ARKANSAS NUCLEAR ONE
APPENDIX R
REGULATORY CONFERENCE

July 10, 2003

- denial
- fire watches in all zones
- NRR guidance coming
- can make changes

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REGULATORY CONFERENCE

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Comp measures since 6/01
CAs –
- procedures for each zone
- op trained on procedures
- procedure guidance – lief

OPENING REMARKS

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Vice President, ANO

INTRODUCTION

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Does this mean they deny the notation?

Problem Statement

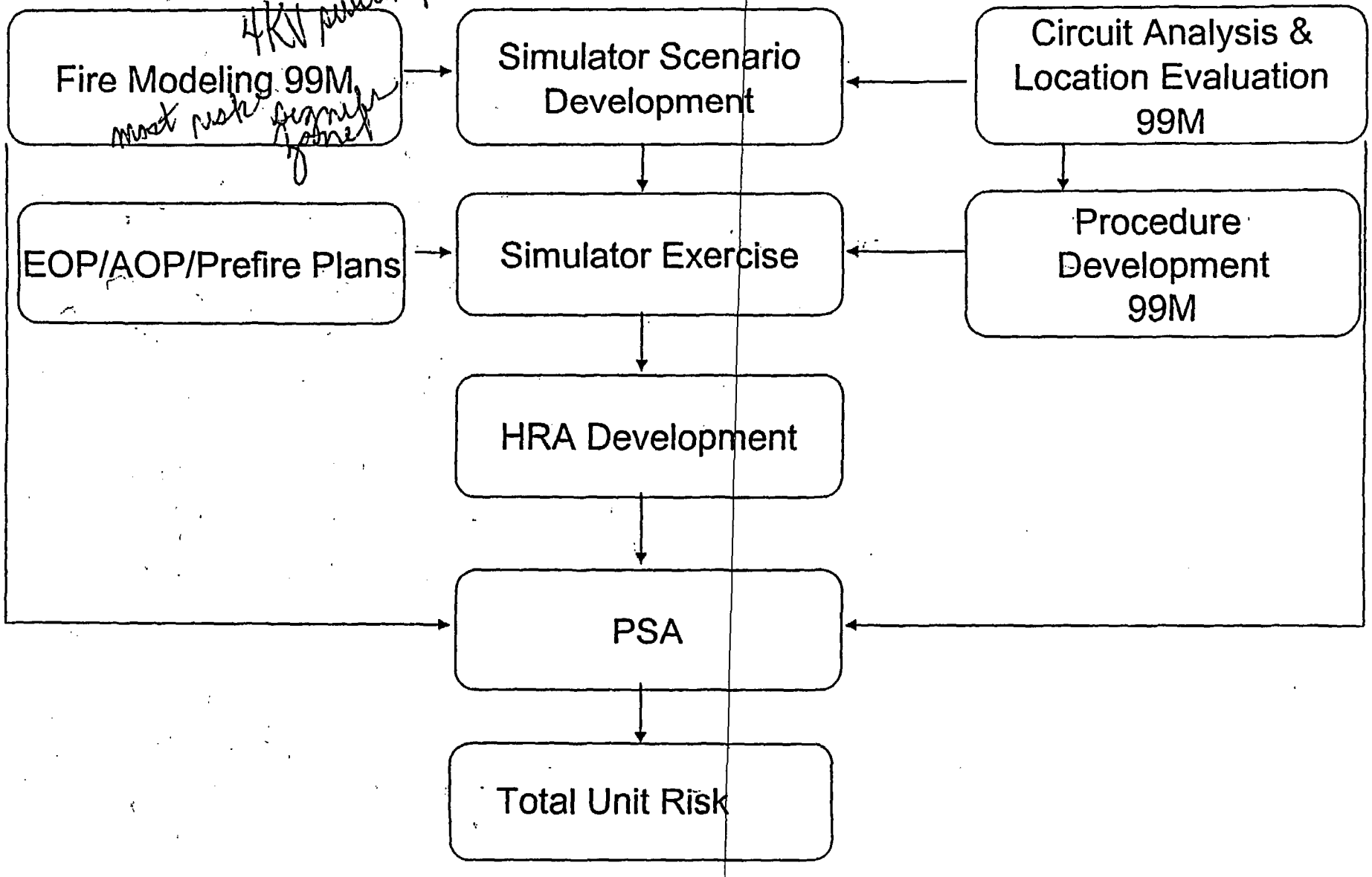
- NRC Conclusions [redacted]
  - ANO's reliance on manual actions in lieu of providing separation design features is in violation of Appendix R 98J 99M
  - ANO's strategy for implementing manual actions is inadequate

Risk Assessment Overview

[redacted]

- NRC's preliminary SDP evaluation concluded unacceptable (greater than green) increase in core damage frequency
- Key assumptions in NRC evaluations vs ANO's preliminary assessment
  - Heat release rate
  - larger Human error probability than ANO
- Subsequent site-specific (SAIC) in-depth assessment
  - Results incorporated into Unit 1 PSA model to derive ΔCDF

Risk Informed Strategy for Zone 99M



safety related zones reviewed
* used to see raw data
looked at each specification & determined if thermoplastic

Risk Assessment Comparison

NRC	ANO
• 425° F cable failure temperature (conservative)	• 700° F cable failure temperature
• Zone wide prompt damage	• Limited time phased damage
• Generic HRA – Based on zone wide prompt damage – Included LOOP	• Plant specific HRA – Scenario specific operator actions evaluated – No LOOP
• Greater than Green finding	• Green finding

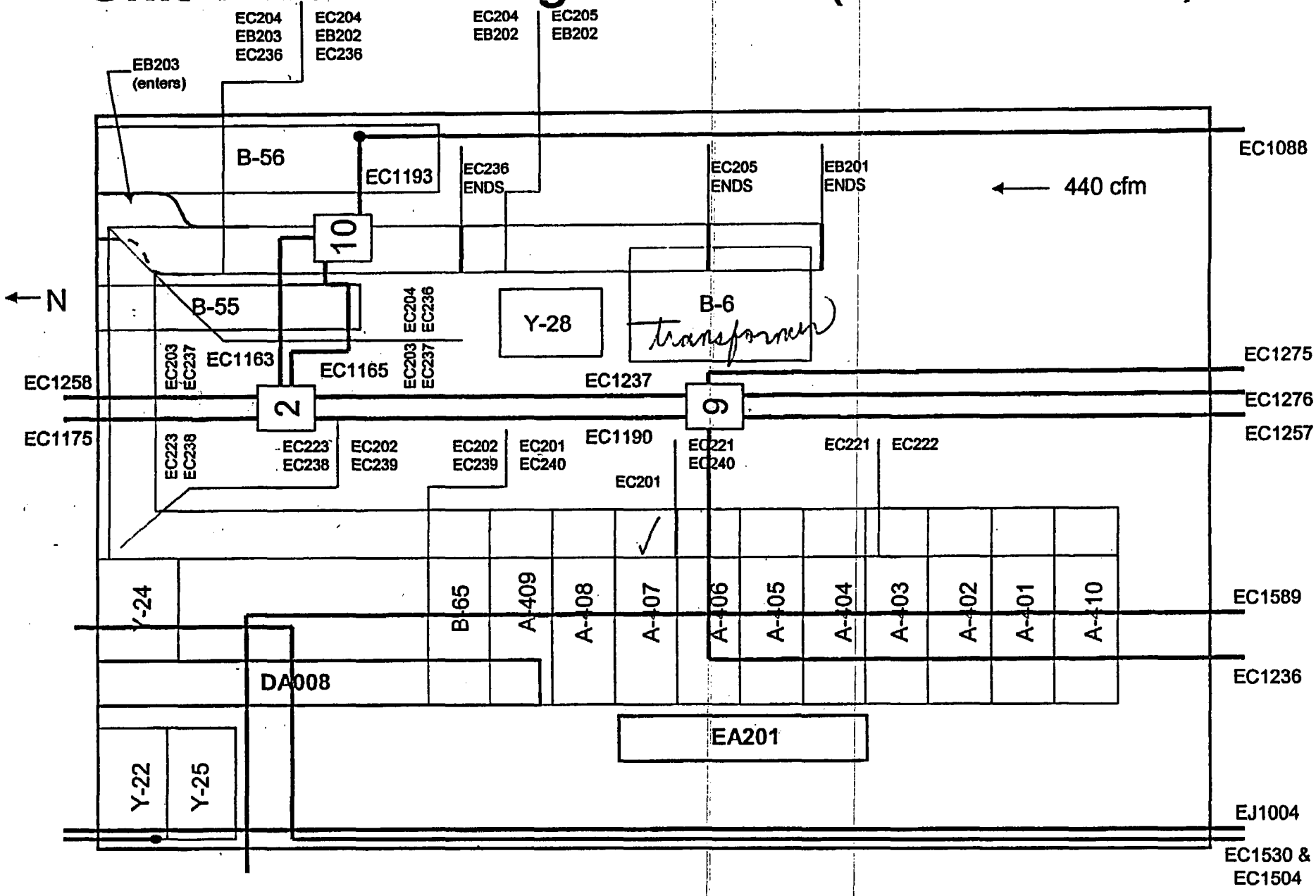
Summary

- In our analysis we will show that:
  - Damage to equipment and instruments needed for safe shutdown will be limited to portions of the room
  - Failures will occur over a period of time, and
  - No credible fire can be postulated that leads to zone-wide damage

assessed everything in room in systematic way!

smoke detect alarm system

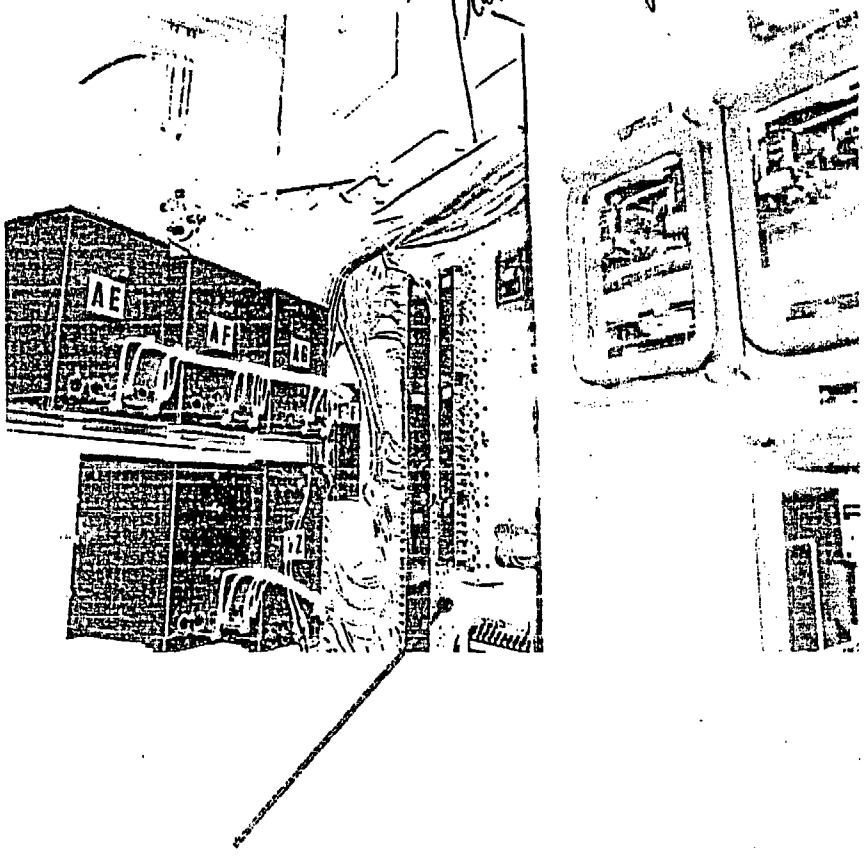
Unit 1 4KV Switchgear Room (fire zone 99M)



less surface burning

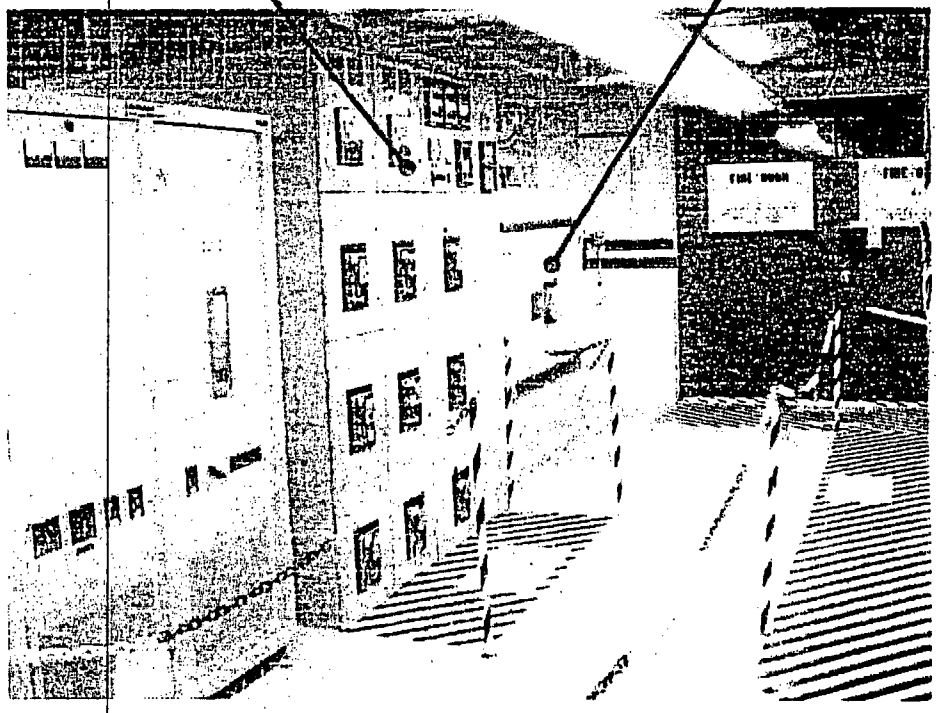
Unit 1 4KV Switchgear Room (fire zone 99M)

cycle burning



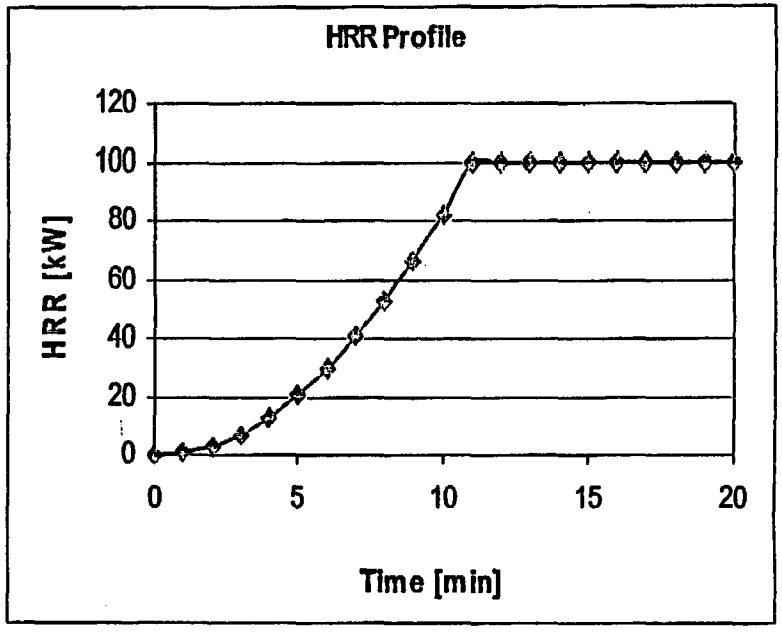
Typical ANO switchgear cabinet wiring, control cubicle

99M - south view



Fire Characterization

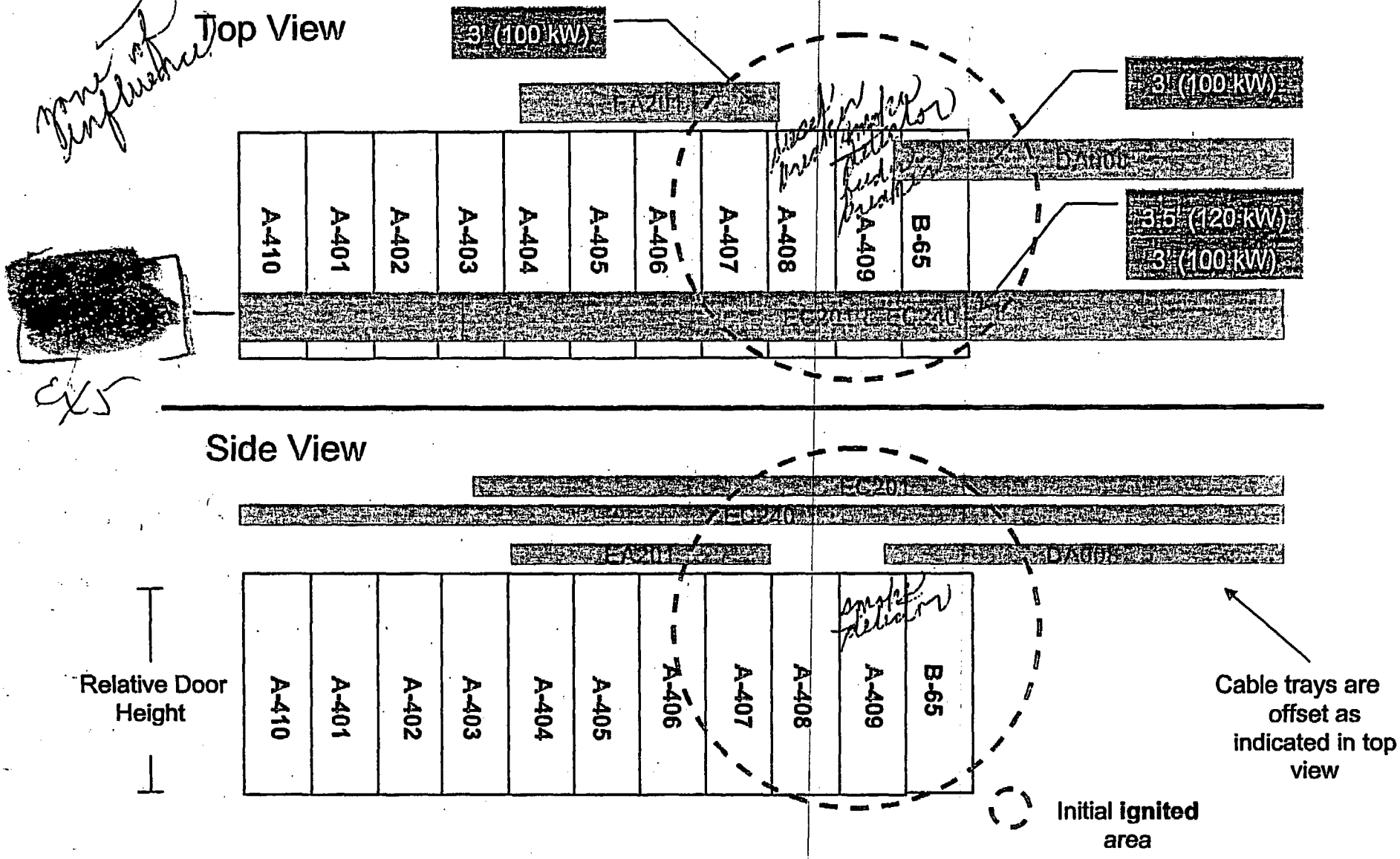
- Electrical cabinet fires
  - The heat release rate data profile is based on the best available fire test data
    - Sandia National Lab (NUREG/CR-4527, 87/88) and VTT (Valtion Teknillinen Tutkimuskeskus, 94/96) in Finland
    - Same test used in the NRC SDP analysis
  - The ANO HRR is based on the 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 – lead to lower internal fires
- Used for scenarios 1a, 2 - 5



Fire Characterization (cont.)
High-energy Switchgear Arcing Fire

- The damage/ignition zone of the initial pressure phase is derived from US nuclear experience (next slide) (EPRI SU105928 Supp to EPRI Fire PRA Guide)
- Ensuing electrical cabinet fires (the switchgear or others exposed to its arcing fault) follow the same behavior as the non-energetic electrical cabinet fires
- Potential ensuing cable fires spread horizontally and spread faster vertically through cable tray stacks
- Observations:
  - Experience of the US nuclear industry indicates that damaging/severe switchgear fires tend to be of the energetic arcing fault type
- Used in scenario 1b

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



galvanized steel

Fire Modeling: Target Damage/Ignition

- Assumed cables inside metal conduits damaged at the same critical temperature, but will not contribute to room heat-up 100°
- High-energy arcing fire
  - Assumed raceways and cabinets in the zone-of-influence are damaged with exposed cables (trays) ignited
  - Assumption conservative for the conduits (if stainless or galvanized steel pipes) where they are likely to survive the short-lived (seconds) initial pressure spike
- Spurious operation of damaged circuits were modeled. In some cases, the likelihood of the spurious actuation was obtained from the EPRI Expert Elicitation report (EPRI 1006961) which was estimated in part based on the data from EPRI/NEI circuit failure characterization fire tests

Results:
Frequency of Fire Scenarios in Fire Zone 99M

high energy

ANO SDP Analysis Results

non energy

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-06
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

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.

EXS

EPRI Calculator

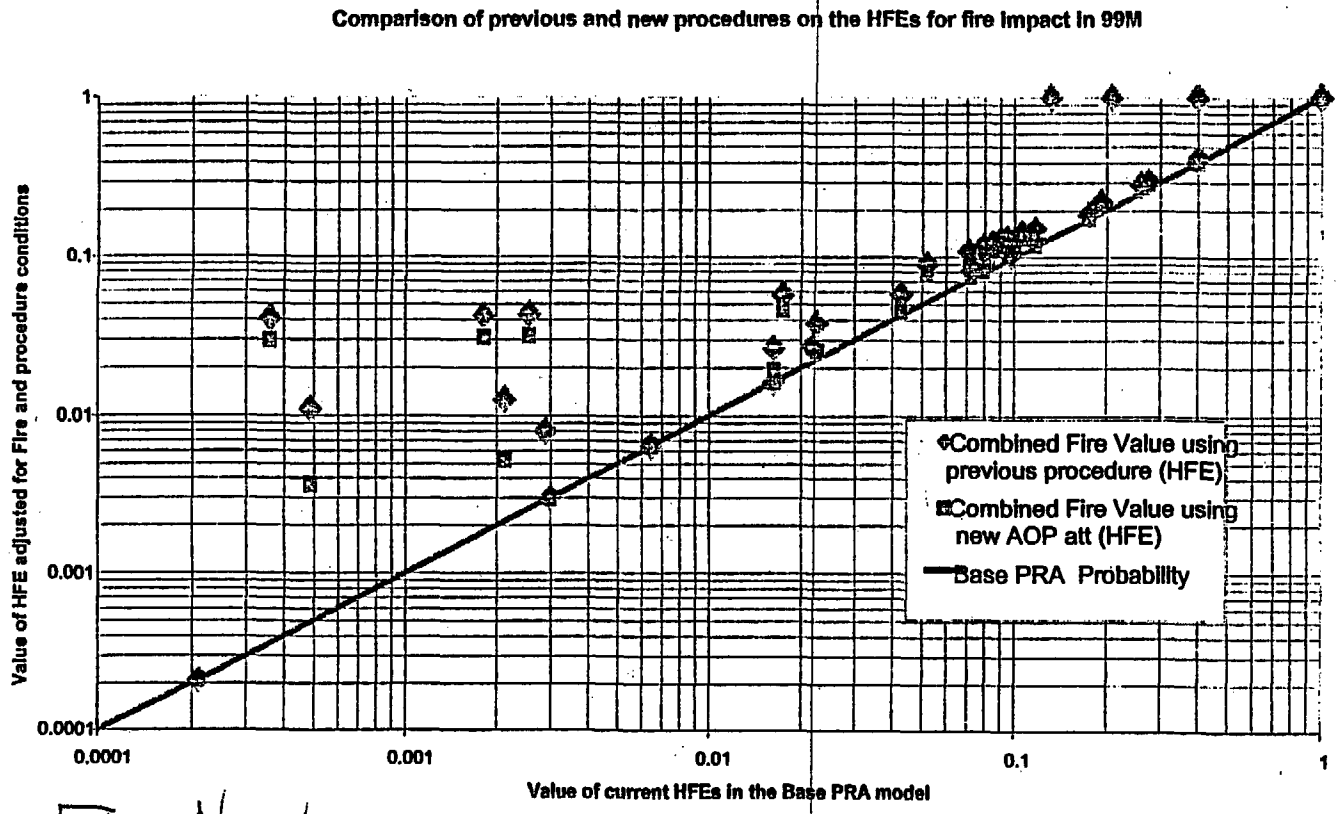
- Industry sponsored method provides a process for book keeping HRA evaluations
- Addresses HRA requirements in ASME PRA Standard 2002
- Includes several methods for quantification
  - Industry and NRC sponsored
  - Generic data quantitatively differentiate human error probabilities (HEP's) for key characteristics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

NUREG 1278 EPRI Project

- HRA analyst judgment is still required

Comparing HFEs from PRA baseline with HFEs in 99M fire

- Fire in 99M increases human failure event (HFE) for typical feasible actions over initial internal events PRA from zero to a value in range of 3E-3 to 4E-2 for various scenarios and conditions
- If action is not feasible, then HFE assessment is set at 1.0
- Very small difference in impact of previous versus new procedures



□ – New
◇ – Old

Total Unit Risk

- The assessment of fire risk in 99M was extrapolated to two other Unit 1 fire zones:
  - Each was assessed with walkdown and examination of the potential fire scenarios threatening the other train raceways (e.g., red train raceway in a green train room)
  - Unit 1 A3 4KV switchgear room (100N)
    - Similar to 99M in combustibles and fire sources
    - Considerably less redundant train cable routed through zone
  - Unit 1 electrical equipment room (104S)
    - Lack of high energy switchgear
    - Considerably less redundant train cable routed through zone
- Each zone is bounded by the results of 99M
  - Conservative estimated fire risk (ΔCDF) for this condition
    - Unit 1 < 6.6E-07/yr

40 zones – requiring manual actions

Overall Summary

1% = thermoplastic

38,000

- 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