PDR

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

DEC 17 1990

MEMORANDUM FOR: Distribution

FROM: John T. Chen, IPEEE PM
Severe Accident Issues Branch
Division of Safety Issue Resolution

SUBJECT: SUMMARY OF NRC/NUMARC MEETINGS ON NUMARC'S COMMENTS ON SEISMIC IPEEE (NOV. 13 & 30, 1990)

REFERENCE: Letter from W. Rasin of NUMARC to W. Minners of NRC, dated Oct. 10, 1990, Subject: Final Industry Comments on Draft Generic Letter 88-20, Supplement 4, "Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities" and Draft NUREG-1407, "Procedural and Submittal Guidance for the IPEEE."

On November 13, 1990, a meeting was held between the NRC staff and representatives of the NUMARC for the purpose of obtaining further clarifications and better understanding of the NUMARC's comments on the seismic portion of the IPEEE. Enclosure 1 is a list of attendees and Enclosure 2 contains material presented during that meeting. On November 30, 1990, a follow-up meeting, at the request of NUMARC, was held to further discuss the relay chatter issue. Enclosure 3 is a list of attendees for the follow-up meeting and Enclosure 4 contains the materials NUMARC presented during the follow-up meeting.

The following is a summary of the major points discussed in the Nov. 13 meeting:

1. The staff agreed to consider a relaxation in the time allowed for the initial licensee response period (60 days), but the completion schedule on the IPEEE will remain 3 years after the issuance of the final generic letter because of the constraint placed on the closure of the severe accident policy implementation. However, case-by-case extensions of the 3 year submittal date will be considered, if justified.

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2. The staff stated that the seismic design criteria for recently constructed plants was not explicitly utilized in the proposed binning for the seismic margins type of review. Rather, the binning was based on seismic hazard.

3. NUMARC proposed a subdivision within the 0.3g bin, but stated that the list of plants to be subdivided in the 0.3g bin will not be provided to the staff. However, a sample calculation on NUMARC's sub-binning will be provided by NUMARC for staff use.

4. NUMARC provided their estimates on the required resources for the seismic portion of the IPEEE (Enclosure 2). NUMARC stated that their cost estimates were based on the scope of work as described in the draft Generic Letter 88-20, Supplement 4. The staff believes that most of the NUMARC estimates are on the high side, and with further understanding of the staff proposals for the seismic IPEEE these estimates would be less.

5. The differences between NUMARC's recommended full-scope and focused-scope review were discussed. These differences affect four areas: relay review, soil evaluation, outlier HCLPF calculations, and input. However, except for relay review the staff believes that the differences are rather insignificant. The staff believes that the NUMARC proposed relay review for full-scope SMA plants, to locate and evaluate only low seismic ruggedness relays, is not adequate because relays, other than the low seismic ruggedness relays, may chatter when they were subjected to the review level earthquake.

The November 30th meeting was centered primarily on the relay chatter issue. The following is a summary of the major points discussed during that meeting.

1. With regard to relay chatter review, NUMARC stated that their recommendations remain the same as that stated in their October 10th letter:

   a. Full-scope review: For A-46 plants, evaluate A-46 relays per A-46 procedures. For relays within the scope of IPEEE (not in A-46, but associated with alternate shutdown path), perform a low ruggedness relays review. For non A-46 plants, perform a low ruggedness relay review within the scope of IPEEE.

b. Focused-scope review: For A-46 plants, evaluate A-46 relays per A-46 procedures. If low ruggedness relays were found, expand to include relays associated with alternate shutdown path. For non A-46 plants, perform a low ruggedness relay review within the scope of IPEEE.

c. Reduced-scope review: Perform A-46 review for A-46 plants. No Additional review for IPEEE scope. For non A-46 plants, no relay review.

2. NUMARC's justification for the above recommendations (Enclosure 4) can be summarized as follows:

a. Full-scope relay reviews are not cost effective.

b. Relay chatter risk significance is not high.

c. Seismic PRAs performed to date indicate negligible relay chatter contribution to core damage frequency (CDF).

d. Seismic PRAs and seismic margins assessments performed to date have not resulted in any hardware or procedural changes.

e. The results of detailed relay chatter reviews, conducted on Hatch, Limerick and Diablo Canyon do not support a detailed review as discussed in items 3, 4 and 5 below.

3. Don Moore of Southern Company Services presented the relay assessment performed at Hatch which identified no relay related vulnerability and made no procedural modifications. A total of 1619 relays were assessed at Hatch that resulted in identifying 19 possible manual operator actions.

4. Alan Marie of Phila. Elec. Co. presented the relay chatter analysis performed at the Limerick Generating Station (LGS) which concluded that the relay chatter is not risk significant. At LGS, there are recovery procedures dealing with seismic events and primary and secondary containment isolation verification and reset. His presentation material is included in Enclosure 4, also.

5. Bruce Smith of Pac. Gas and Elec. presented the relay chatter evaluation performed at the Diablo Canyon. The results indicate that relay chatter affects all systems intermittently; but, they are easily recovered and caused no permanent equipment damage. No relays were replaced and no procedural changes were required. His presentation material is included in Enclosure 4, also.

6. The staff stated that this conclusion may be valid for these three plants. However, to extrapolate these conclusions generically to other plants may be questionable. It is important to note that these three studies all pointed out that recovery actions in terms of resetting certain relays are needed.

John T. Chen, IPEEE PM
Severe Accident Issues Branch
Division of Safety Issue Resolution

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R. Kenneally, RES
G. Kelly, NRR
R. Ng, NUMARC

ENCLOSURE 1

~~PRE-MTG~~

NOV. 13, 1990

NRC/NUMARC MTG ON NUMARC COMMENTS ON SEISMIC / PEEE

ATTENDEES:

JOHN T. CHEN	NRC/SAIB	301-492-3919
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T. Y. Chang	RES/EIB	301-492-3922
Pei-Ying Chen	NRC/NRR/EMEB	301-492-0789
Andrew Murphy	RES/DE/SSEB	492-3860
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ENCLOSURE 2

PRELIMINARY COST ESTIMATE OF

FULL-SCOPE

SEISMIC MARGIN ASSESSMENT

	ACTIVITIES	COST
1.	Selection & Development of Success Path Equip.	60,000
2.	Walkdowns	90,000
3.	Relay Evaluation	200,000
4.	SMA/Outliers	180,000
5.	Reports & Documentation	70,000
6.	SSI Analysis & Develop FRS	200,000
7.	Soils Evaluation	100,000
8.	Walkdown Travel Expense	50,000
9.	Minor Enhancements to Seismic Models	60,000
10.	Containment Review	
	a) Isolation, Bypass, Structural Integrity	80,000
	b) Long Term Mitigation	40,000 (*)
11.	Misc. Cost (startup, training, plant support, peer review, NRC interaction)	120,000
	TOTAL ~	1,300,000

(*) Based on drawing review. Cost of walkdown would be additional and would vary greatly from plant to plant.

NOTES:

1) Cost estimates are based on the scope work as described in the draft Generic Letter 88-20, Supplement 4.

2) The Seismic Margin Assessment methodology assumed in cost estimates is the EPRI methodology. If NRC methodology is used, the total is expected to increase.

AVERAGE BEST ESTIMATE COSTS BASED ON NUMARC RECOMMENDATIONS

CATEGORY OF REVIEW	AVERAGE COST
Full-Scope	900,000
Focused-Scope	600,000
Reduced Scope	350,000

NOTES:

1) It is assumed that the scope of work in each category will be based on the NUMARC recommendations included in the October 10, 1990 submittal.

2) Cost estimates are based on usage of EPRI SMA methodology.

3) The above costs are the average best estimate costs for plants within each category. Individual plant costs may be higher or lower depending on the need for seismic reanalysis, availability of existing documentation, level of design, and so on.

ENCLOSURE 3

11-30-90

NRC/NUMARC MTG ON SEISMIC IPEEE

RELAY CHATTER ISSUE.

ATTENDEES:

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ENCLOSURE 4

OUTLINE

- INTRODUCTION
- NUMARC RECOMMENDATIONS
- JUSTIFICATION FOR NUMARC RECOMMENDATIONS
- INDIVIDUAL PLANT PRESENTATIONS:
  - HATCH
  - LIMERICK
  - DIABLO CANYON
- SUMMARY

NUMARC RECOMMENDATIONS FOR RELAY CHATTER REVIEW

Review Type	Plant Type	Recommended Review
Full-Scope	A-46	Evaluate A-46 relays per A-46. For relays within IPEEE (not in A-46), perform a bad actors review
	Non A-46	Perform a bad actors review for all relays within IPEEE
Focused-Scope	A-46	Evaluate A-46 relays per A-46 (SSE). If bad actors are found, expand scope to include IPEEE relays
	Non A-46	Perform a bad actors review for all relays within IPEEE
Reduced-Scope	A-46	Perform A-46 review. No additional review for IPEEE relays
	Non A-46	No relay evaluation

JUSTIFICATION FOR NUMARC RECOMMENDATIONS

- o FULL-SCOPE RELAY REVIEWS ARE NOT COST EFFECTIVE
- o LOW SEISMIC RUGGEDNESS LIST (BAD ACTORS LIST) REPRESENT SIGNIFICANT INDUSTRY AND NRC EFFORT
- o RELAY CHATTER RISK SIGNIFICANCE IS NOT HIGH
- o SPRAs PERFORMED TO DATE INDICATE NEGLIGIBLE RELAY CHATTER CONTRIBUTION TO CDF
- o SPRAs AND SMAs PERFORMED TO DATE HAVE NOT RESULTED IN ANY HARDWARE OR PROCEDURAL CHANGES
- o SOME RELAYS THAT MAY CHATTER SHOULD NOT BE REPLACED; REPLACEMENT MAY INCREASE PLANT RISK
- o OVER 60 UNITS WILL PERFORM DETAILED A-46 RELAY REVIEW
- o REDUCED SCOPE PLANTS:
  - RELAYS AT NON A-46 PLANTS QUALIFIED TO SSE; NO NEED TO REVIEW AGAIN
  - A-46 PLANTS WILL ADDRESS RELAY REVIEW

HATCH SMA - RELAY ASSESSMENT

PURPOSE: TO EVALUATE THE EPRI SMA METHODOLOGY FOR A BWR AND FOR A SOIL SITE.

WHAT WAS DONE: ALL ELECTRICAL DEVICES WITH CONTACTS* THAT COULD AFFECT SUCCESS-PATH COMPONENTS** WERE EVALUATED FOR CONTACT CHATTER.

* DEVICES INCLUDE CONTROL SWITCHES; PRESSURE, LEVEL, FLOW, TEMPERATURE AND LIMIT SWITCHES; CONTACTORS; AND RELAYS. THE TERM "RELAY" IS USED FOR ALL THESE DEVICES.

** THERE WERE TWO INDEPENDENT SUCCESS PATHS WHICH INCLUDED BOTH ACTIVE AND PASSIVE COMPONENTS.

HATCH SMA - RELAY ASSESSMENT

HOW IT WAS DONE:

STEP 1: IDENTIFY RELAYS

- IDENTIFY CONTROL ELEMENTARY DRAWINGS FOR EACH SUCCESS-PATH COMPONENT.
- IDENTIFY THE ASSOCIATED RELAYS BY PLANT ID NUMBER, PANEL NUMBER, VENDOR NAME AND MODEL, AND REF. DWG.
- ENTER INFORMATION INTO COMPUTER DATA BASE
- RESULT IN LIST OF RELAY-COMPONENT COMBINATIONS

STEP 2: IDENTIFY SEISMICALLY RUGGED AND SEISMICALLY VULNERABLE RELAYS

- SEISMICALLY RUGGED RELAYS ARE SOLID STATE RELAYS, MECHANICALLY ACTUATED CONTACTS, ETC.
- SEISMICALLY VULNERABLE RELAYS ARE RELAYS SUSCEPTIBLE TO CHATTER AS IDENTIFIED BY SQUG

STEP 3: SCREEN OUT RELAYS USING THE MOST COST EFFECTIVE METHODS PRIOR TO THE WALKDOWN

- PERFORM CIRCUIT ANALYSIS IF IT IS EXPECTED THE SYSTEM CAN BE EASILY SCREENED OUT (E.G. THE REACTOR PROTECTION SYSTEM).
- ALTERNATELY USE SQUG IN-PANEL AMPLIFICATION FACTORS AND LOWER BOUND GERS UNLESS STATUS OF CONTACT IS KNOWN (NO, NC, ENERGIZED, DE-ENERGIZED)
- CASCADING RELAY CONTACT CHATTER IS CONSIDERED.
- RELAYS SCREENED OUT BY USE OF GERS ARE CONSIDERED ESSENTIAL UNLESS A CIRCUIT ANALYSIS SHOULD OTHERWISE.
- RESULT IN A LIST OF "ESSENTIAL RELAYS" FOR WALKDOWN

HATCH SMA - RELAY ASSESSMENT

HOW IT WAS DONE:

STEP 4: RELAY WALKDOWN
- SPOT CHECK RELAY MOUNTINGS
- SPOT CHECK RELAY TYPE AND LOCATIONS
- GATHER DATA AS NEEDED TO BETTER DEFINE SEISMIC DEMAND

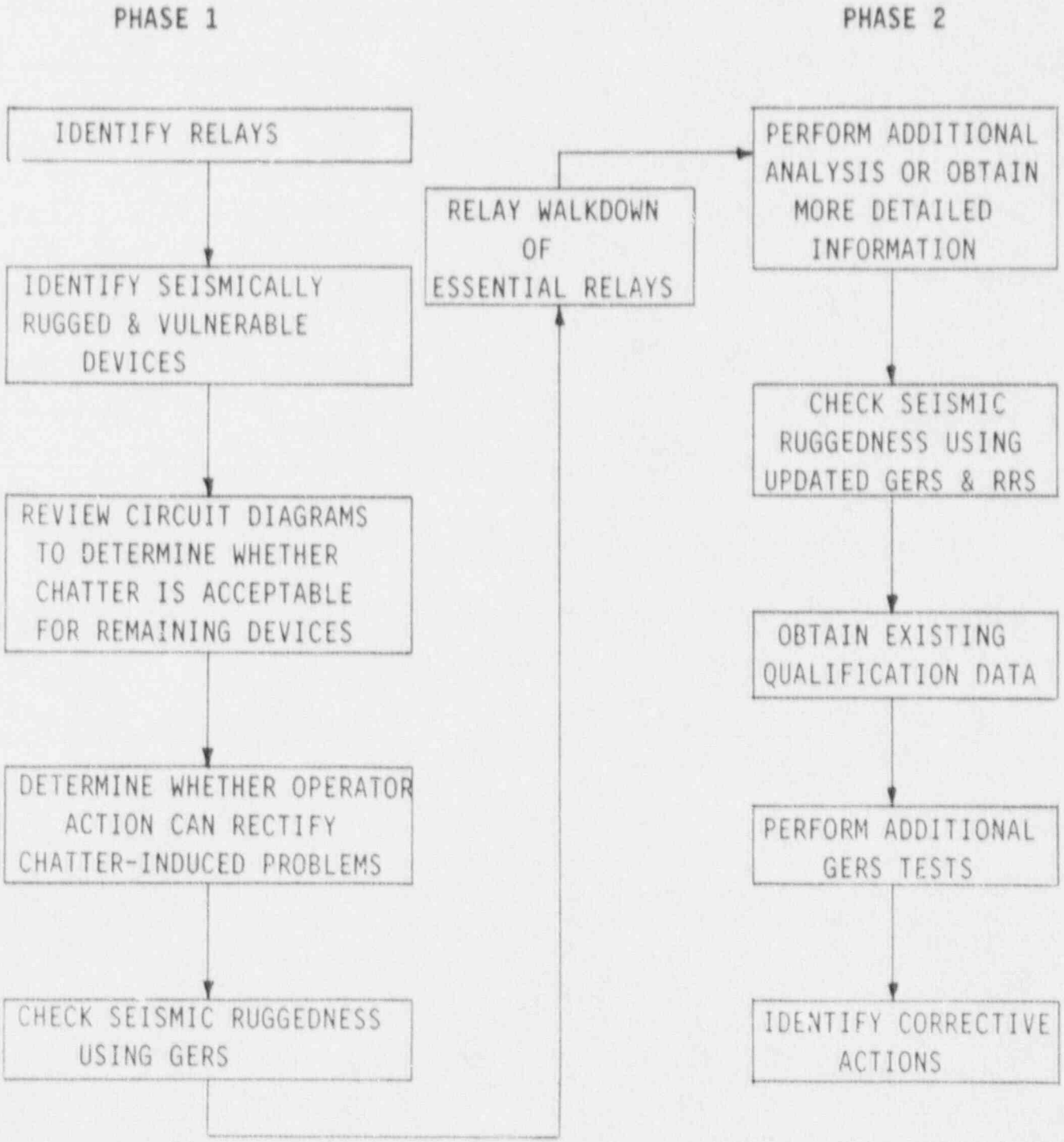
STEP 5: CONTINUE THE SCREENING OUT OF RELAYS AFTER RELAY WALKDOWN
- IN-DEPTH CIRCUIT ANALYSIS PERFORMED IN ATTEMPT TO SHOW THAT CHATTER IS ACCEPTABLE
- ALTERNATELY DETERMINE COMPLETE MODEL NUMBER, COIL VOLTAGE AND CONTACT CONDITION FOR COMPARISON TO APPROPRIATE GERS. USE WALKDOWN DATA OR INSITU TESTING TO BETTER DEFINE SEISMIC DEMAND.
- OBTAIN EXISTING SEISMIC QUALIFICATION DATA
- DETERMINE IF OPERATOR ACTION CAN RECTIFY CHATTER-INDUCED PROBLEMS
- PERFORM RELAY TESTS (APPROXIMATELY 9 RELAYS WERE TESTED FOR HATCH AS PART OF THE SQUG/EPRI RELAY TEST PROGRAM)

STEP 6: IDENTIFY CORRECTIVE ACTIONS
- NO CORRECTIVE ACTIONS REQUIRED FOR HATCH UNIT 1

STEP 7: DOCUMENT RESULTS

HATCH SMA-RELAY ASSESSMENT

HOW IT WAS DONE:



HATCH SMA - RELAY ASSESSMENT

FINAL CONCLUSIONS:

5471 RELAY-COMPONENT COMBINATIONS EVALUATED
A TOTAL OF 1619 RELAYS

STATUS	NUMBER OF COMBINATIONS
CHATTER ACCEPTABLE	3695
SEISMICALLY ACCEPTABLE	656
RESOLVED BY OPERATOR ACTIONS*	56
RESOLVED WITH GERS	780
DUAL STATUS-GERS/CA	42
COMPONENTS NOT AFFECTED BY RELAYS	242
TOTAL	5471

* - A TOTAL OF 19 POSSIBLE MANUAL OPERATOR ACTIONS
- 11 OPERATOR ACTIONS FOR THE PRIMARY PATH
- 8 OPERATOR ACTIONS FOR THE ALTERNATE PATH
- ALL OPERATOR ACTIONS PERFORMED IN CONTROL ROOM EXCEPT RESET OF DIESEL DIFFERENTIAL LOCKOUT RELAYS IN DIESEL SWITCHGEAR ROOM, ONE PER DIESEL; AND MANUAL TRANSFER SWITCH IN CONTROL BUILDING.

FINAL RESULTS: THE HATCH RELAY ASSESSMENT IDENTIFIED NO VULNERABILITIES. NO MODIFICATIONS REQUIRED BASED ON THE RELAY ASSESSMENT.

HATCH SMA - RELAY ASSESSMENT

LESSON LEARNED

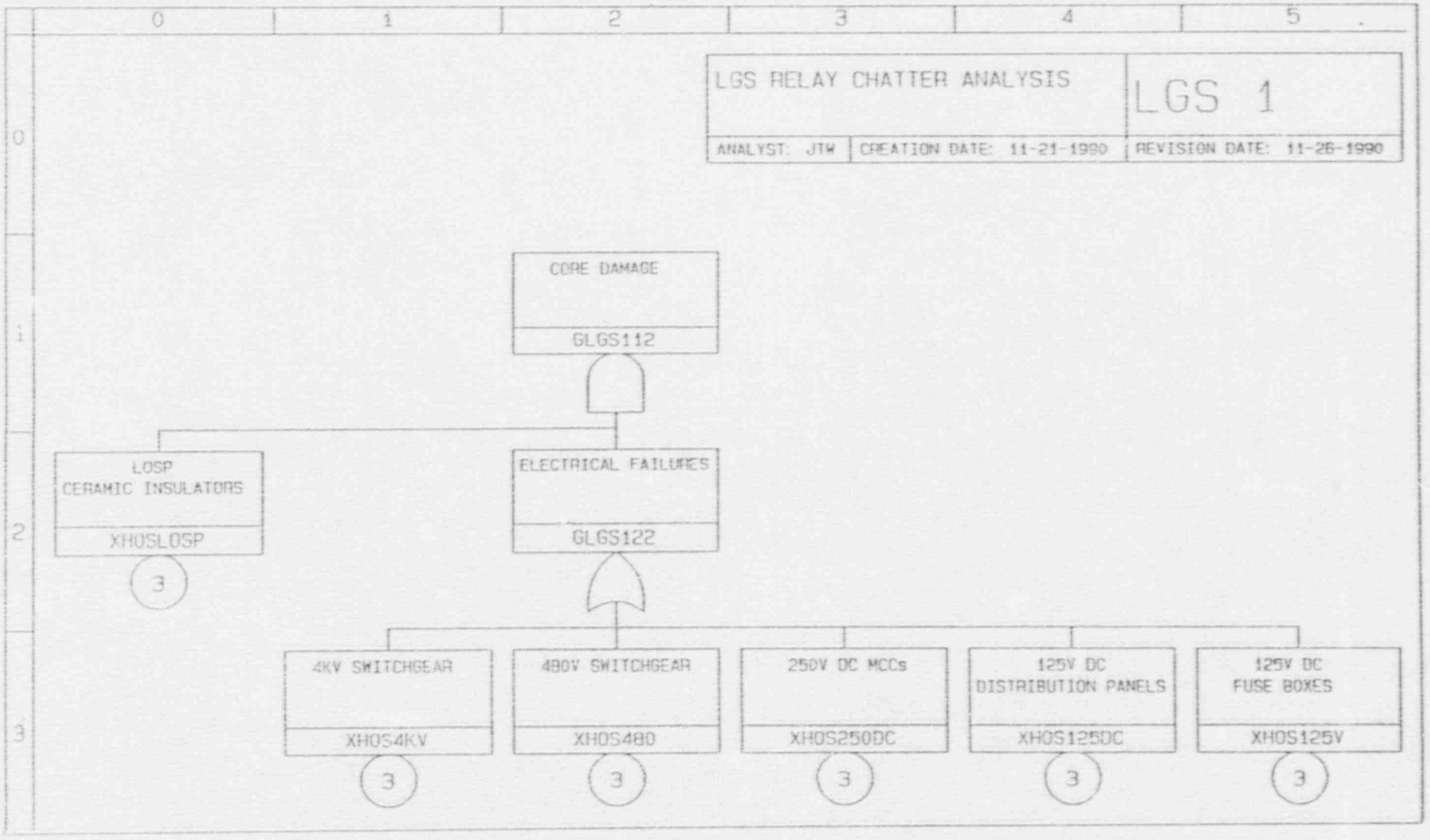
- THE COST OF THE HATCH RELAY EVALUATION WAS AFFECTED BY:
  - UNRESOLVED RELAY ISSUES
  - LACK OF GERS
  - LACK OF SME IRS EARLY IN THE EVALUATION
  - CHANGES IN THE SUCCESS PATH COMPONENTS
  - LACK OF TRAINING
- EVEN WITH OPTIMIZATION, PLANT OF SIMILAR VINTAGE WOULD STILL HAVE A MAN-HOUR INTENSIVE EFFORT
- NO SIGNIFICANT VULNERABILITIES IDENTIFIED FROM THE HATCH RELAY CHATTER EVALUATION.
- ESSENTIAL RELAYS AND THEIR CABINETS NEED TO BE IDENTIFIED BEFORE THE SEISMIC CAPACITY WALKDOWN.
- IDENTIFY ADDITIONAL RELAY TESTING EARLY IN THE EVALUATION.
- NO OPERATOR ACTIONS ARE REQUIRED FOR ANY RELAYS IN THE FLUID OR MECHANICAL SYSTEMS.
- ALL OPERATOR ACTIONS ARE ASSOCIATED WITH THE DIESEL GENERATORS AND ELECTRIC POWER SYSTEM.
- WORK ON THE MOST COMPLEX SYSTEM FIRST.
- ONLY RELAYS THAT SEAL-IN OR LOCKOUT AND THE OPERATED SWITCH THAT WILL REMOVE THE SEAL-IN OR LOCKOUT WERE GIVEN AN "OPERATOR ACTION" STATUS.
- A CIRCUIT ANALYSIS HAD TO BE PERFORMED FOR THE ENTIRE DIESEL GENERATOR SYSTEM DUE TO LACK OF GERS.
- THE EVALUATION OF POWER SOURCES WAS DIFFICULT DUE TO THEIR COMPLEXITY, LACK OF GERS, AND MOST OF THE CIRCUIT SCHEMES WERE DEPENDENT UPON EACH OTHER.

RELAY CHATTER ANALYSES
LIMERICK GENERATING STATION

- 1983 SARA Did Not Explicitly Address Relay Chatter (Assumed Recoverable)

- BNL Review of SARA (NUREG/CR3493) Concluded SARA Should Assess Non-Recovery of Relays/Breakers

- Scoping Assessment Performed
  - Five Major Groups of Equipment
  - Assumptions:
    - Failure of any one Group and LOOP = CD
    - Non-recovery Probability for Chatter = 0.2
    - Common-Cause Factor within a Group = 1.0
  - Resulted in 26% Increase in Seismic CDF


0
1
2
3
4
5
LGS RELAY CHATTER ANALYSIS
LGS 1
ANALYST: JTW
CREATION DATE: 11-21-1990
REVISION DATE: 11-26-1990
CORE DAMAGE
GLGS112
LOSP
CERAMIC INSULATORS
XHOSLOSP
3
ELECTRICAL FAILURES
GLGS122
4KV SWITCHGEAR
XHOS4KV
3
480V SWITCHGEAR
XHOS480
3
250V DC MCCs
XHOS250DC
3
125V DC
DISTRIBUTION PANELS
XHOS125DC
3
125V DC
FUSE BOXES
XHOS125V
3

RELAY CHATTER ANALYSES
LIMERICK GENERATING STATION

- Result of Scoping Assessment Included in Seismic Risk Profile for SAMDA Evaluation (6/23/89)
  CDF = 3.4E-6 (Total Seismic)

- Concluded that Relay Chatter is not Risk Signficant

- Recovery Procedures Implemented at LGS
  - SE-5 Seismic
  - GP-8 Primary and Secondary Containment Isolation Verification and Reset

- Spurious Relay Trips have Occurred and were Countered

LIMERICK RELAY CHATTER ANALYSIS LEA AGREEMENT

- Compile List of Previously Identified "Chatter-Prone" Relays

- Compare List to Relays Installed at LGS in Equipment for two SSD Methods

- Perform Circuit Analysis for any Relays Identified and Evaluate Replacement

DIABLO CANYON

RELAY CHATTER

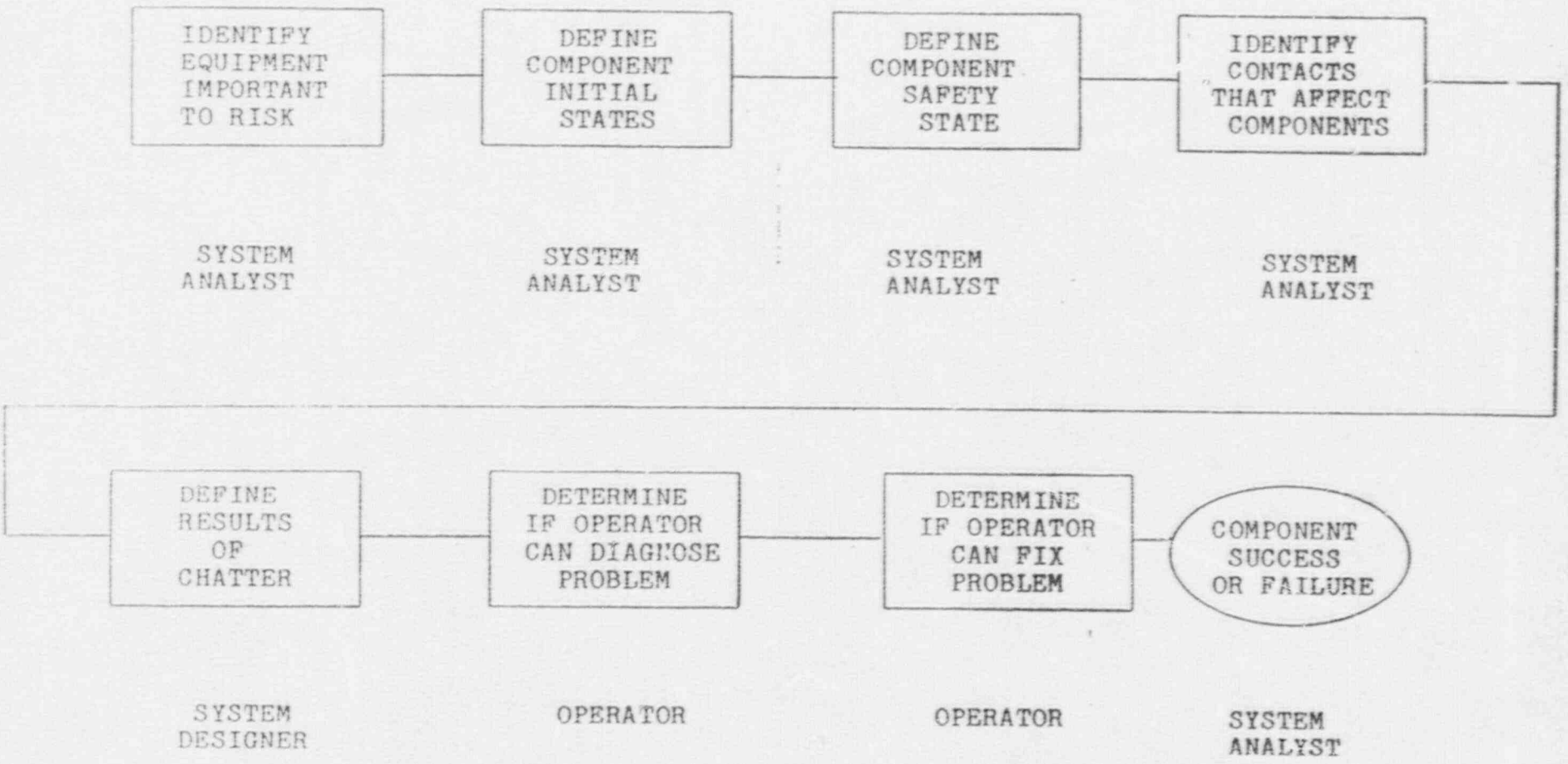
- APPROACH
  - — IDENTIFY COMPONENTS IMPORTANT TO RISK
  - — ASSUME ALL CONTACTS CHATTER
  - -- DETERMINE WORST CASE CONSEQUENCES
  - — DETERMINE RECOVERY MEASURES

- SCOPE

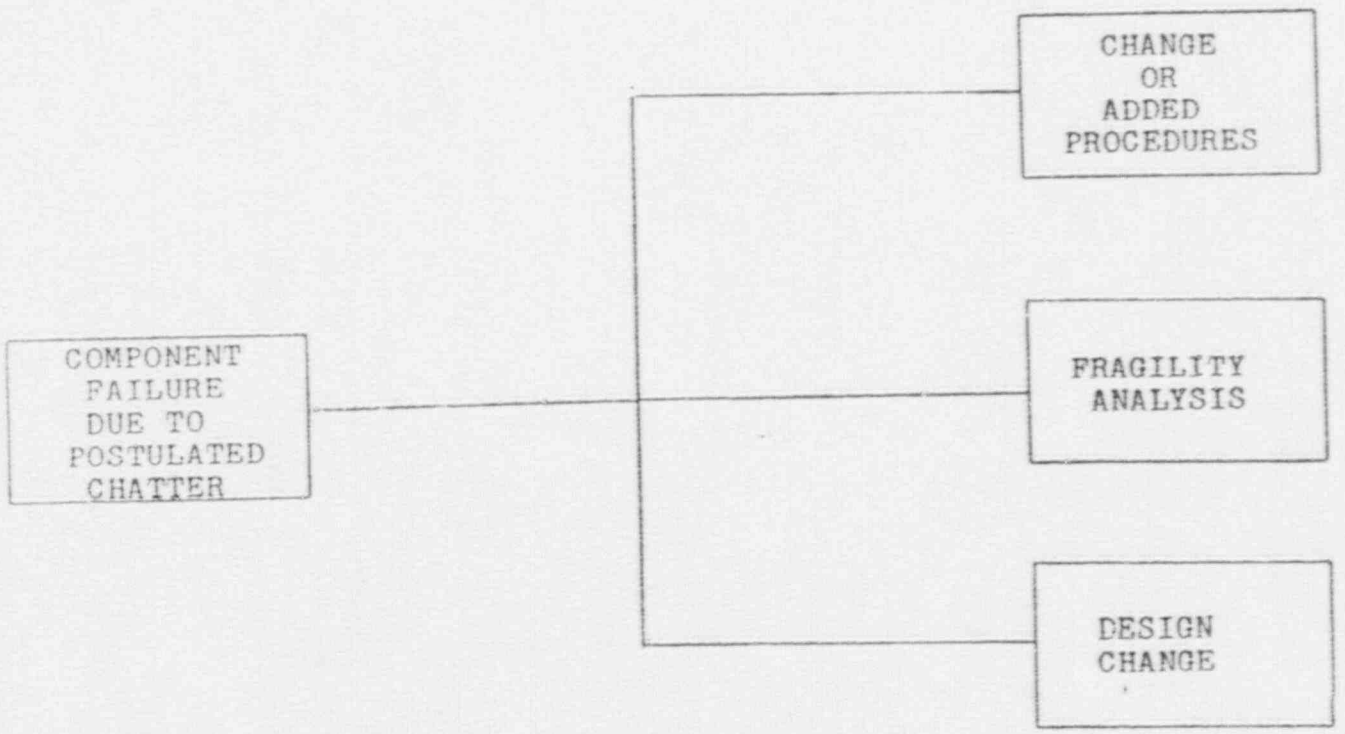
  THE FOLLOWING SYSTEMS WERE ANALYZED FOR THE EFFECTS OF RELAY CHATTER:

  - — AUXILIARY FEEDWATER
  - — AUXILIARY SALTWATER
  - — COMPONENT COOLING WATER
  - — CONDENSATE
  - — CONTAINMENT ISOLATION
  - — CONTAINMENT SPRAY
  - — CONTROL ROOM VENTILATION
  - — DIESEL FUEL OIL
  - — DIESEL GENERATOR
  - — DC (125V BATTERIES)
  - — FAN COOLERS
  - — INSTRUMENT AC (INVERTERS)
  - — MAKEUP WATER TRANSFER
  - — REACTOR COOLANT
  - — REACTOR TRIP
  - — RESIDUAL HEAT REMOVAL
  - — SAFETY INJECTION/CHARGING
  - — TURBINE STEAM
  - — VENTILATION
  - — 4,160V BUS/480V BUS
  - — AUTOMATIC BUS TRANSFER SCHEMES

RELAY CHATTER ANALYSIS



RELAY CHATTER MITIGATION



DIABLO CANYON

RELAY CHATTER (continued)

- RESULTS
  - — AFFECTS ALL SYSTEMS INTERMITTENTLY
  - — EASILY RECOVERED
  - — CAUSES MISLEADING INDICATIONS AND ALARMS
  - — NO PERMANENT EQUIPMENT DAMAGE
  - — IMPORTANT CONTRIBUTORS
    - 4-kV BREAKER TRIP (PROTECTIVE RELAY SEAL-IN)
    - MOTOR-OPERATED VALVE TRANSFER
    - DIESEL GENERATOR CONTROL TRIP (LOCKOUT RELAY)
    - PORV OPENING

DIABLO CANYON

RELAY CHATTER EVALUATION RESULTS

- NO RELAYS REPLACED
- NO PROCEDURAL CHANGES REQUIRED
- REPLACED THREE CONTROL SWITCHES ON MOV'S (NOT DUE TO RELAY CHATTER)

RELAY CHATTER REVIEW BASIS AND RESULTS AT THREE PLANTS

SUBJECT	PLANT A	PLANT B	PLANT C
REVIEW METHOD	DETER./ PROB.	DETER.	PROB.
REVIEW BASIS	-	0.3 g	-
RELAY REVIEW METHOD	ALL IN SPRA	ALL IN SS PATHS	SCREEN
RELAYS REVIEWED	~1000	~1600	NA
RELAYS REQUIRING CORRECTIVE ACTION	0	0	0
PROCEDURAL CHANGES/ NEW PROCEDURES	NONE	NONE	NONE
FURTHER EVALUATION TESTING	0	9	0