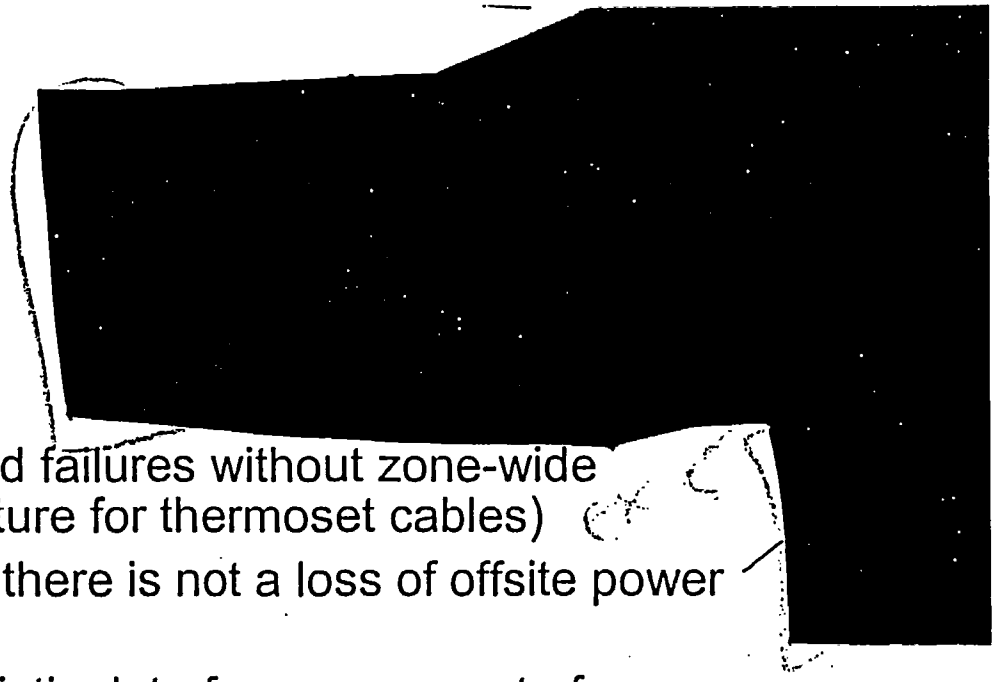
7 Cables installed in U2

None in unit 1

Looked at all cable nos. in 9017

1 Pinched sealed cable

Overall Summary



- Detailed analysis of zone 99M
  - Credible fires result in time-phased failures without zone-wide damage (700°F damage temperature for thermoset cables)
  - Detailed circuit analysis indicates there is not a loss of offsite power from any fire scenario
  - Simulator scenarios provided realistic data for assessment of operator reliability in the use of previous and new procedures
  - ΔCDF for 99M is 2.2E-07/yr
- Total Unit Risk
  - Two additional zones considered risk significant for Unit 1
  - Risk assessment of zone 99M conservative with respect to other zones
  - Conservative estimate of total unit ΔCDF is < 6.6E-07/yr
- The significance of the use of manual actions to achieve safe shutdown has very low safety significance and should be characterized as GREEN

Overall Summary (cont.)

- ANO fire protection program
  - Defense in depth strategy to prevent and mitigate fires
  - Explicit control of combustibles
  - Fire brigade effectiveness
- Primarily rely on barriers or physical separation for equipment required for safe shutdown
  - Fire detection and suppression
  - Limited use of manual actions utilized for Appendix R compliance
- Actions taken to further reduce risk
  - Validated circuit analysis
  - Feasibility evaluation of manual actions (IE 71111.05)
  - New procedures developed to enhance operator response
  - Fire detection reliability improved
- ANO can successfully achieve safe shutdown in the event of a fire in any zone